1. Necessary Data Imports

In [1]:
```python
import pandas as pd
import numpy as np
import seaborn as sns
from matplotlib import pyplot as plt
from sklearn import preprocessing
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import StandardScaler

from skmultiflow.data import HyperplaneGenerator
from sklearn import metrics
import scipy.stats as stats
from scipy.stats import norm

import random
from numpy.random import seed
from numpy.random import randn
from scipy.stats import shapiro
from scipy.stats import normaltest
from scipy.stats import anderson

import tensorflow
import tensorflow.keras.backend as K
import tensorflow.keras.layers as layers

import warnings
warnings.filterwarnings('ignore')
```

2. Dataset

In [2]:
```python
data=pd.read_csv("D:/Concept Drift Papers for Proposal Defence/Datasets/NOAA.csv")
```

In [3]:
```python
data
```

Out[3]:

	attribute1	attribute2	attribute3	attribute4	attribute5	attribute6	attribute7	attribute8	cla
0	19.8	14.0	1019.6	8.4	9.9	15.9	28.9	14.0	
1	26.8	22.2	1006.2	8.1	10.9	19.0	34.0	21.0	
2	34.6	32.9	1004.6	3.9	13.8	22.0	36.0	33.1	
3	26.4	21.5	1006.9	8.0	18.7	30.1	39.9	16.0	
4	14.7	7.9	1009.9	8.1	14.1	22.0	21.0	9.0	
...	...	...	...	...	...	...	...	...	
18154	32.6	21.9	1022.7	7.0	12.4	26.0	41.0	24.8	
18155	36.8	25.4	1014.9	7.0	10.0	19.0	57.2	21.2	
18156	41.9	29.9	1010.0	7.0	4.7	9.9	62.6	28.4	

	attribute1	attribute2	attribute3	attribute4	attribute5	attribute6	attribute7	attribute8	cla
18157	42.4	29.7	1011.3	7.0	3.3	8.9	51.8	32.0	
18158	36.6	29.5	1017.9	6.8	4.8	13.0	53.6	24.8	

18159 rows × 9 columns

In [4]:
```python
data['class'].value_counts()
```

Out[4]:
```
1    12461
2     5698
Name: class, dtype: int64
```

3. Data Preprocessing

1. Apply one-hot encoding to object types
2. Apply Minmax normalization to numeric columns
3. Keep the class column as it is
4. Initial 70% data is used for training (training aand validation for AE)
5. Next 20 % data is used as a validation set to compute thresholds
6. Next 10 % data is used as a test stream initilally without drift and then after introdicung drift

Remove any irrelavant attributes like dates etc if needed

In [5]:
```python
def normalize_encode_split(data,label_col,pos_val,neg_val):
    # Apply Label Encoding

    for col in data.columns:
        if ((data[col].dtype=='object')and (col!=label_col)):
            data = pd.get_dummies(data, columns=[col])

    # Apply Minmax Normalization
    for col in data.columns:
        if (((data[col].dtype=='float64')or(data[col].dtype=='int64')) and (col!=labe
            data[col] = np.round((data[col] - data[col].min()) / (data[col].max() -


    # Split into training  , test (validation set 1) and stream (Validation Set II)

    train=data[0:int(len(data)*0.70)]
    test=data[int((0.70*len(data))):int((0.90*len(data)))]
    stream=data[int((0.90*len(data))):len(data)]

    train_positives = train[train[label_col] == pos_val]
    train_negatives = train[train[label_col] == neg_val]

    X_positive=train_positives.drop([label_col],axis=1)
    X_negative=train_negatives.drop([label_col],axis=1)
    return train, test, X_positive,X_negative , stream
```

In [6]:
```python
train, test, X_positive,X_negative , stream =normalize_encode_split(data,'class',2,1)
```

In [7]:
```python
train['class'].value_counts()
```

Out[7]:
```
1    8955
2    3756
Name: class, dtype: int64
```

In [8]:
```python
data
```

Out[8]:

	attribute1	attribute2	attribute3	attribute4	attribute5	attribute6	attribute7	attribute8	cl
0	0.302	0.384	0.009	0.335	0.351	0.297	0.321	0.343	
1	0.369	0.464	0.006	0.323	0.387	0.363	0.364	0.410	
2	0.444	0.567	0.005	0.153	0.491	0.427	0.381	0.525	
3	0.366	0.457	0.006	0.319	0.667	0.599	0.414	0.362	
4	0.253	0.325	0.007	0.323	0.502	0.427	0.254	0.296	
...	...	...	...	...	...	...	...	...	
18154	0.425	0.461	0.009	0.278	0.441	0.512	0.423	0.446	
18155	0.465	0.495	0.008	0.278	0.355	0.363	0.561	0.412	
18156	0.514	0.538	0.007	0.278	0.165	0.170	0.606	0.480	
18157	0.519	0.536	0.007	0.278	0.115	0.149	0.515	0.515	
18158	0.464	0.534	0.008	0.270	0.168	0.236	0.530	0.446	

18159 rows × 9 columns

In [9]:
```python
test['class'].value_counts()
```

Out[9]:
```
1    2341
2    1291
Name: class, dtype: int64
```

In [10]:
```python
train['class'].value_counts()
```

Out[10]:
```
1    8955
2    3756
Name: class, dtype: int64
```

In [11]:
```python
stream['class'].value_counts()
```

Out[11]:
```
1    1165
2     651
Name: class, dtype: int64
```

4. Training of Autoencoders

Adjust the layers manullay for each dataset based on dimensions

In [12]:
```python
def autoencoder (train,epochs,val_set):

    input_layer = tensorflow.keras.Input(shape=train.shape[1:]) # Input Layer
    h1 = layers.Dense(6, activation='relu')(input_layer) # Code Layer 1
    bottleneck=layers.Dense(2,activation='relu')(h1) # Bottleneck
    R1=layers.Dense(6,activation='relu')(bottleneck)# Decode Layer 1
    output = layers.Dense(train.shape[1], activation='sigmoid')(R1) # Output Layer


    autoencoder = tensorflow.keras.Model(input_layer, output)
    # above model maps an input to its reconstruction


    autoencoder.compile(optimizer='adam', loss='mse')
    history=autoencoder.fit(train,train,
                epochs=epochs,
                batch_size=32,
                shuffle=True,
                validation_data=(val_set, val_set)).history
    return  autoencoder , history
```

In [13]:
```python
def train_encoders(X_Positive,X_Negative, epochs):

    X_Positive_train=X_Positive[0:int(len(X_Positive)*0.90)]
    X_Positive_test=X_Positive[int((0.90*len(X_Positive))):len(X_Positive)-1]

    X_Negative_train=X_Negative[0:int(len(X_Negative)*0.90)]
    X_Negative_test=X_Negative[int((0.90*len(X_Negative))):len(X_Negative)-1]

    print("Training Autoencoder on Positive Examples ")
    encoder_pos_class, history_positive_class=autoencoder(X_Positive_train,epochs,X_P
    print("Training Autoencoder on Negative Examples ")
    encoder_neg_class,history_negative_class=autoencoder(X_Negative_train,epochs,X_Ne

    return encoder_pos_class, history_positive_class ,encoder_neg_class,history_negat
```

In [14]:
```python
encoder_pos_class, history_positive_class ,encoder_neg_class,history_negative_class=t
```

```
Training Autoencoder on Positive Examples
Epoch 1/100
106/106 [==============================] - 8s 74ms/step - loss: 0.0520 - val_loss:
0.0269
Epoch 2/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0227 - val_loss: 0.0
164
Epoch 3/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0157 - val_loss: 0.0
151
Epoch 4/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0140 - val_loss: 0.0
138
Epoch 5/100
```

```
106/106 [==============================] - 0s 3ms/step - loss: 0.0124 - val_loss: 0.0
129
Epoch 6/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0117 - val_loss: 0.0
121
Epoch 7/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0113 - val_loss: 0.0
114
Epoch 8/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0107 - val_loss: 0.0
111
Epoch 9/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0101 - val_loss: 0.0
103
Epoch 10/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0093 - val_loss: 0.0
096
Epoch 11/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0088 - val_loss: 0.0
091
Epoch 12/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0084 - val_loss: 0.0
086
Epoch 13/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0078 - val_loss: 0.0
076
Epoch 14/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0071 - val_loss: 0.0
069
Epoch 15/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0064 - val_loss: 0.0
064
Epoch 16/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0063 - val_loss: 0.0
054
Epoch 17/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0058 - val_loss: 0.0
050
Epoch 18/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0054 - val_loss: 0.0
050
Epoch 19/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0054 - val_loss: 0.0
045
Epoch 20/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0050 - val_loss: 0.0
043
Epoch 21/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0049 - val_loss: 0.0
044
Epoch 22/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0046 - val_loss: 0.0
044
Epoch 23/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0046 - val_loss: 0.0
040
Epoch 24/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0046 - val_loss: 0.0
041
Epoch 25/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0043 - val_loss: 0.0
041
```

```
Epoch 26/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0042 - val_loss: 0.0
040
Epoch 27/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0042 - val_loss: 0.0
040
Epoch 28/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0043 - val_loss: 0.0
040
Epoch 29/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0042 - val_loss: 0.0
039
Epoch 30/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0041 - val_loss: 0.0
041
Epoch 31/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0041 - val_loss: 0.0
040
Epoch 32/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0041 - val_loss: 0.0
040
Epoch 33/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0038 - val_loss: 0.0
037
Epoch 34/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0039 - val_loss: 0.0
040
Epoch 35/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0039 - val_loss: 0.0
038
Epoch 36/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0038 - val_loss: 0.0
040
Epoch 37/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0037 - val_loss: 0.0
037
Epoch 38/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0038 - val_loss: 0.0
039
Epoch 39/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0038 - val_loss: 0.0
042
Epoch 40/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0037 - val_loss: 0.0
041
Epoch 41/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0037 - val_loss: 0.0
041
Epoch 42/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0036 - val_loss: 0.0
039
Epoch 43/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0036 - val_loss: 0.0
042
Epoch 44/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0035 - val_loss: 0.0
042
Epoch 45/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0035 - val_loss: 0.0
039
Epoch 46/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0036 - val_loss: 0.0
```

```
042
Epoch 47/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0035 - val_loss: 0.0
047
Epoch 48/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0034 - val_loss: 0.0
040
Epoch 49/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0034 - val_loss: 0.0
040
Epoch 50/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0034 - val_loss: 0.0
044
Epoch 51/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0034 - val_loss: 0.0
045
Epoch 52/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0034 - val_loss: 0.0
042
Epoch 53/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0034 - val_loss: 0.0
051
Epoch 54/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0034 - val_loss: 0.0
043
Epoch 55/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0034 - val_loss: 0.0
044
Epoch 56/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0033 - val_loss: 0.0
041
Epoch 57/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0033 - val_loss: 0.0
043
Epoch 58/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
043
Epoch 59/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
042
Epoch 60/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
044
Epoch 61/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0033 - val_loss: 0.0
046
Epoch 62/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
043
Epoch 63/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0033 - val_loss: 0.0
046
Epoch 64/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
043
Epoch 65/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
042
Epoch 66/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
045
Epoch 67/100
```

```
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
044
Epoch 68/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0033 - val_loss: 0.0
045
Epoch 69/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
046
Epoch 70/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
043
Epoch 71/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
041
Epoch 72/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
044
Epoch 73/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
044
Epoch 74/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0030 - val_loss: 0.0
045
Epoch 75/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
046
Epoch 76/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
044
Epoch 77/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
042
Epoch 78/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
044
Epoch 79/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
043
Epoch 80/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
045
Epoch 81/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
044
Epoch 82/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
042
Epoch 83/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
043
Epoch 84/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
043
Epoch 85/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0030 - val_loss: 0.0
042
Epoch 86/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
047
Epoch 87/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
047
```

```
Epoch 88/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
042
Epoch 89/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
044
Epoch 90/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
044
Epoch 91/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
045
Epoch 92/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
045
Epoch 93/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
044
Epoch 94/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
043
Epoch 95/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0030 - val_loss: 0.0
045
Epoch 96/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
043
Epoch 97/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0032 - val_loss: 0.0
046
Epoch 98/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0033 - val_loss: 0.0
045
Epoch 99/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
047
Epoch 100/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0031 - val_loss: 0.0
045
Training Autoencoder on Negative Examples
Epoch 1/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0692 - val_loss: 0.0
315
Epoch 2/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0258 - val_loss: 0.0
148
Epoch 3/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0131 - val_loss: 0.0
090
Epoch 4/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0083 - val_loss: 0.0
070
Epoch 5/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0062 - val_loss: 0.0
056
Epoch 6/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0050 - val_loss: 0.0
050
Epoch 7/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0045 - val_loss: 0.0
047
Epoch 8/100
```

```
252/252 [==============================] - 1s 2ms/step - loss: 0.0044 - val_loss: 0.0
045
Epoch 9/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0043 - val_loss: 0.0
045
Epoch 10/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0042 - val_loss: 0.0
046
Epoch 11/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0041 - val_loss: 0.0
044
Epoch 12/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0040 - val_loss: 0.0
047
Epoch 13/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0040 - val_loss: 0.0
046
Epoch 14/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0040 - val_loss: 0.0
046
Epoch 15/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0040 - val_loss: 0.0
047
Epoch 16/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
045
Epoch 17/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
046
Epoch 18/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
046
Epoch 19/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
045
Epoch 20/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
046
Epoch 21/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
044
Epoch 22/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
045
Epoch 23/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 24/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
047
Epoch 25/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 26/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
044
Epoch 27/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
048
Epoch 28/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0039 - val_loss: 0.0
046
```

```
Epoch 29/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
048
Epoch 30/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0038 - val_loss: 0.0
046
Epoch 31/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
046
Epoch 32/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0039 - val_loss: 0.0
045
Epoch 33/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
048
Epoch 34/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
045
Epoch 35/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
045
Epoch 36/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
047
Epoch 37/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0038 - val_loss: 0.0
048
Epoch 38/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0037 - val_loss: 0.0
048
Epoch 39/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
046
Epoch 40/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
047
Epoch 41/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 42/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
046
Epoch 43/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
049
Epoch 44/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
049
Epoch 45/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 46/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
048
Epoch 47/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
045
Epoch 48/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
047
Epoch 49/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
```

```
045
Epoch 50/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 51/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
048
Epoch 52/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0038 - val_loss: 0.0
049
Epoch 53/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
045
Epoch 54/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0039 - val_loss: 0.0
050
Epoch 55/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
046
Epoch 56/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 57/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0038 - val_loss: 0.0
048
Epoch 58/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
049
Epoch 59/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
050
Epoch 60/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
047
Epoch 61/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
046
Epoch 62/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 63/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
046
Epoch 64/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
046
Epoch 65/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
048
Epoch 66/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
046
Epoch 67/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0039 - val_loss: 0.0
047
Epoch 68/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0037 - val_loss: 0.0
047
Epoch 69/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
048
Epoch 70/100
```

```
252/252 [==============================] - 1s 3ms/step - loss: 0.0037 - val_loss: 0.0
046
Epoch 71/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
046
Epoch 72/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 73/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
047
Epoch 74/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
047
Epoch 75/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
048
Epoch 76/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0039 - val_loss: 0.0
046
Epoch 77/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
048
Epoch 78/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
048
Epoch 79/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
045
Epoch 80/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 81/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
049
Epoch 82/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 83/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
046
Epoch 84/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 85/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
049
Epoch 86/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0038 - val_loss: 0.0
051
Epoch 87/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
048
Epoch 88/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
049
Epoch 89/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0038 - val_loss: 0.0
049
Epoch 90/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
```

```
Epoch 91/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
048
Epoch 92/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
049
Epoch 93/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
049
Epoch 94/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 95/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
046
Epoch 96/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0038 - val_loss: 0.0
047
Epoch 97/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0039 - val_loss: 0.0
050
Epoch 98/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
048
Epoch 99/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
048
Epoch 100/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0038 - val_loss: 0.0
048
```

In [15]:
```python
#Plot the model loss for give number of epochs
def plot_loss(history):
    plt.plot(history['loss'], linewidth=2, label='Training_Loss')
    plt.plot(history['val_loss'], linewidth=2, label='Validation_Loss')
    plt.legend(loc='upper right')
    plt.title('Model loss')
    plt.ylabel('Loss')
    plt.xlabel('Epoch')

    plt.show()
```

In [16]:
```python
plot_loss(history_negative_class)
```
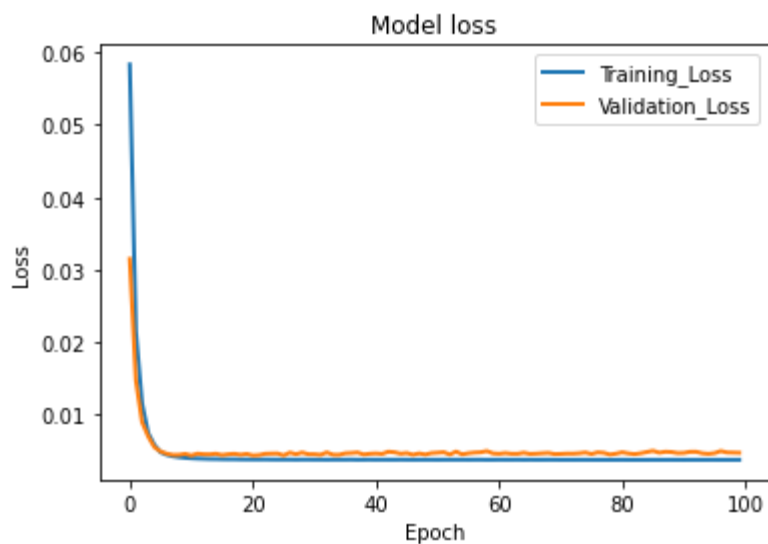
```
In [17]:   plot_loss(history_positive_class)
```
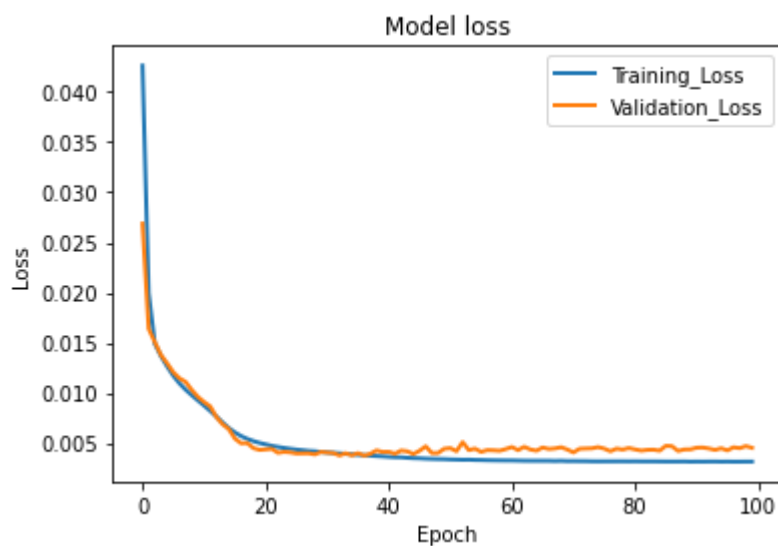

5. Threshold Computation & Plotting

This function computes the reconstruction error for each instance in test set

```
In [18]:   def mse_predictions(test, encoder):

               test=np.array(test)
               predictions=[]
               for i in range(0, test.shape[0]):
                   ROW = np.array([test[i]])
                   pred= encoder.predict(ROW)
                   mse = np.mean(np.power(test[i] - pred, 2))
                   predictions.append(mse)

               return predictions
```

In [19]:
```python
def plot_results(predictions):
    df=pd.DataFrame(predictions,columns=['MSE'])

    df['MSE']=df['MSE'].round(6)    # Rounding upto 2 decimal places was causing probl

    mean=np.round(np.mean( df['MSE']),10)   # rounding off changed from 3 to 10 due to
    max=np.round(np.max( df['MSE']),10)
    min=np.round(np.min( df['MSE']),10)
    var=np.round(np.var( df['MSE']),10)
    med=np.round(np.median(df['MSE']),10)

    f, axes = plt.subplots(1, 2,figsize=(16,4))
    f.suptitle('Boxplots and Distribution plot for Reconstruction Error')

    sns.boxplot(x=df['MSE'], data=df, ax=axes[0])

    sns.distplot(x=df['MSE'],  ax=axes[1])
    print('mean={},median={} ,max={},min={},variance={}'.format(mean,med,max,min,var)

    fig, ax = plt.subplots(figsize=(16,5))
    ax.set_title('MSE plot ')
    plt.plot(df['MSE'],'.',label="MSE")

    plt.legend()
    plt.show()
```

Adjust Manually based on name of class column

In [20]:
```python
test_pos_class=test[test['class']==2]
test_neg_class=test[test['class']==1]
```

In [21]:
```python
del test_pos_class['class']
del test_neg_class['class']
```

5. A) Negative Class Data

In [22]:
```python
predictions_neg=mse_predictions(test_neg_class,encoder_neg_class)
```

In [23]:
```python
plot_results(predictions_neg)
```

mean=0.002660255,median=0.001618 ,max=0.038786,min=7.2e-05,variance=1.17678e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot
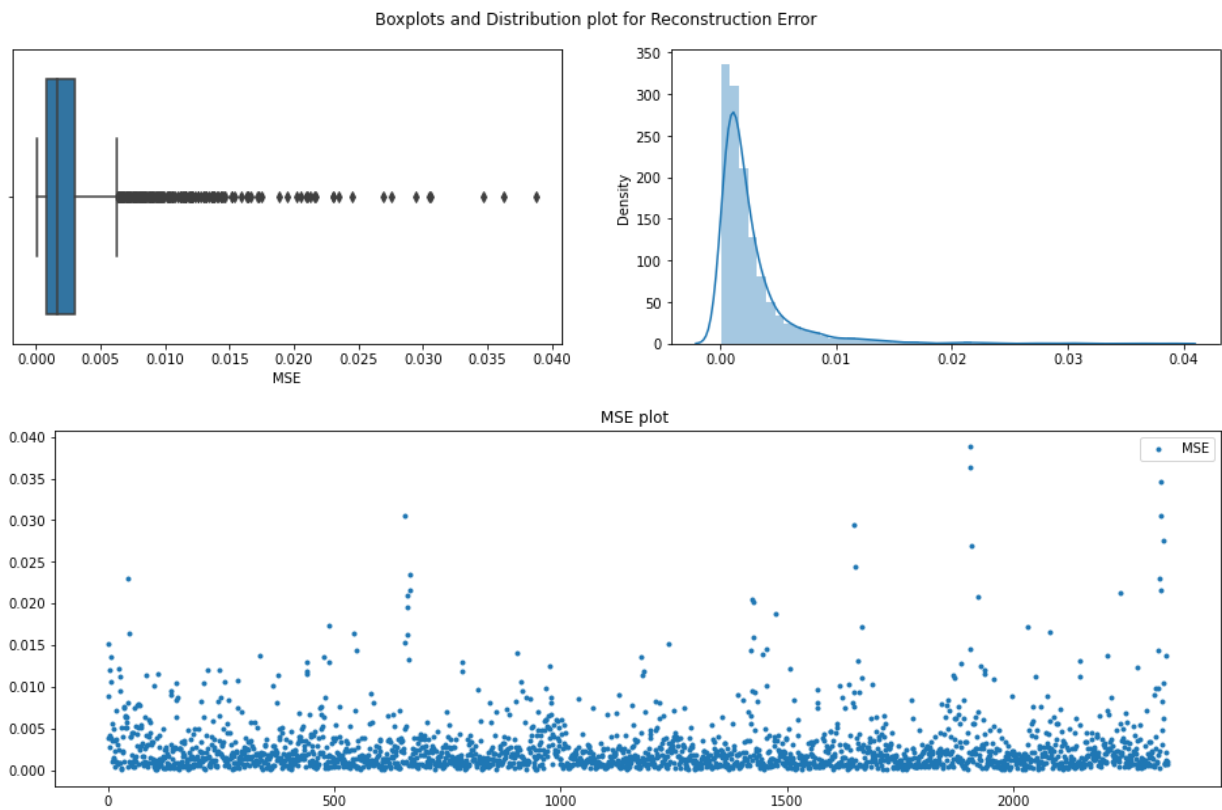
In [24]:
```python
def make_batches(test_data):
    data=np.array(test_data)
    batch_size=32
    batches={}
    count=0
    for index in range(0,data.shape[0],batch_size):
        batches[count]=data[index:min(index+batch_size,data.shape[0]),:]
        count+=1
    return batches
    #print(batch.shape)
```

In [25]:
```python
batches_neg=make_batches(test_neg_class)
```

Functions to test normality of batch loss values

In [26]:
```python
# Anderson-Darling Test
def Anderson_Darling(data):
    result = anderson(data)
    print('Statistic: %.3f' % result.statistic)
    p = 0
    for i in range(len(result.critical_values)):
        sl, cv = result.significance_level[i], result.critical_values[i]
        if result.statistic < result.critical_values[i]:
            print('%.3f: %.3f, data looks normal (fail to reject H0)' % (sl, cv))
        else:
            print('%.3f: %.3f, data does not look normal (reject H0)' % (sl, cv))
```

In [27]:
```python
# D'Agostino and Pearson's Test
def D_Agostino(data):
    stat, p = normaltest(data)
    print('Statistics=%.3f, p=%.3f' % (stat, p))
    # interpret
    alpha = 0.05
    if p > alpha:
        print('Sample looks Gaussian (fail to reject H0)')
    else:
        print('Sample does not look Gaussian (reject H0)')
```

In [28]:
```python
# Shapiro-Wilk Test
def Shapiro_Wilk(data):
    stat, p = shapiro(data)
    print('Statistics=%.3f, p=%.10f' % (stat, p))
    # interpret
    alpha = 0.05
    if p > alpha:
        print('Sample looks Gaussian (fail to reject H0)')
    else:
        print('Sample does not look Gaussian (reject H0)')
```

In [29]:
```python
# This function computes reconconstruction error for each instance as well as average
def compute_instance_loss_batch_loss(batch,batch_size,encoder):
    mse_list=[]
    mse_sum=0
    for i in range(0,batch.shape[0]):
        ROW = np.array([batch[i]])
        pred= encoder.predict(ROW)
        mse = np.round(np.mean(np.power(batch[i] - pred, 2)),5)
        mse_list.append(mse)
        mse_sum+=mse
    avg_mse=mse_sum/batch_size
    return mse_list,avg_mse
```

In [30]:
```python
# This function computes recon.errr of all the batches . Checks each batch for normal
def check_all_batch_normality(batches,encoder,batch_size):
    batch_avg_mse=[]
    batch_mse_values={}
    for b in batches:
        print("\n *******************")
        print('Batch: {}'.format(b))
        mse_list,average_mse=compute_instance_loss_batch_loss(batches[b],batch_size,e
        plot_results(mse_list)

        #print("\nShapiro_Wilk Test")
        #Shapiro_Wilk(mse_list)
        # print("D_Agostino Test")
        #D_Agostino(mse_list)
        print("\nAnderson_Darling Test")
        Anderson_Darling(mse_list)
        batch_avg_mse.append(average_mse)
        batch_mse_values[b]=mse_list
    return batch_avg_mse,batch_mse_values
```

In [31]:
```python
batch_avg_mse_neg_en_neg,batch_mse_values_neg_en_neg=check_all_batch_normality(batche
```

```
 *******************
Batch: 0
mean=0.0049425,median=0.003635 ,max=0.01519,min=0.00019,variance=1.85492e-05
```


Boxplots and Distribution plot for Reconstruction Error
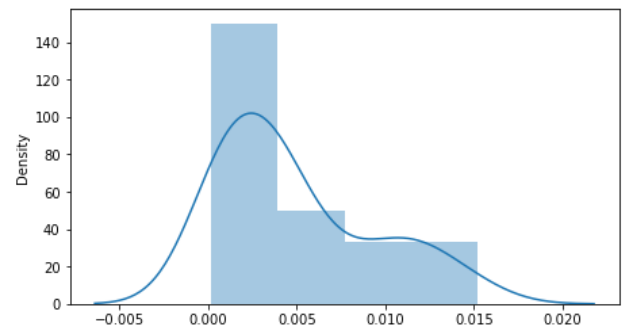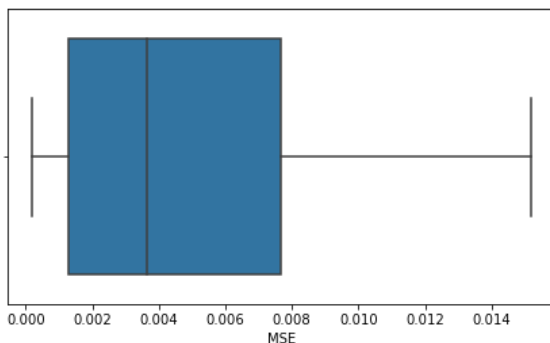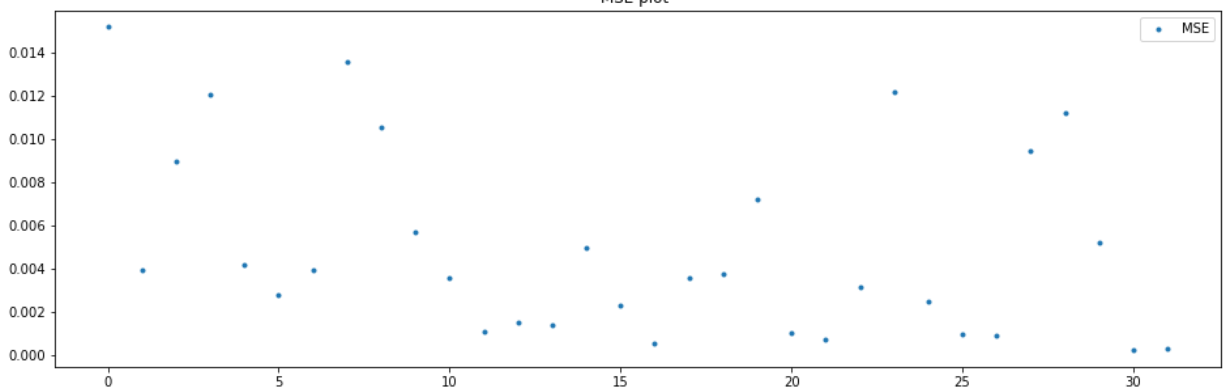
MSE plot

```
Anderson_Darling Test
Statistic: 1.528
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
```
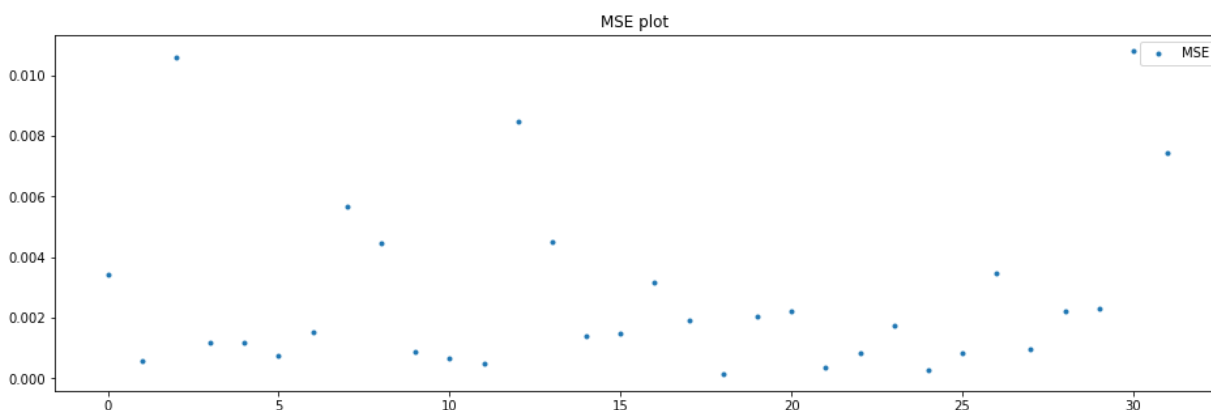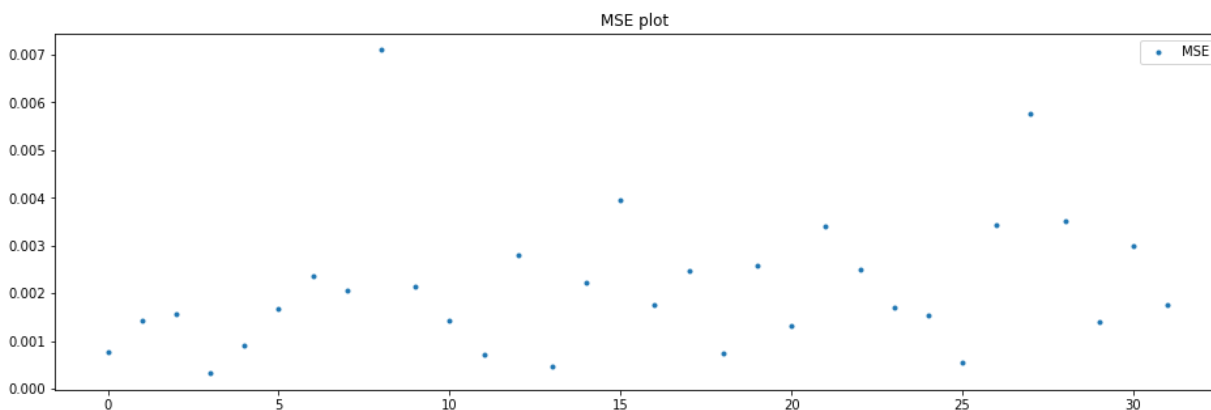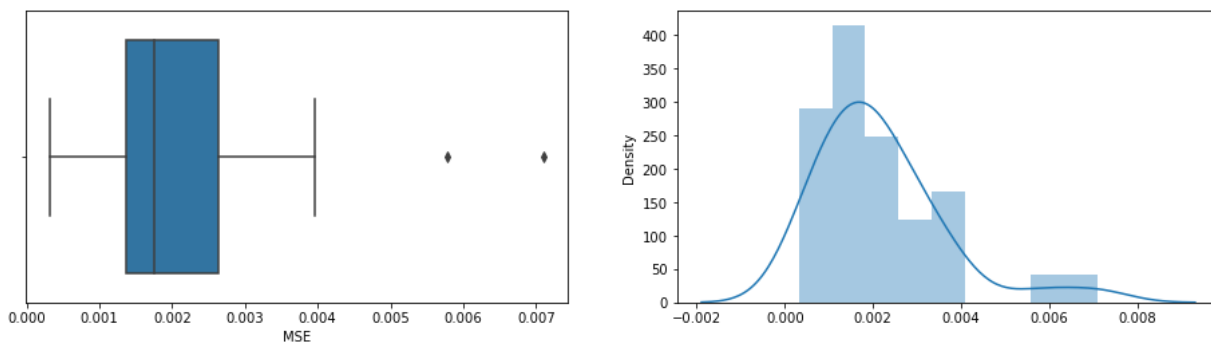
1.000: 0.992, data does not look normal (reject H0)

  ****
Batch: 1
mean=0.0046525,median=0.004045 ,max=0.02301,min=0.00039,variance=2.18787e-05

Boxplots and Distribution plot for Reconstruction Error
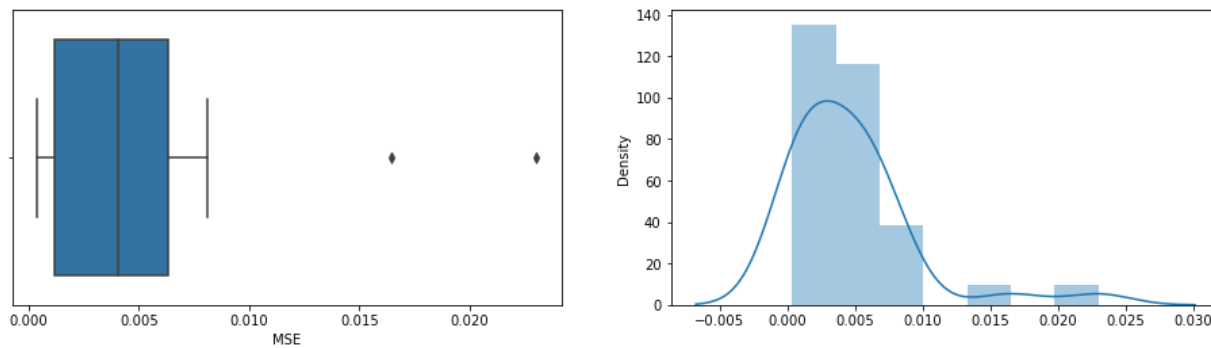
MSE plot
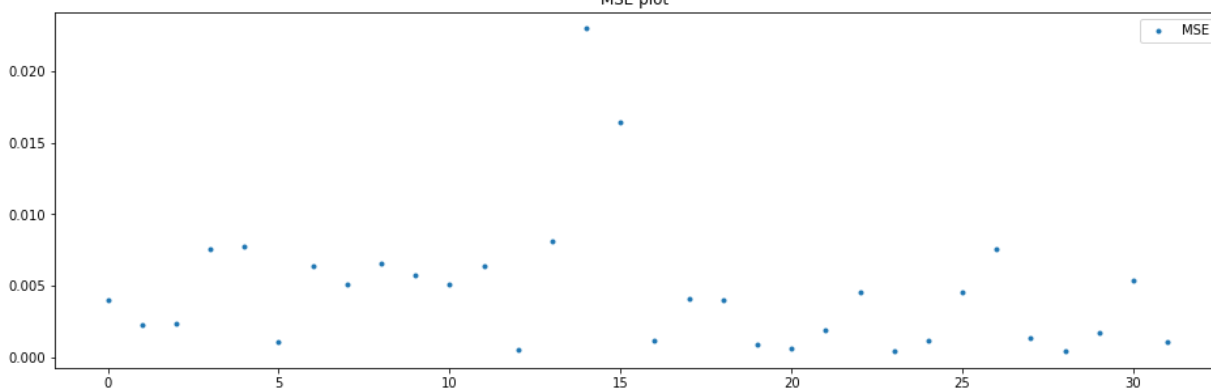
Anderson_Darling Test
Statistic: 2.020
15.000: 0.523, data does not look normal (reject H0)
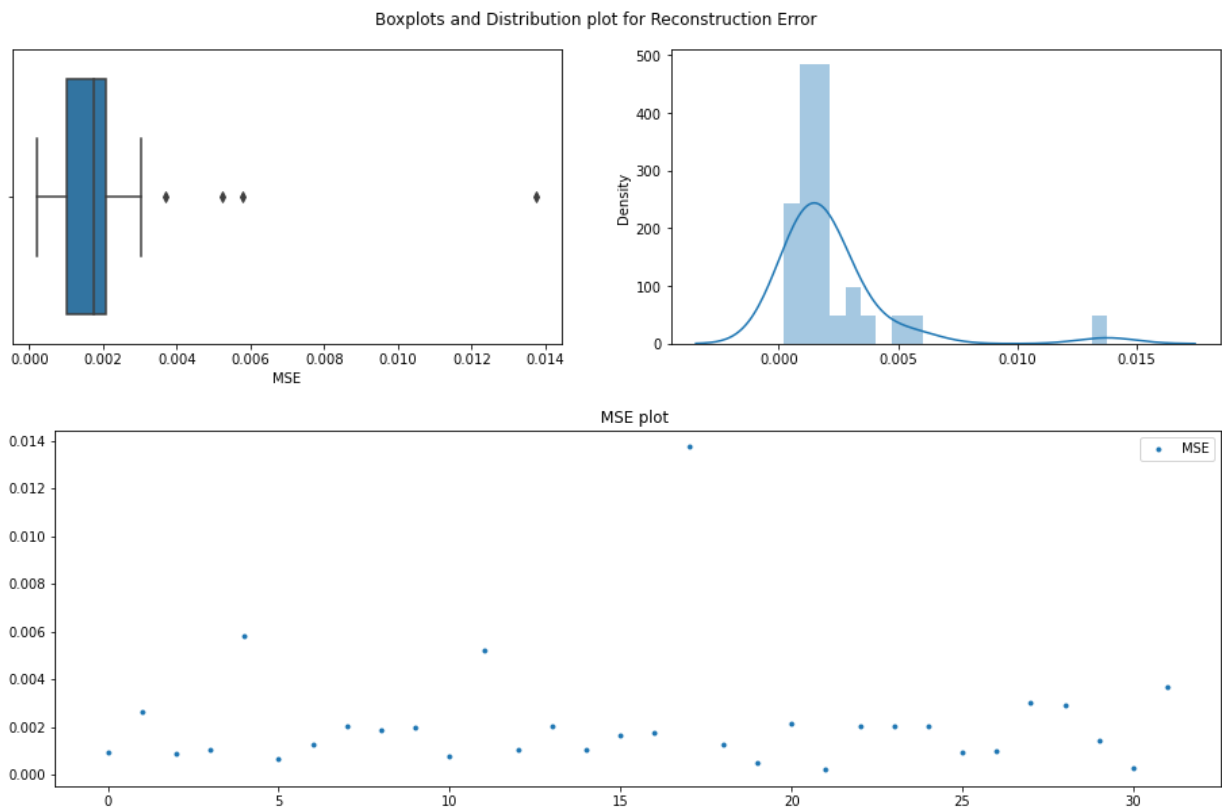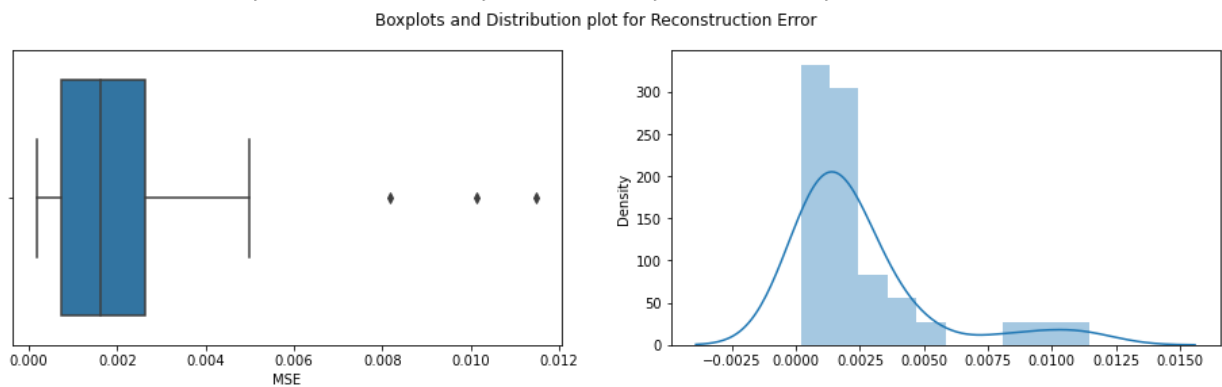10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

  ****
Batch: 2
mean=0.00368125,median=0.003015 ,max=0.0114,min=0.00043,variance=6.8773e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
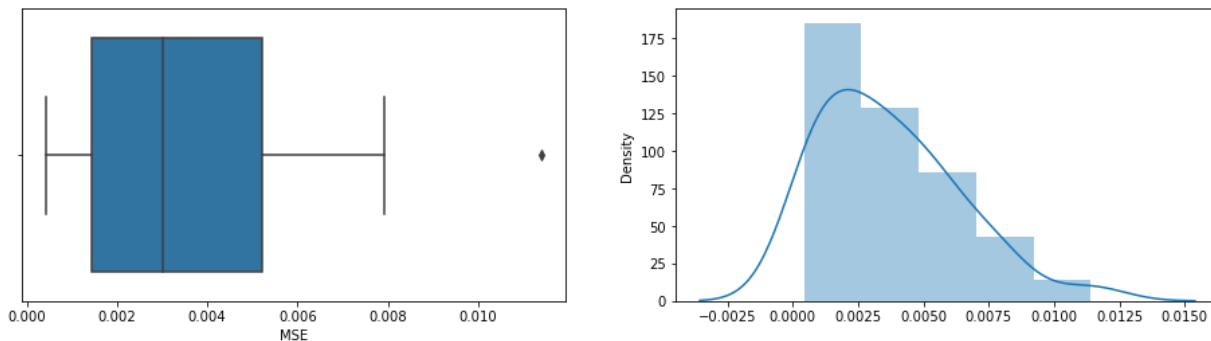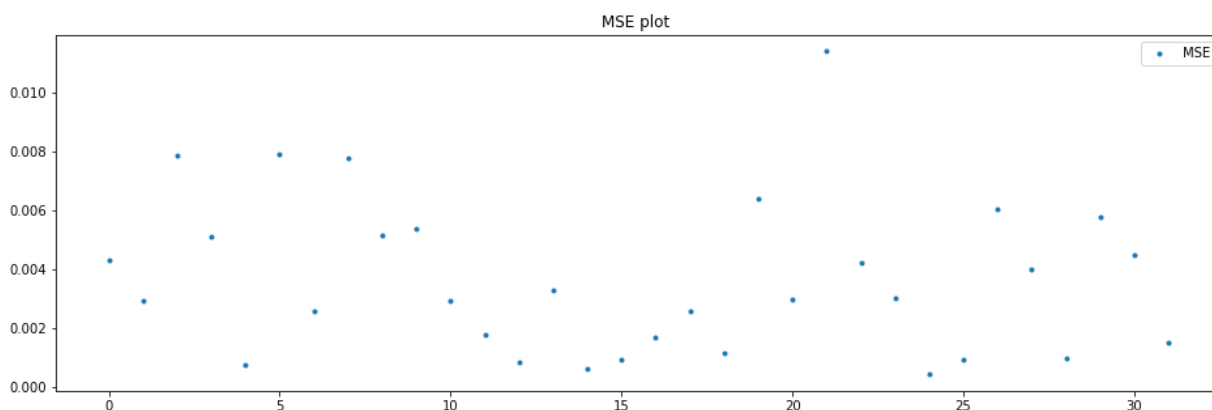
```
Anderson_Darling Test
Statistic: 0.701
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 *******************
Batch: 3
mean=0.0021625,median=0.001265 ,max=0.0116,min=0.00019,variance=6.7582e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
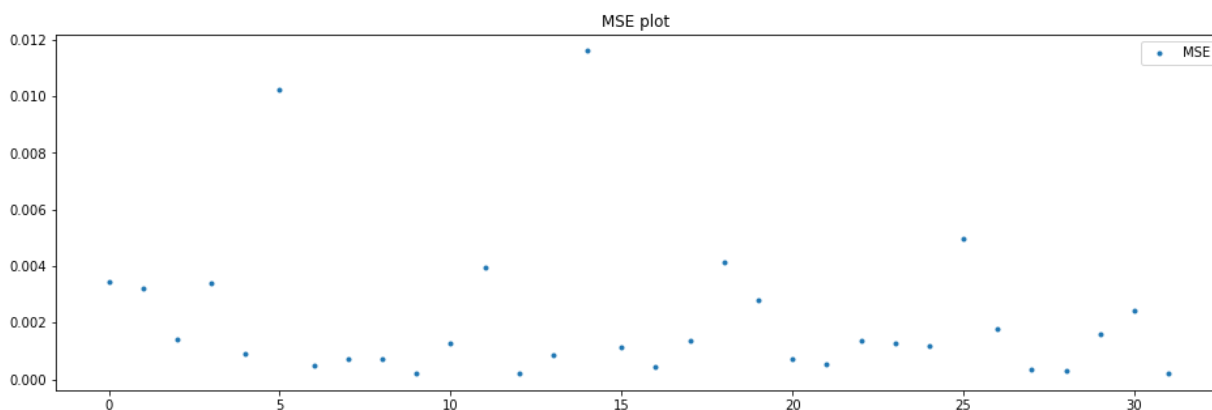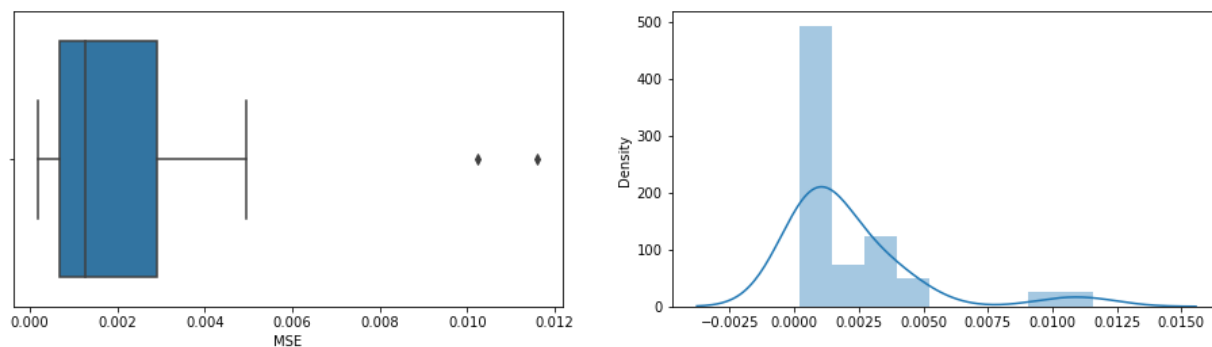

```
Anderson_Darling Test
Statistic: 3.237
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 4
mean=0.002758125,median=0.001565 ,max=0.01049,min=0.00015,variance=9.5059e-06
```
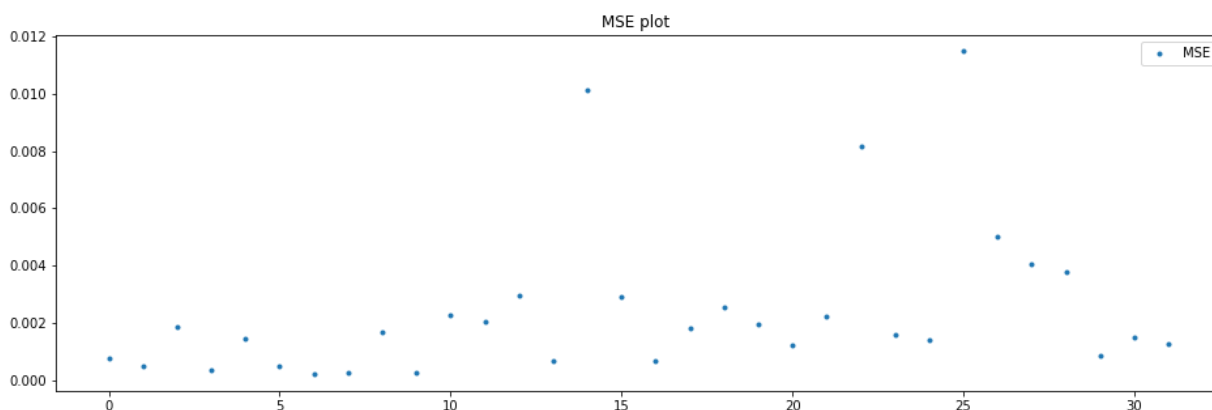
Boxplots and Distribution plot for Reconstruction Error

MSE plot
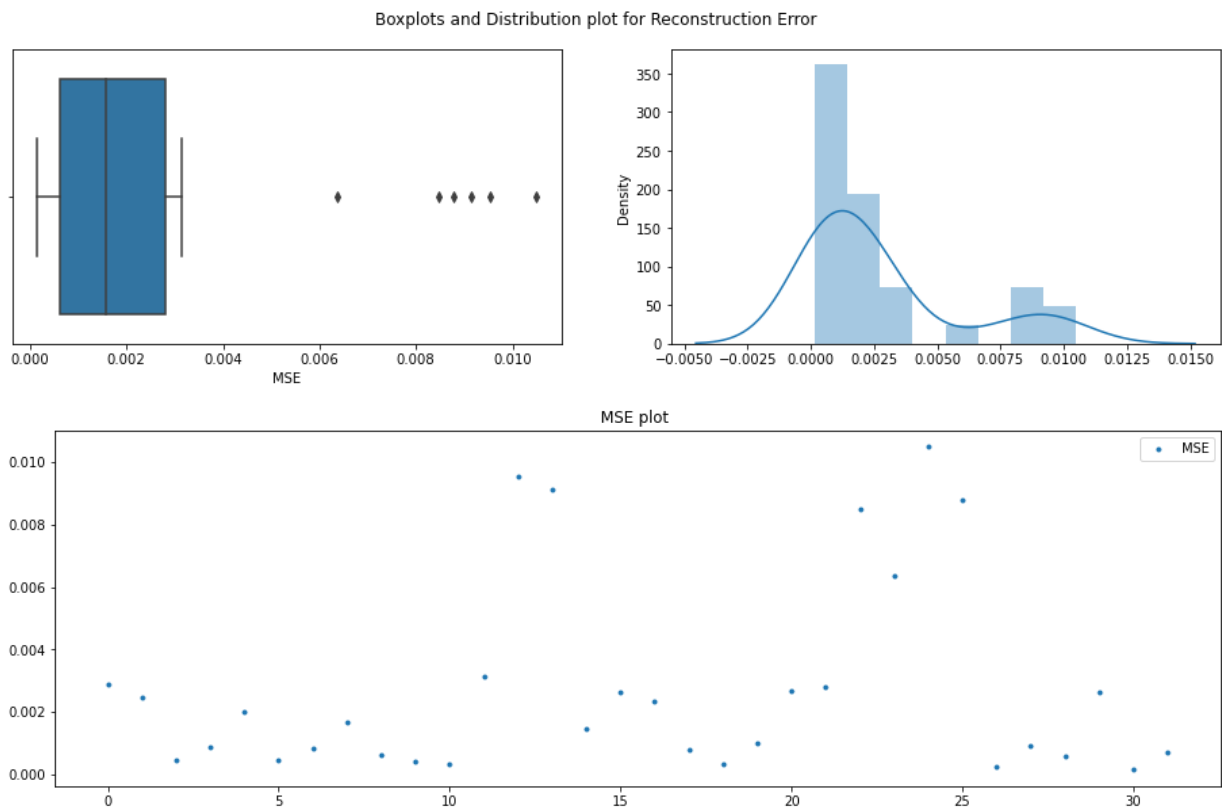
Anderson_Darling Test
Statistic: 3.357
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
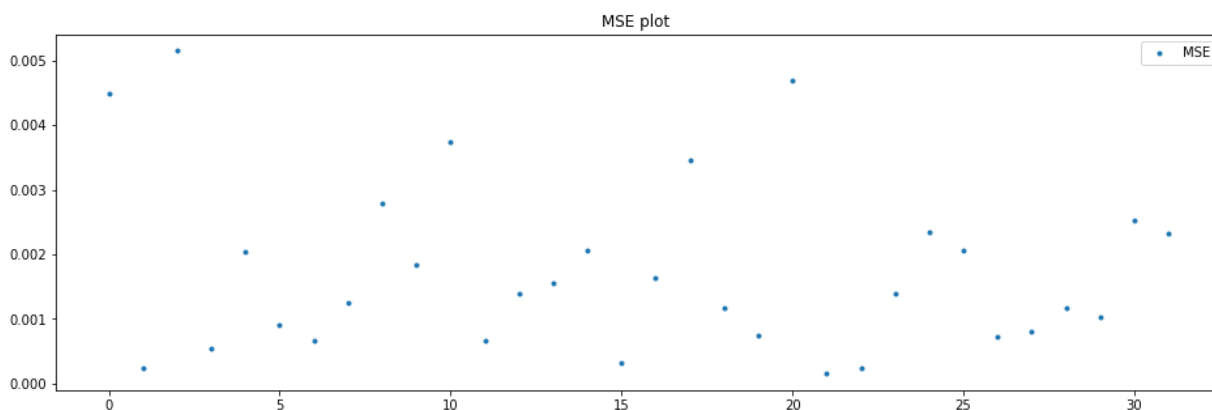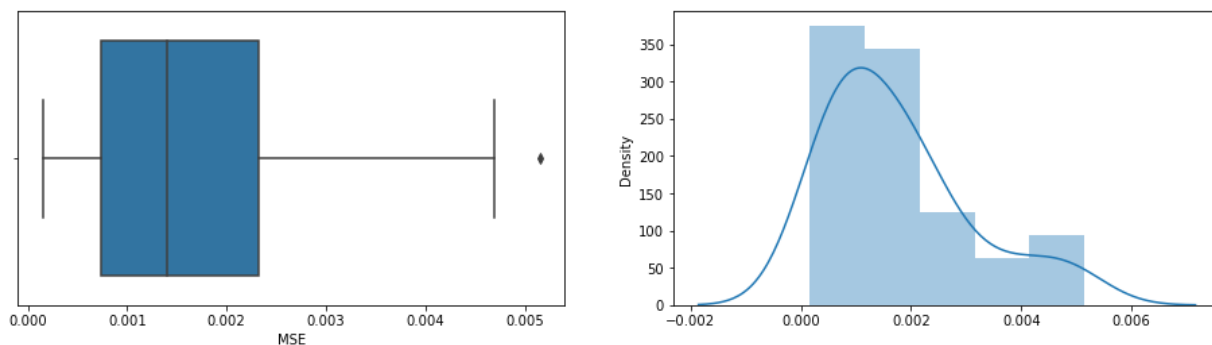5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 5
mean=0.00171,median=0.001375 ,max=0.00477,min=0.00016,variance=1.6124e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
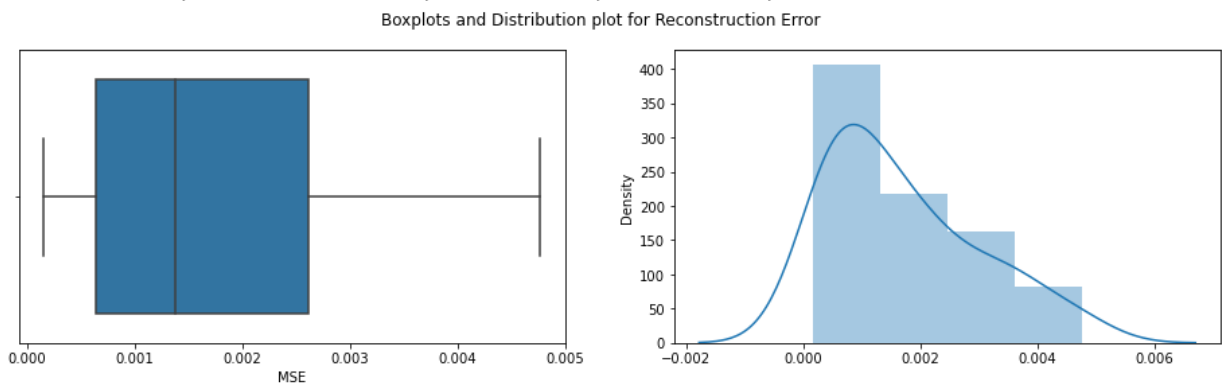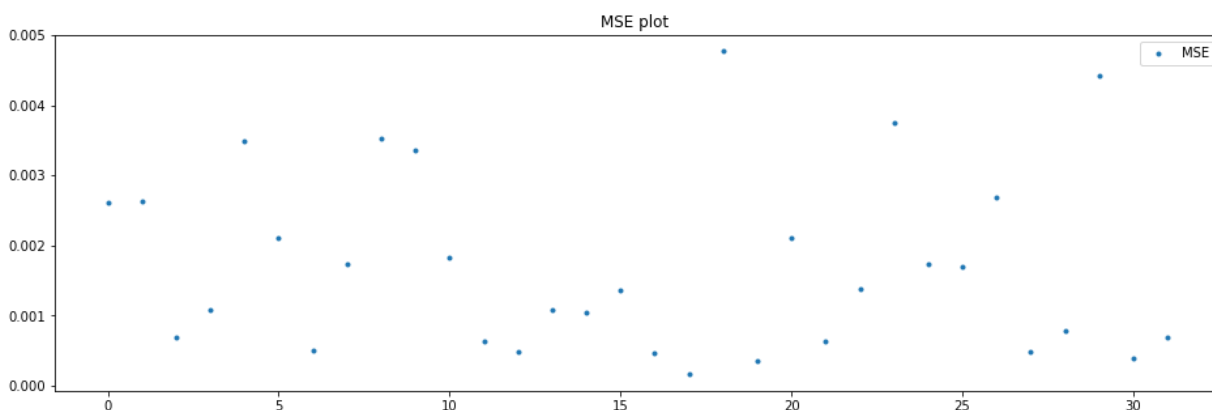
Anderson_Darling Test
Statistic: 1.137
15.000: 0.523, data does not look normal (reject H0)
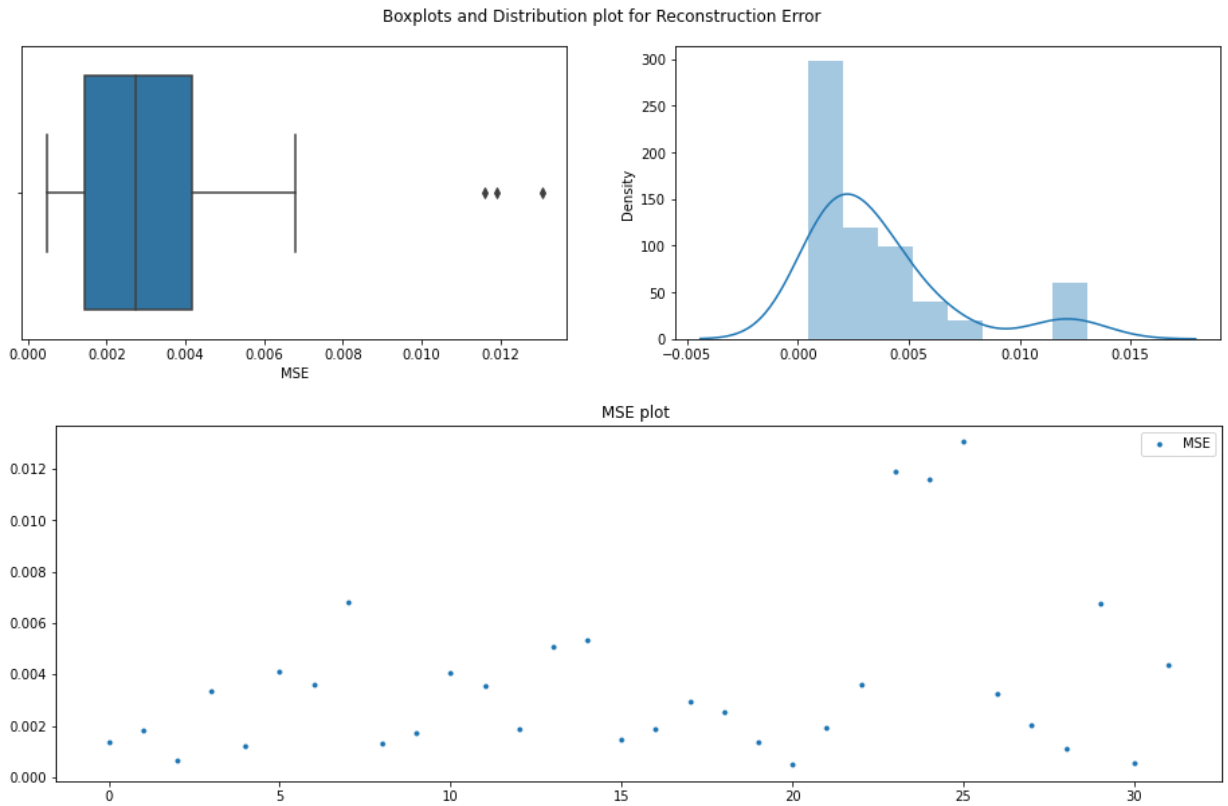10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

  ****
Batch: 6
mean=0.0027984375,median=0.001665 ,max=0.01213,min=9e-05,variance=8.0551e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
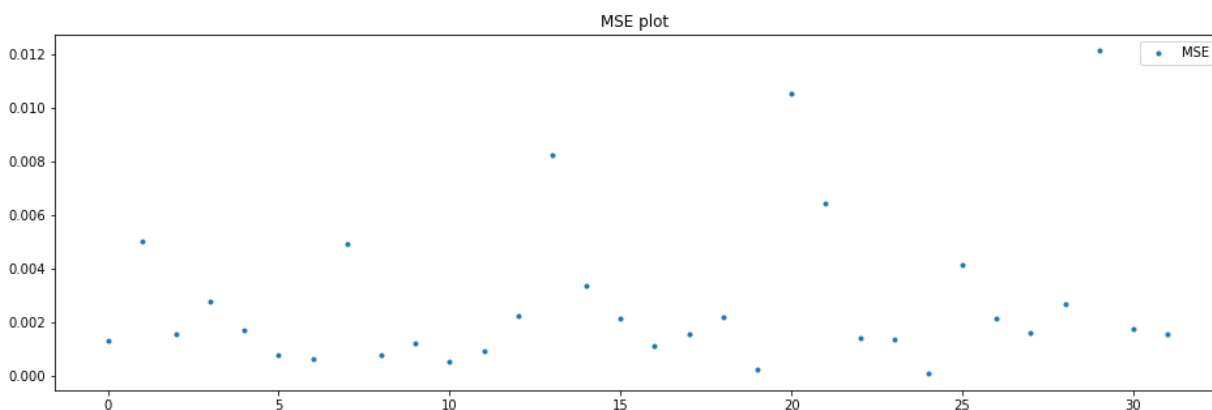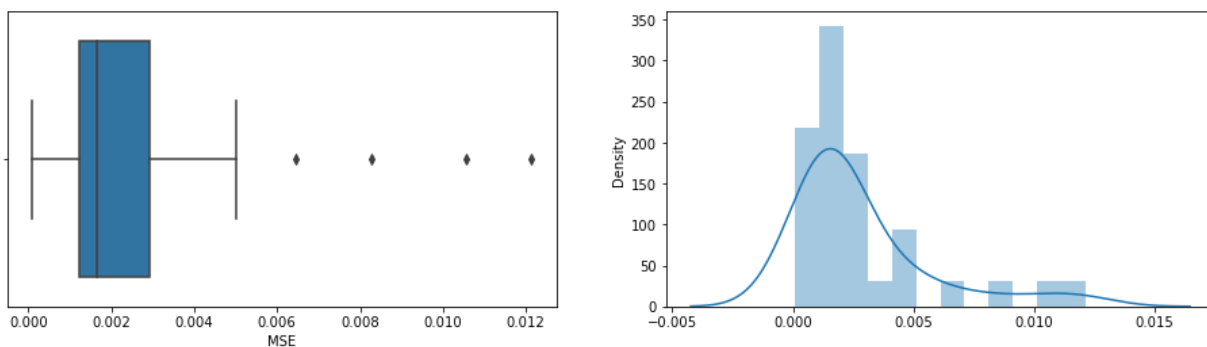
Anderson_Darling Test
Statistic: 3.015
15.000: 0.523, data does not look normal (reject H0)
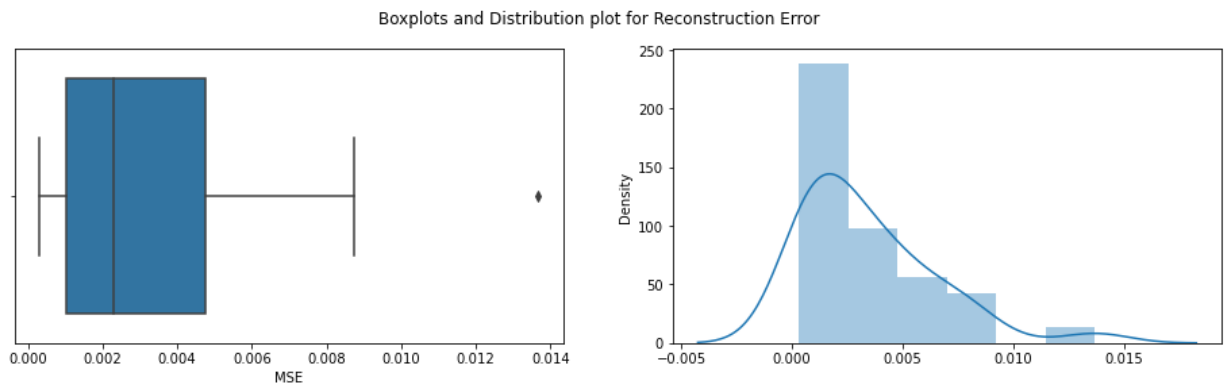10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

  ****
Batch: 7
mean=0.0029428125,median=0.002025 ,max=0.012,min=0.00049,variance=7.2501e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
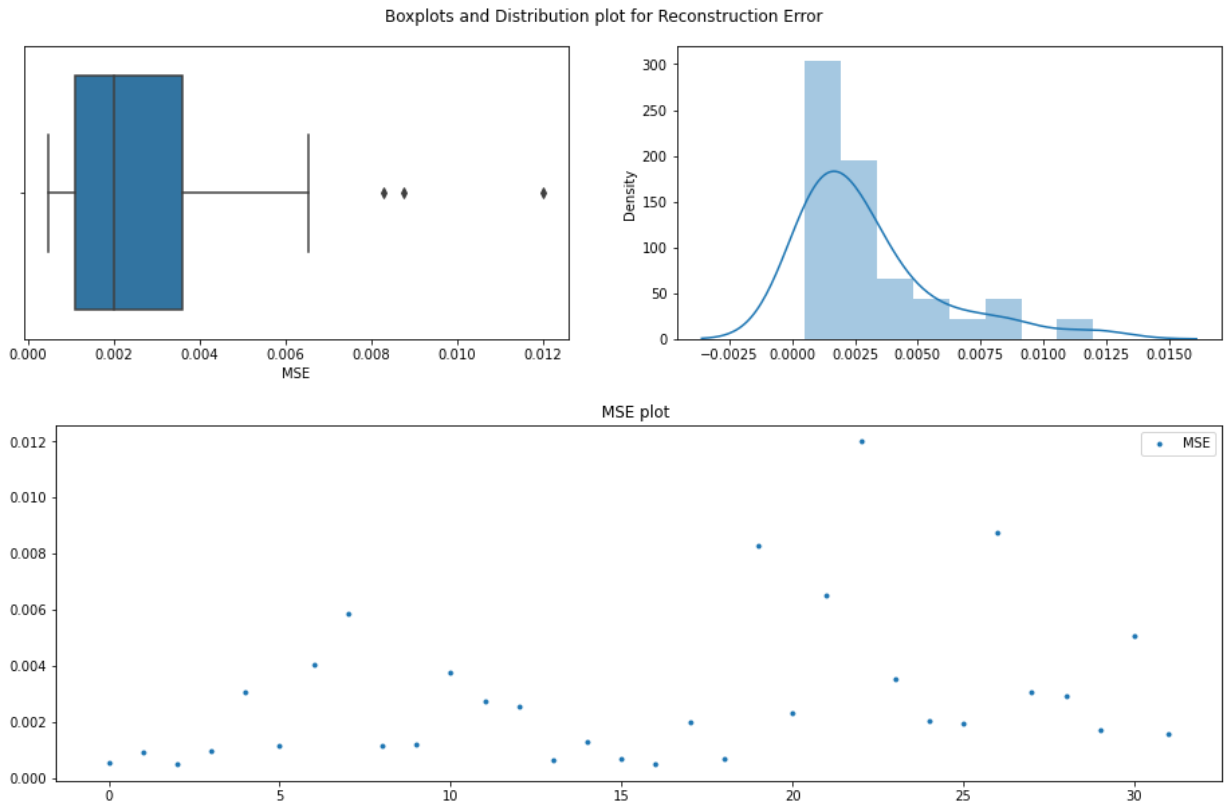

```
Anderson_Darling Test
Statistic: 2.048
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 8
mean=0.00275375,median=0.001645 ,max=0.01079,min=0.00013,variance=8.1186e-06
```
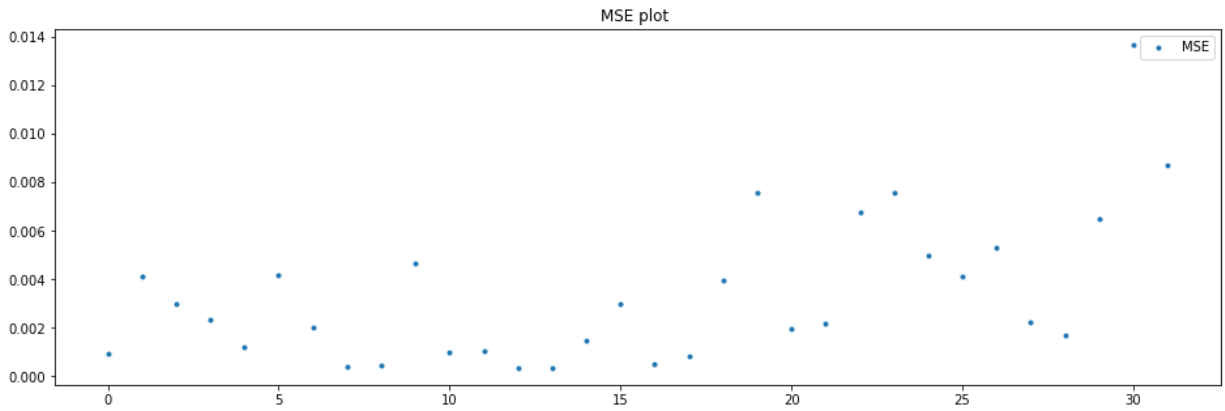
Boxplots and Distribution plot for Reconstruction Error

MSE plot
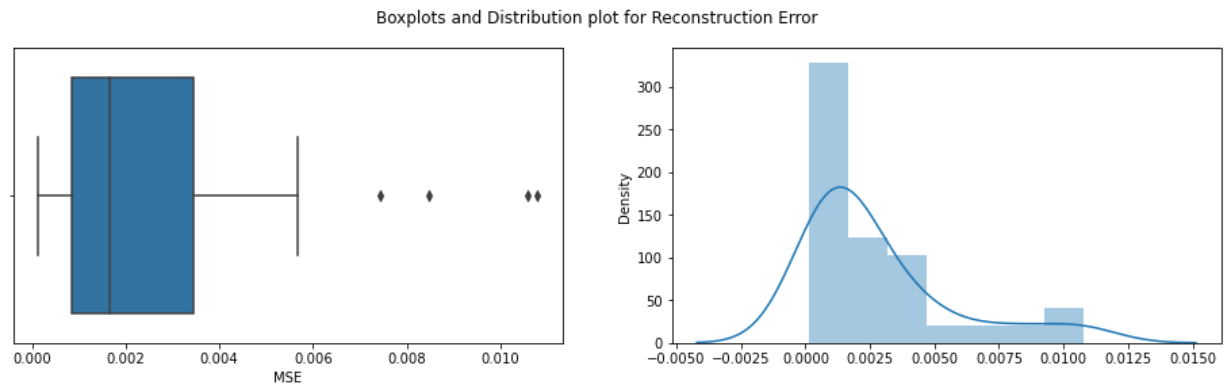
Anderson_Darling Test
Statistic: 2.654
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
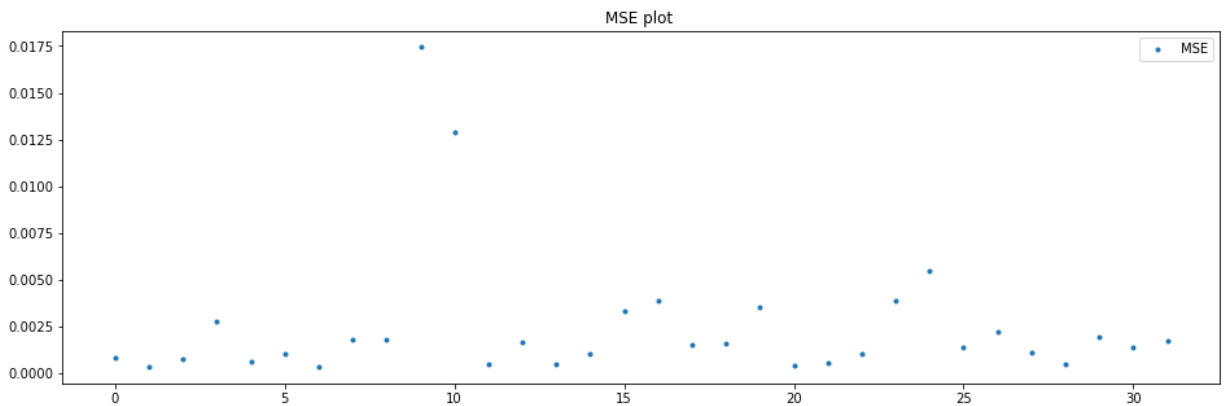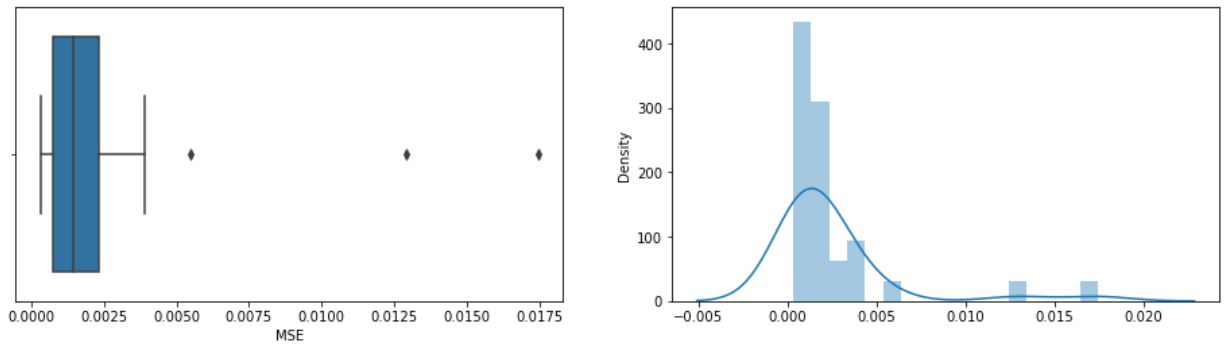5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 9
mean=0.002166875,median=0.00176 ,max=0.0071,min=0.00032,variance=2.1108e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.086
15.000: 0.523, data does not look normal (reject H0)
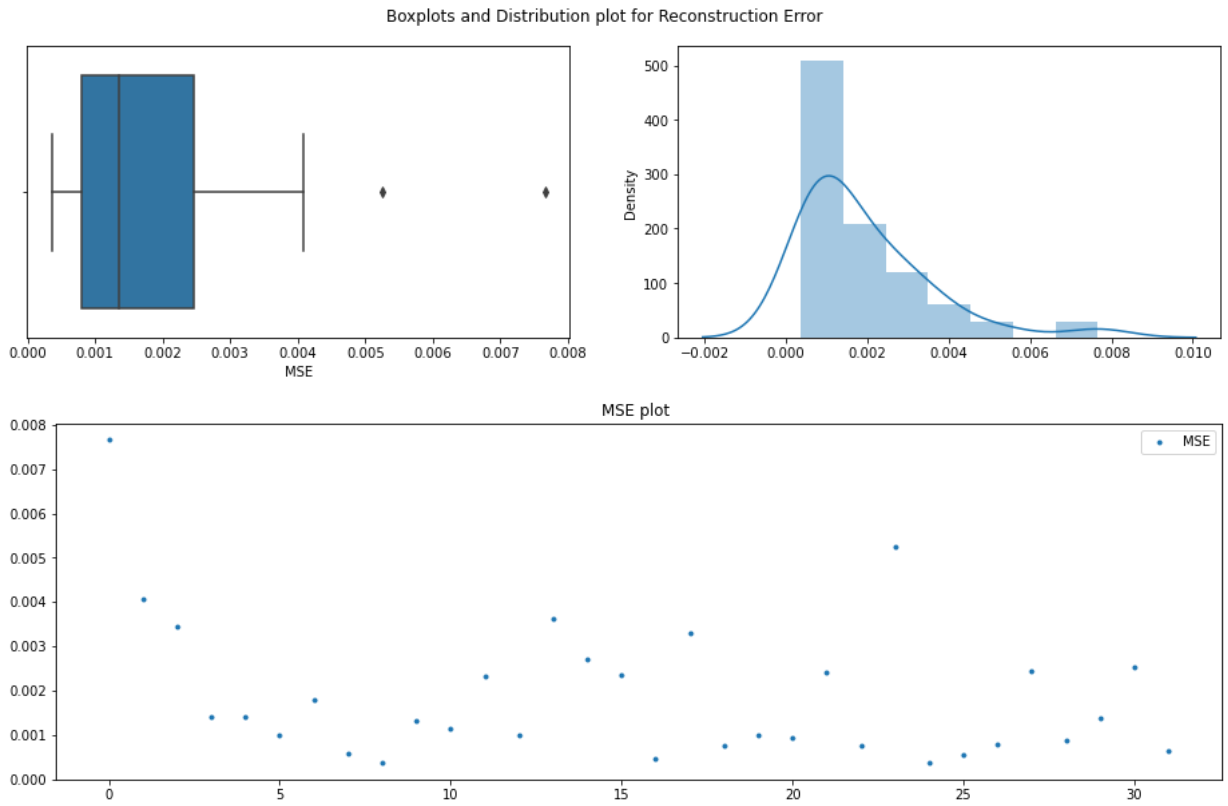10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 10
mean=0.00219125,median=0.001735 ,max=0.01375,min=0.00021,variance=5.8528e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 3.709
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************

Batch: 11
mean=0.0024428125,median=0.00163 ,max=0.01148,min=0.00019,variance=7.2431e-06
```
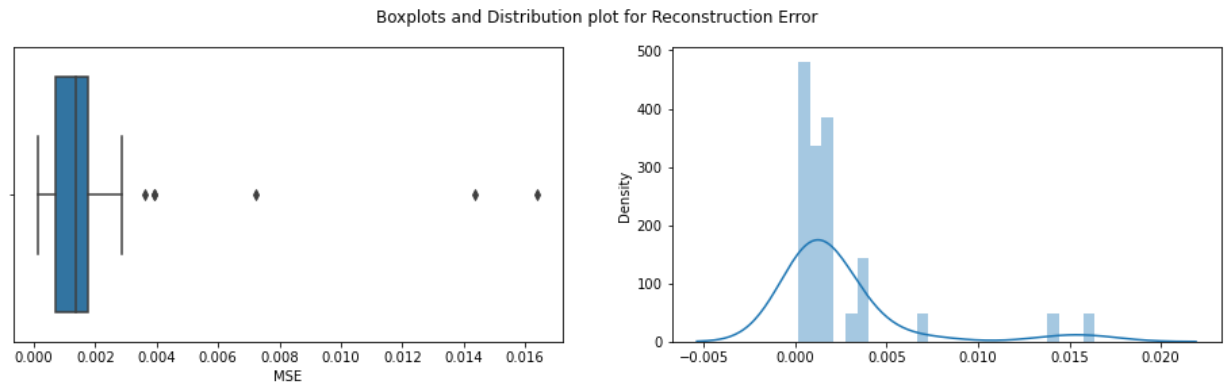
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 3.177
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
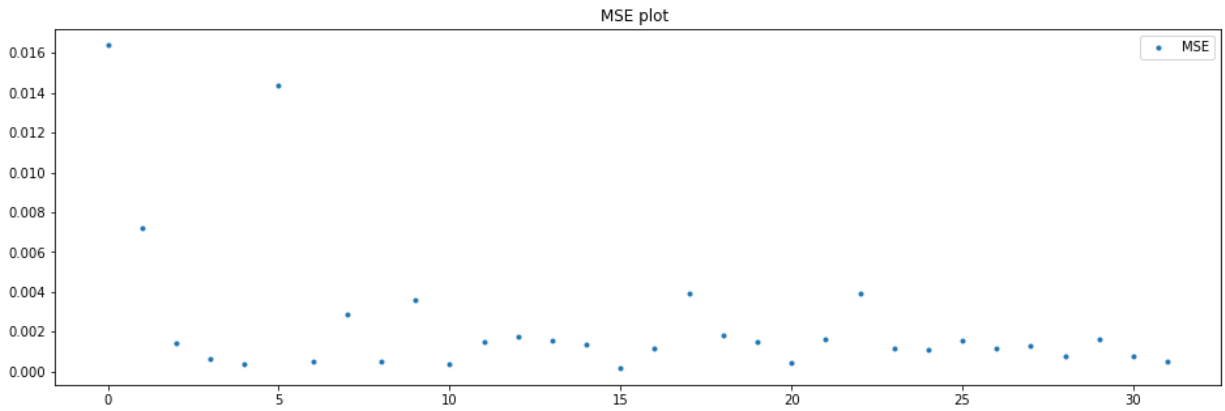5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 12
mean=0.0017540625,median=0.001395 ,max=0.00515,min=0.00015,variance=1.7379e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.093
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
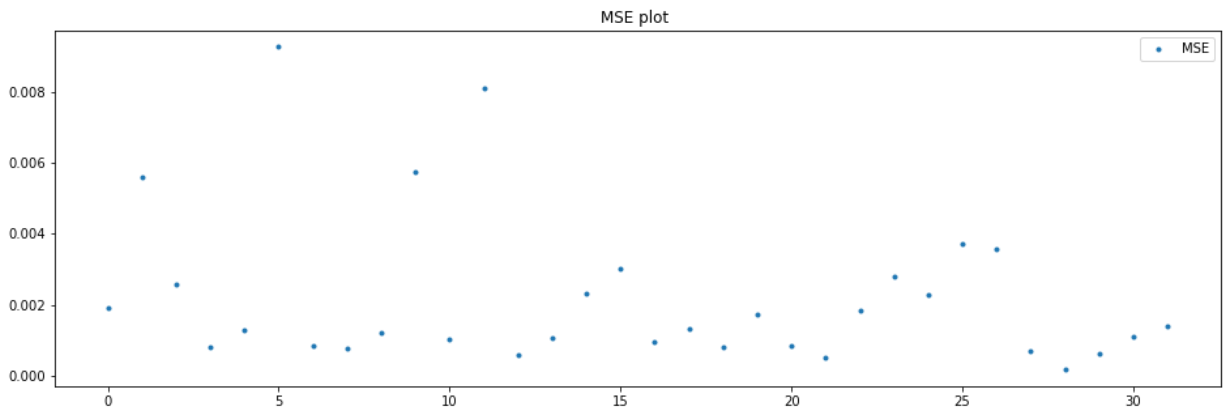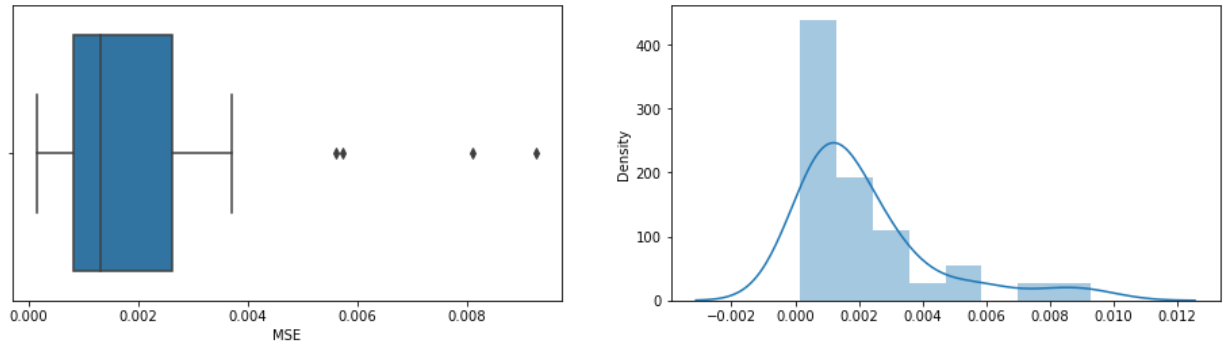5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 13
mean=0.0036475,median=0.00275 ,max=0.01305,min=0.00048,variance=1.02278e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 2.338
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 14
mean=0.0034121875,median=0.00228 ,max=0.01367,min=0.00032,variance=9.0008e-06
```
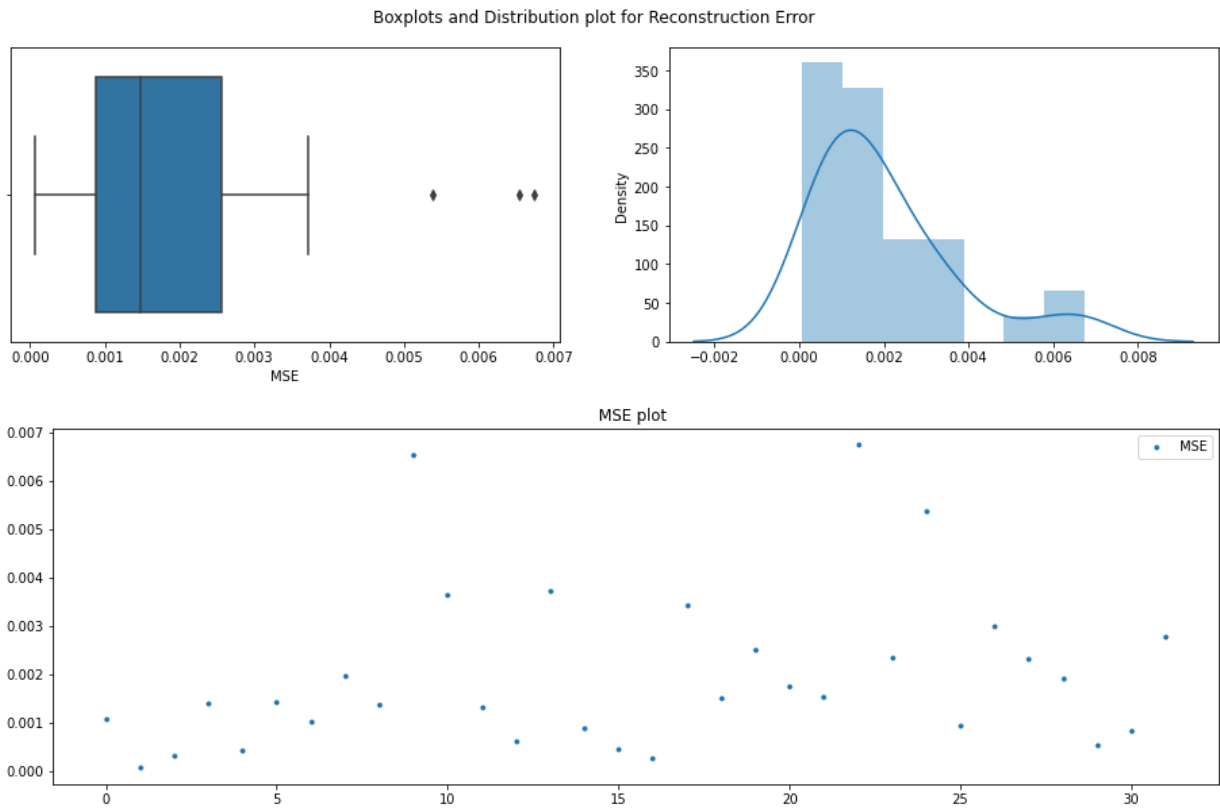
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 1.221
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 15
mean=0.002495625,median=0.00145 ,max=0.01744,min=0.00032,variance=1.25198e-05
```
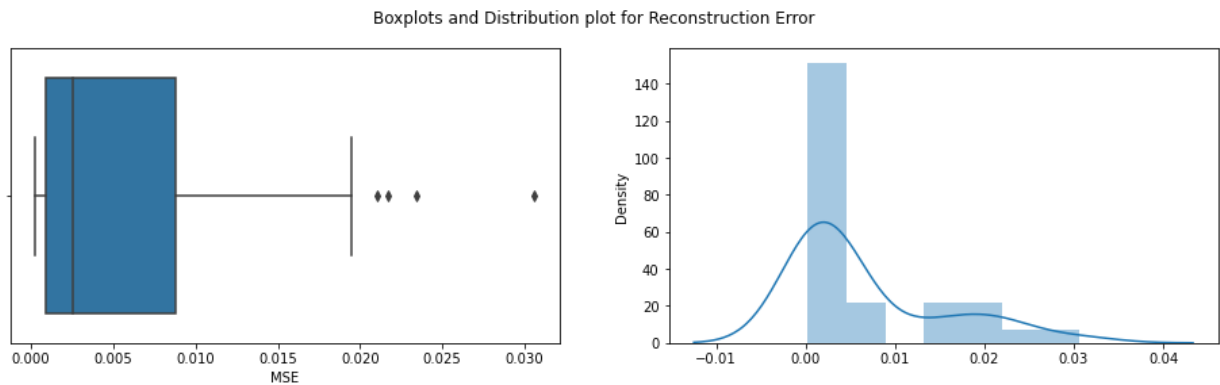

Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 4.847
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 16
mean=0.0018984375,median=0.001355 ,max=0.00766,min=0.00036,variance=2.5087e-06
```
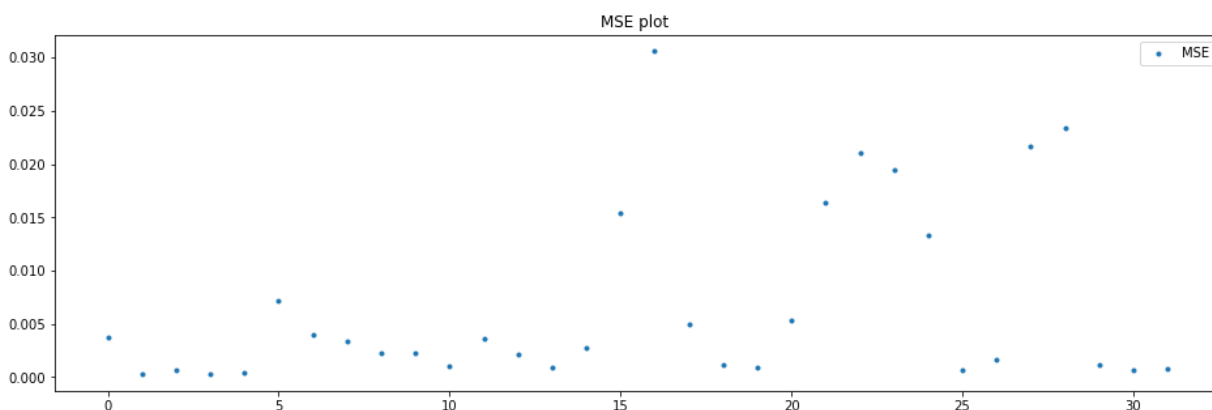
Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 1.748
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 17
mean=0.00246125,median=0.001385 ,max=0.01639,min=0.00014,variance=1.31252e-05
```
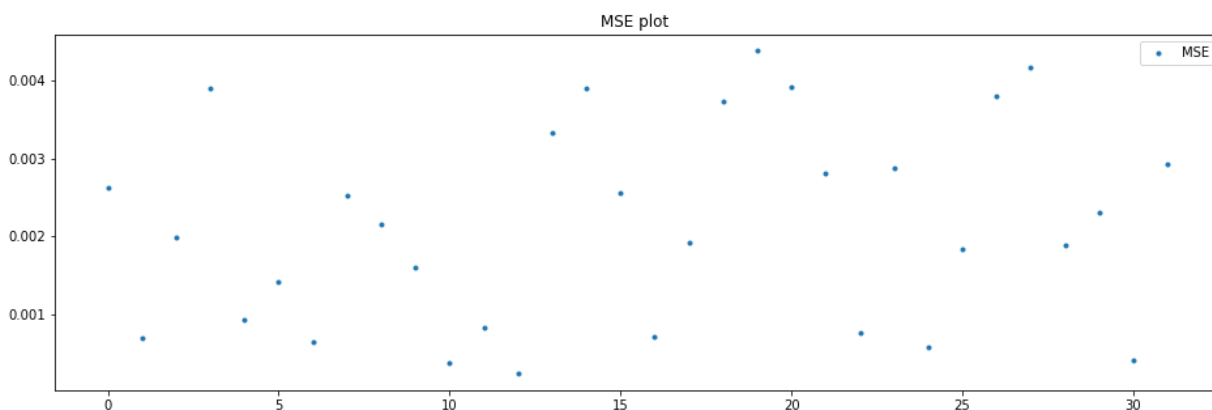
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 5.381
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
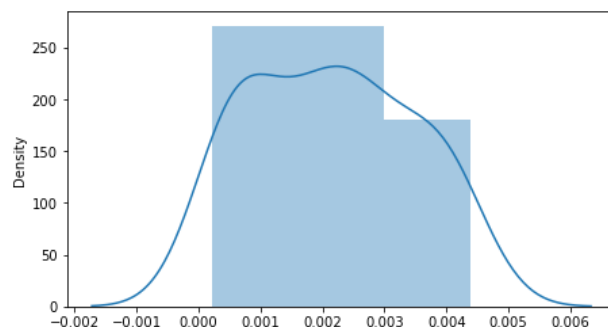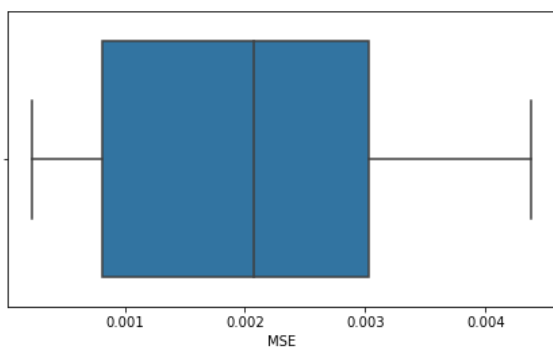5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 18
mean=0.0022,median=0.001305 ,max=0.00927,min=0.00016,variance=4.6165e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 2.830
15.000: 0.523, data does not look normal (reject H0)
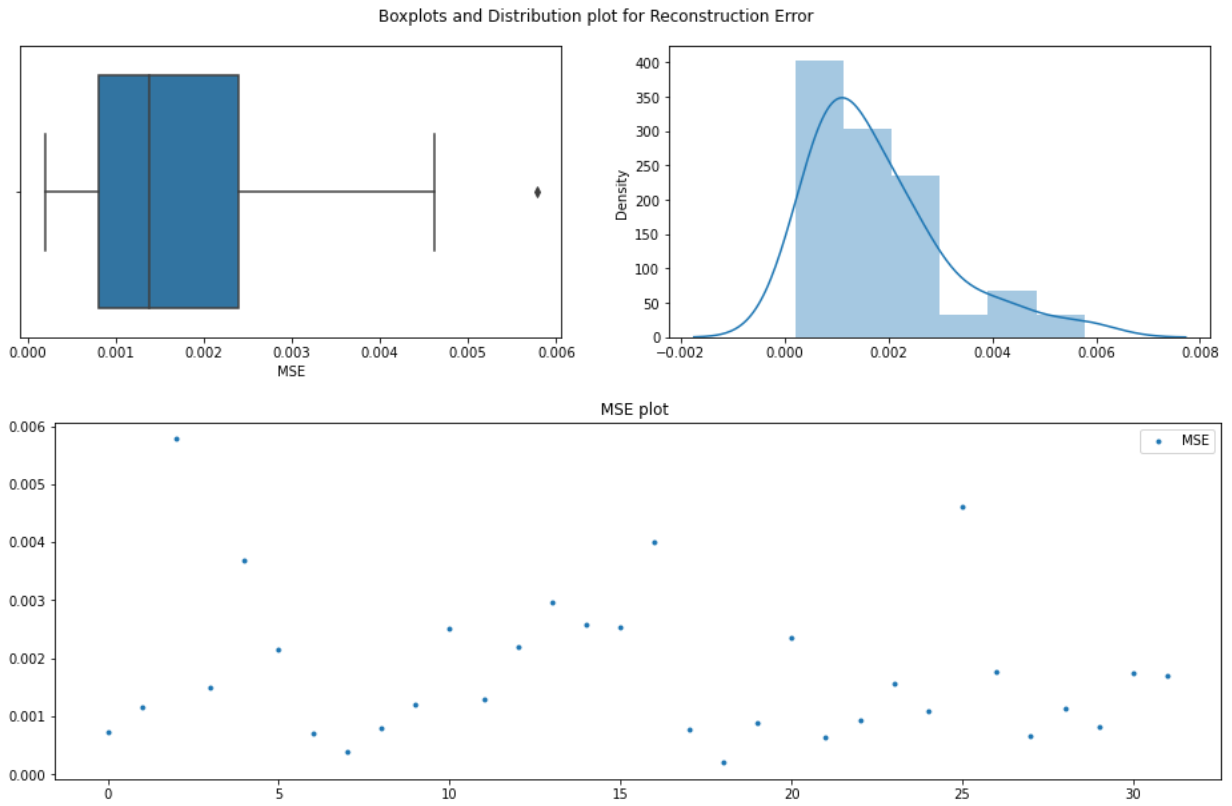10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 19
mean=0.0020040625,median=0.001475 ,max=0.00674,min=7e-05,variance=2.8181e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 1.511
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 20
mean=0.0066659375,median=0.00251 ,max=0.0306,min=0.00024,variance=6.96378e-05
```
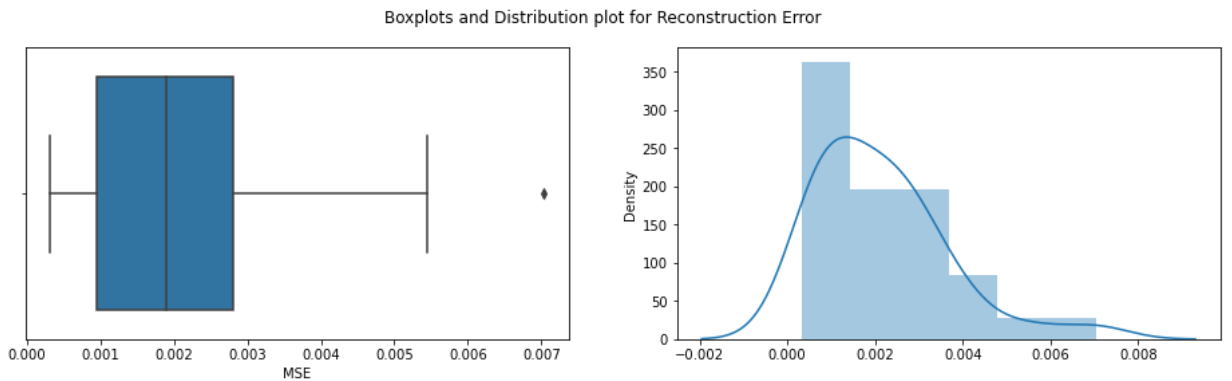
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 3.550
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 21
mean=0.0021459375,median=0.00207 ,max=0.00438,min=0.00023,variance=1.6309e-06
```
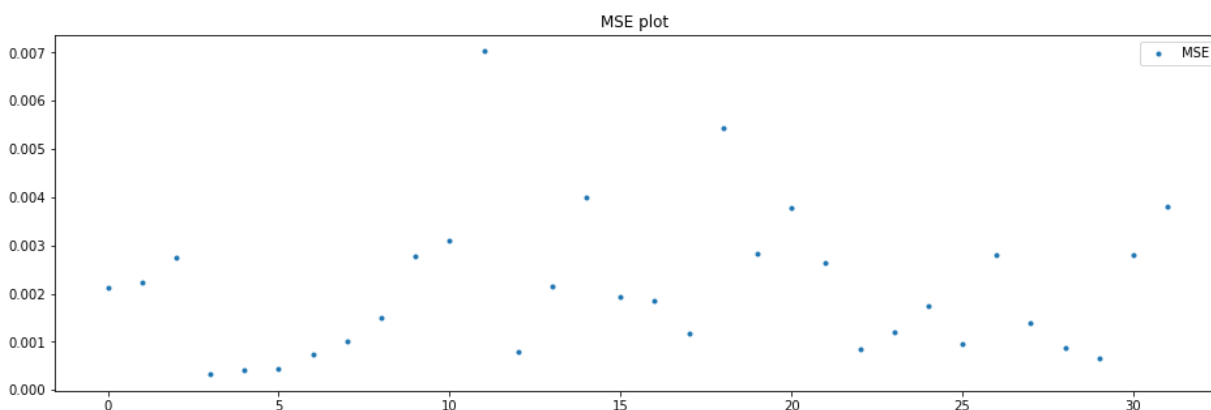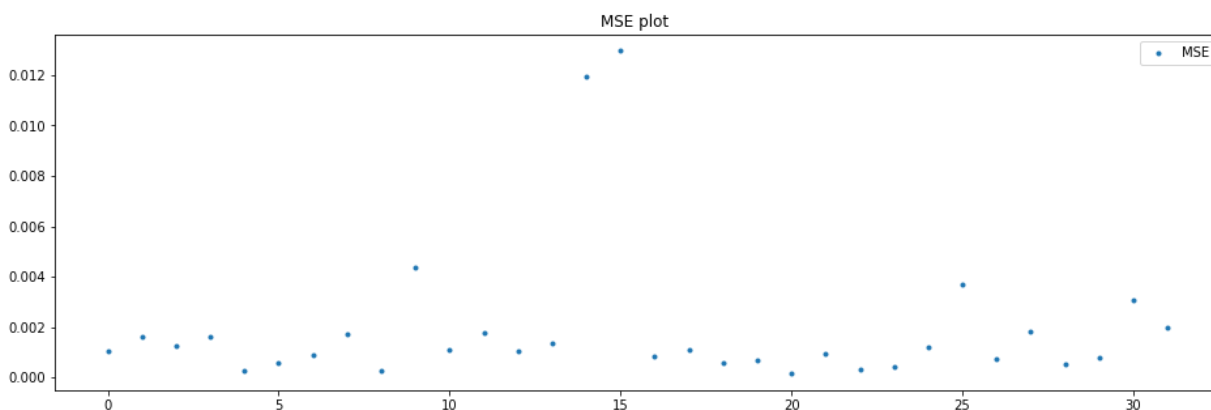

Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 0.633
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

 *******************
Batch: 22
mean=0.0017828125,median=0.00139 ,max=0.00578,min=0.0002,variance=1.6279e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 1.352
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 23
mean=0.00213,median=0.001895 ,max=0.00703,min=0.00032,variance=2.2264e-06
```
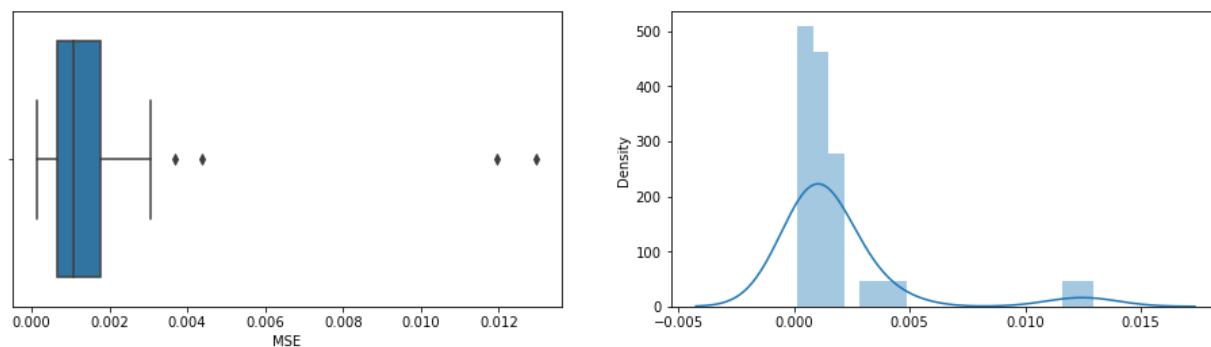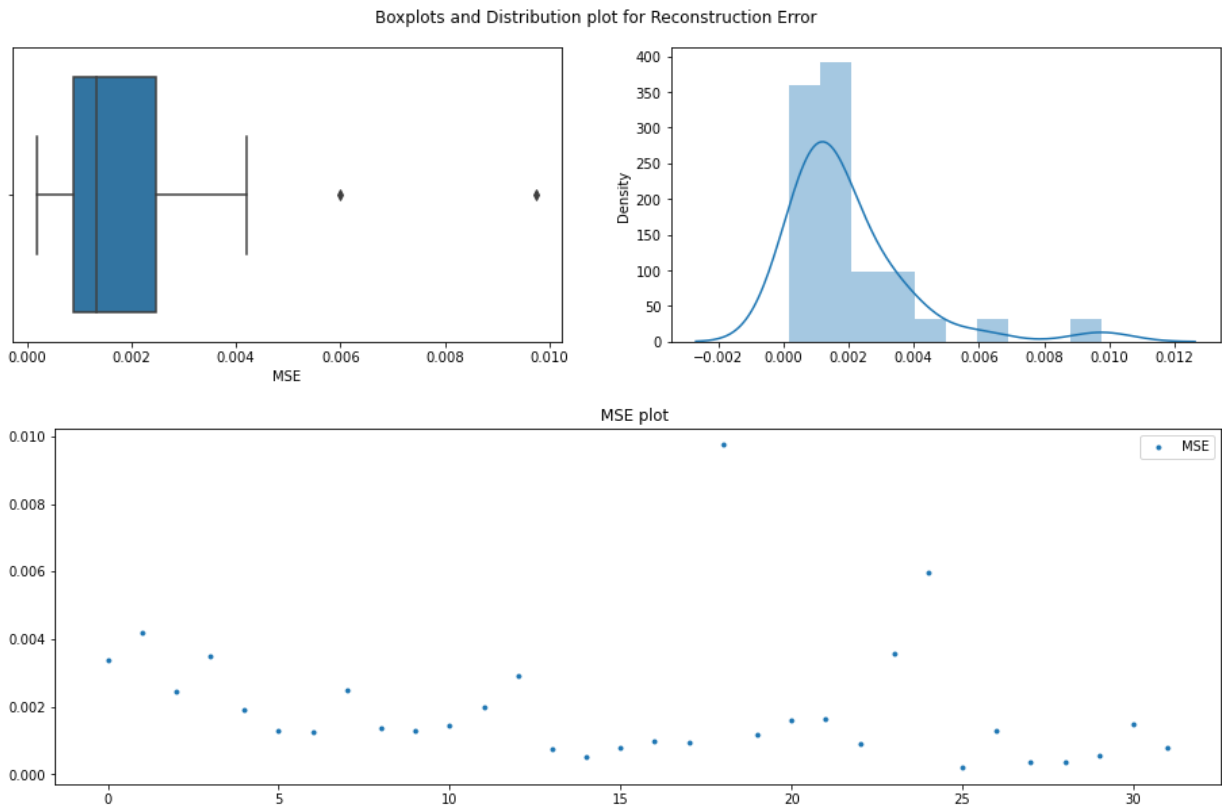
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 0.904
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

 ****
Batch: 24
mean=0.001959375,median=0.00108 ,max=0.01296,min=0.00014,variance=8.2446e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 5.486
15.000: 0.523, data does not look normal (reject H0)
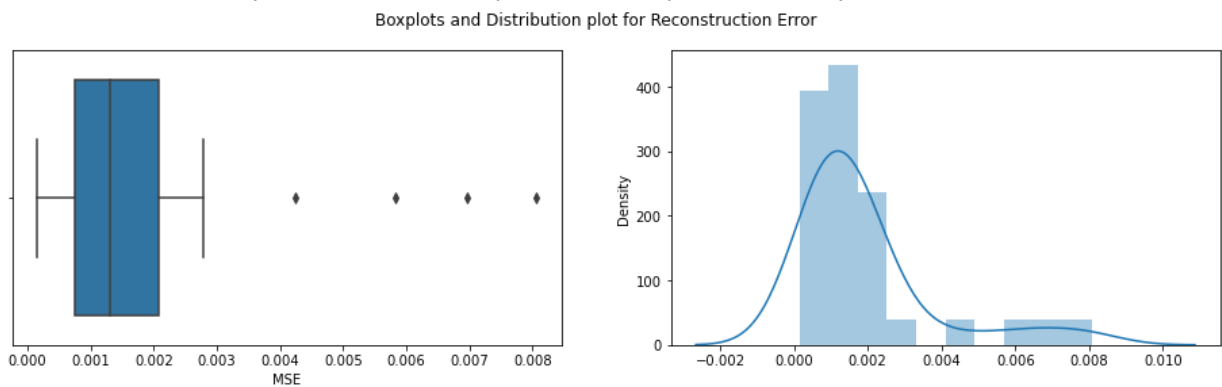10.000: 0.596, data does not look normal (reject H0)
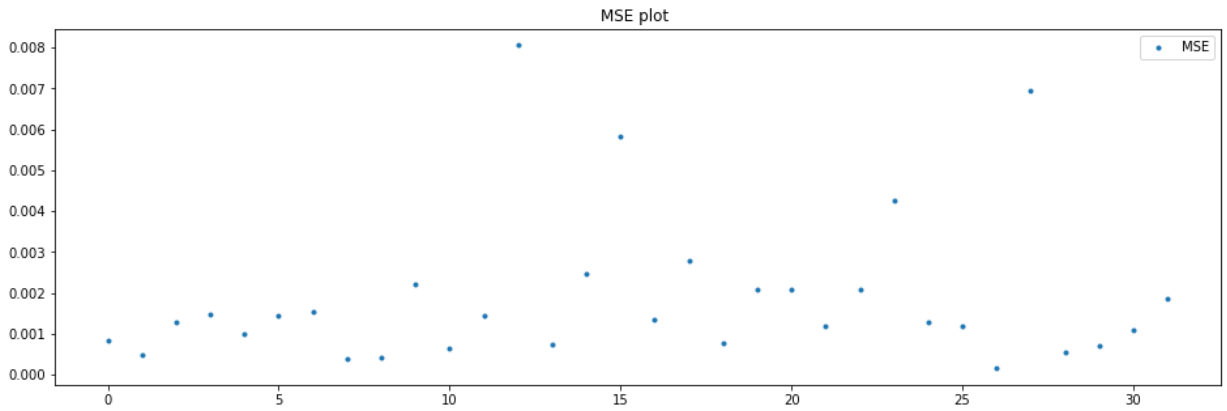5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 25
mean=0.001973125,median=0.001335 ,max=0.00975,min=0.00019,variance=3.5441e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 2.472
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 26
mean=0.0018934375,median=0.001305  ,max=0.00806,min=0.00015,variance=3.3846e-06
```
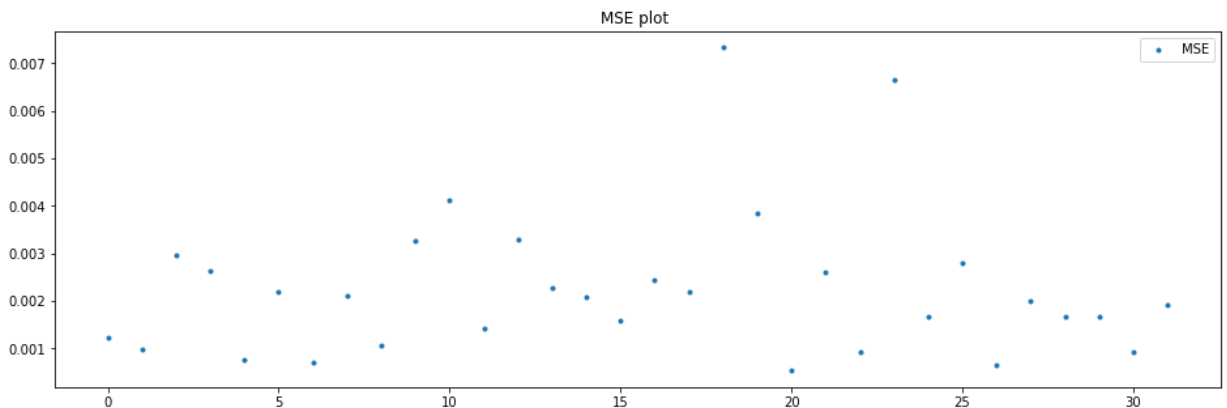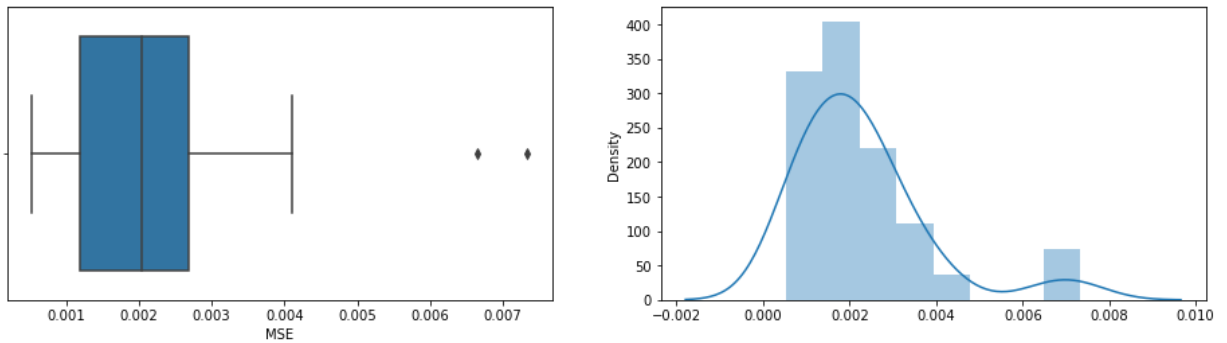
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 3.182
15.000: 0.523, data does not look normal (reject H0)
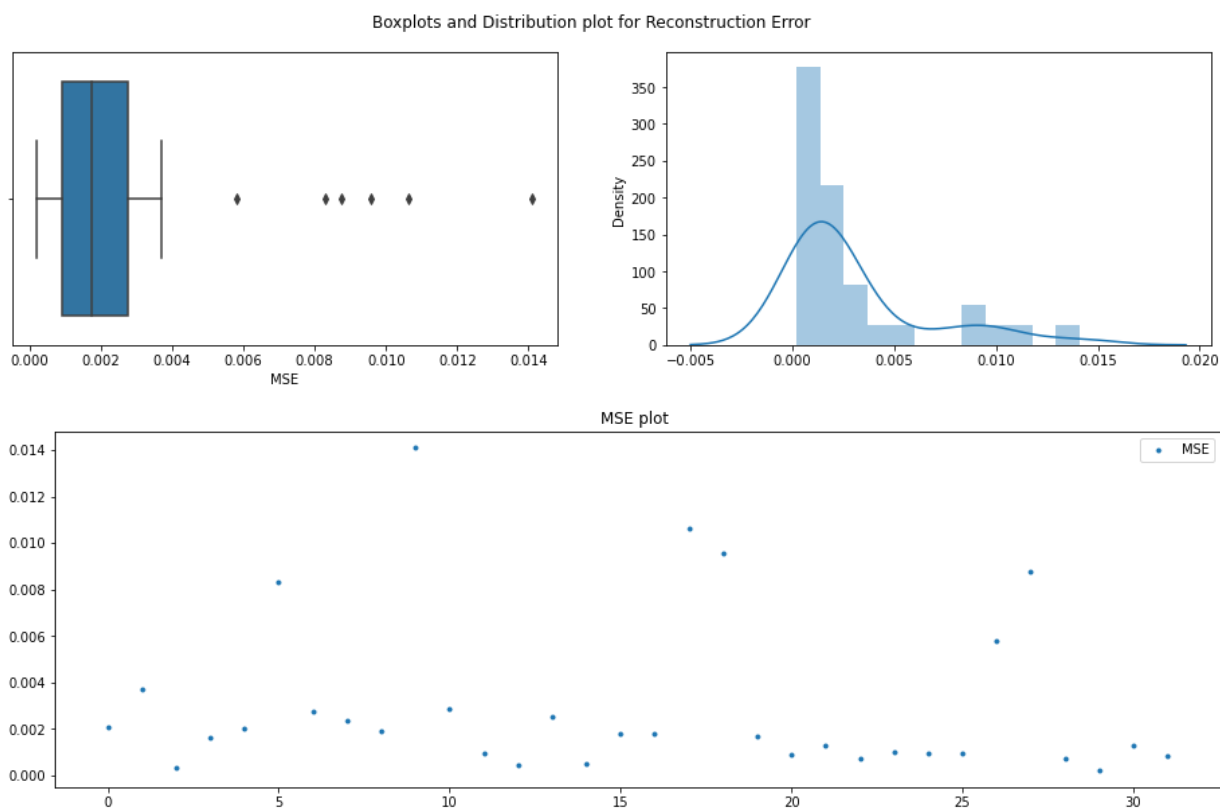10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 27
mean=0.00226625,median=0.002035 ,max=0.00733,min=0.00053,variance=2.3246e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.475
15.000: 0.523, data does not look normal (reject H0)
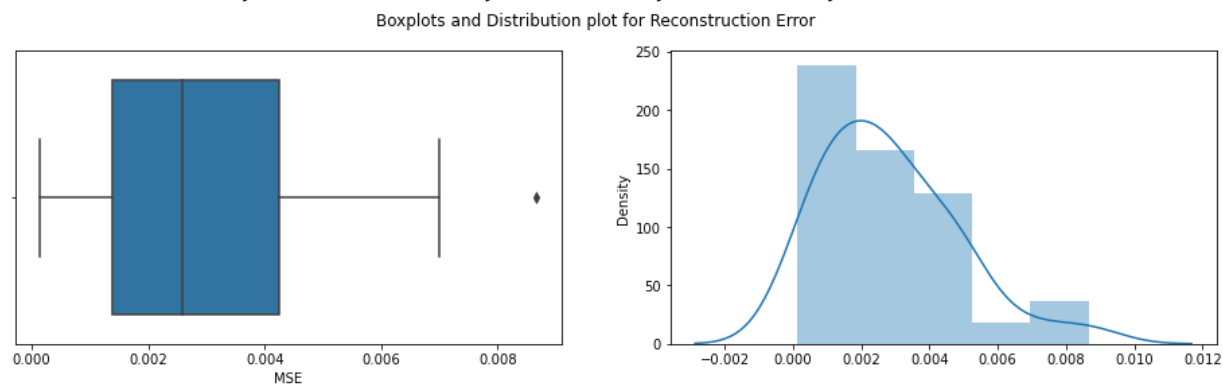10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 28
mean=0.002980625,median=0.001745 ,max=0.0141,min=0.0002,variance=1.16979e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 3.763
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

  ********************
Batch: 29
mean=0.002825625,median=0.002585 ,max=0.00866,min=0.00014,variance=3.8947e-06
```
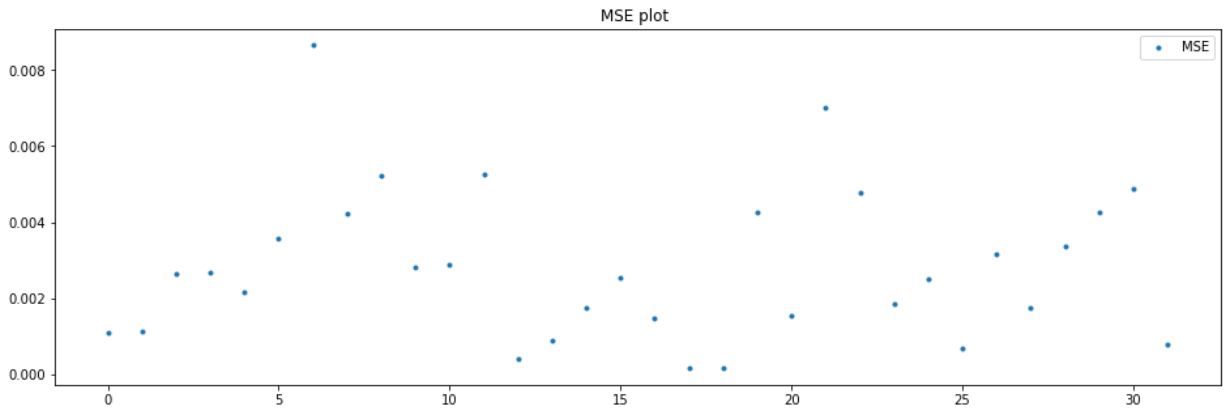
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 0.527
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 30
mean=0.0044465625,median=0.004205 ,max=0.01253,min=0.00028,variance=7.7015e-06
```
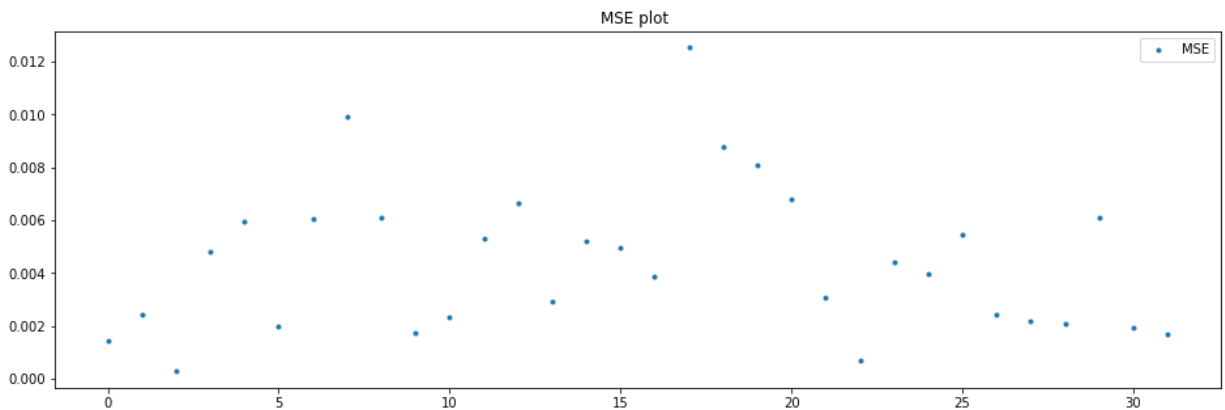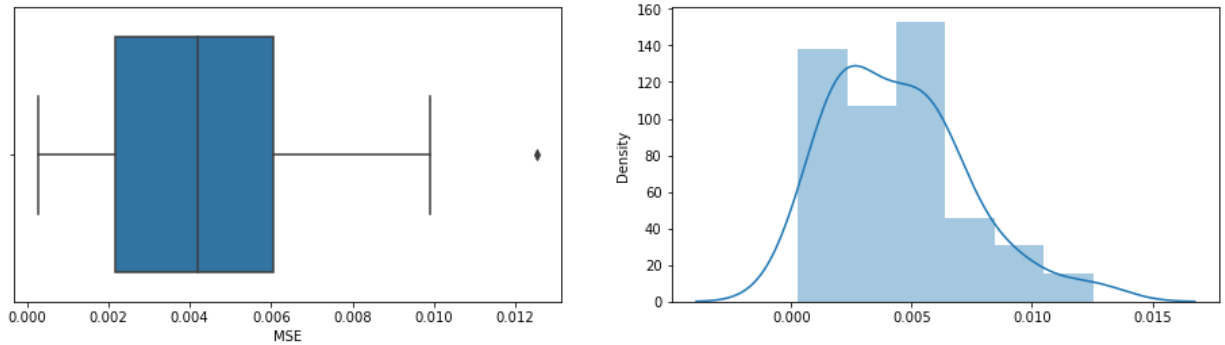

Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 0.620
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 31
mean=0.002285,median=0.00155 ,max=0.00605,min=0.00027,variance=3.1932e-06
```
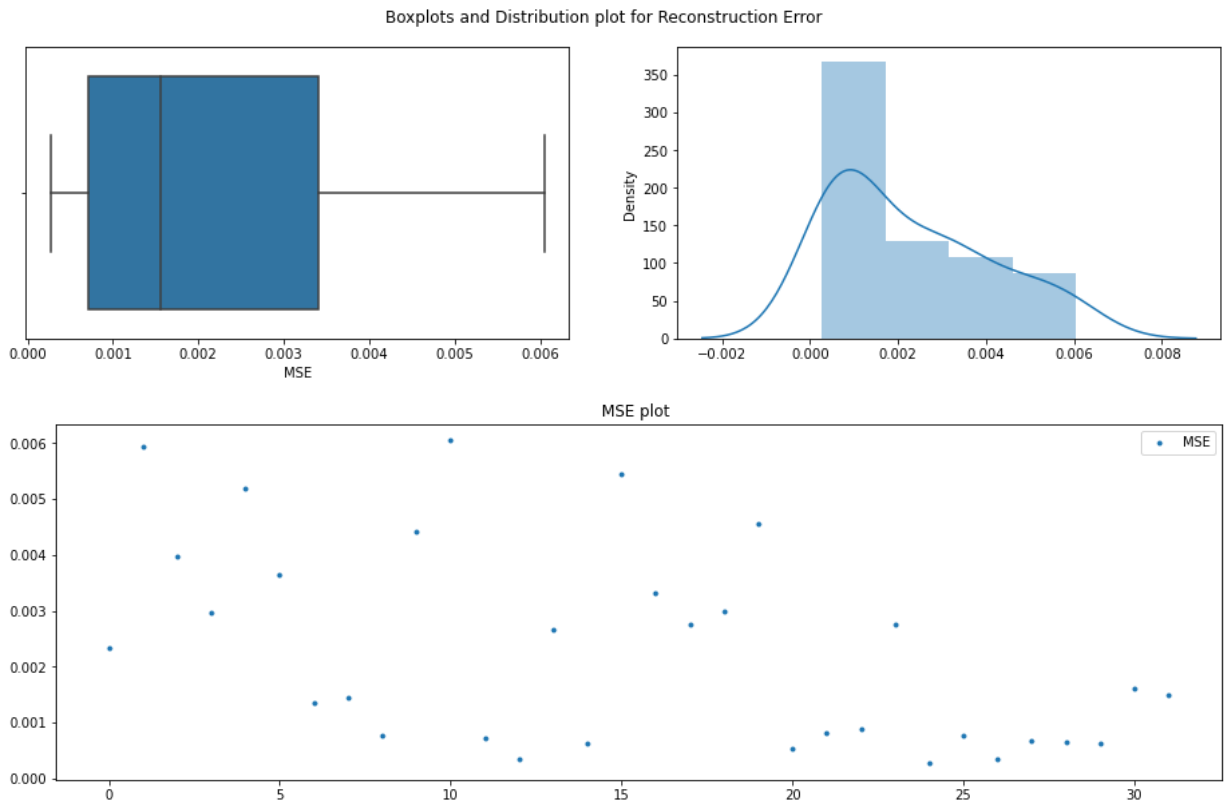
Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 1.337
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 32
mean=0.0017553125,median=0.00136 ,max=0.00853,min=0.00038,variance=2.1577e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 2.690
15.000: 0.523, data does not look normal (reject H0)
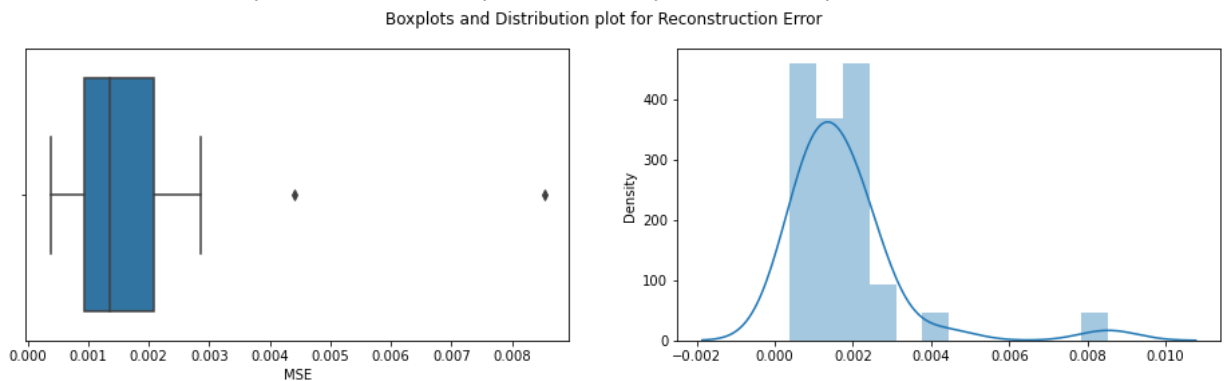10.000: 0.596, data does not look normal (reject H0)
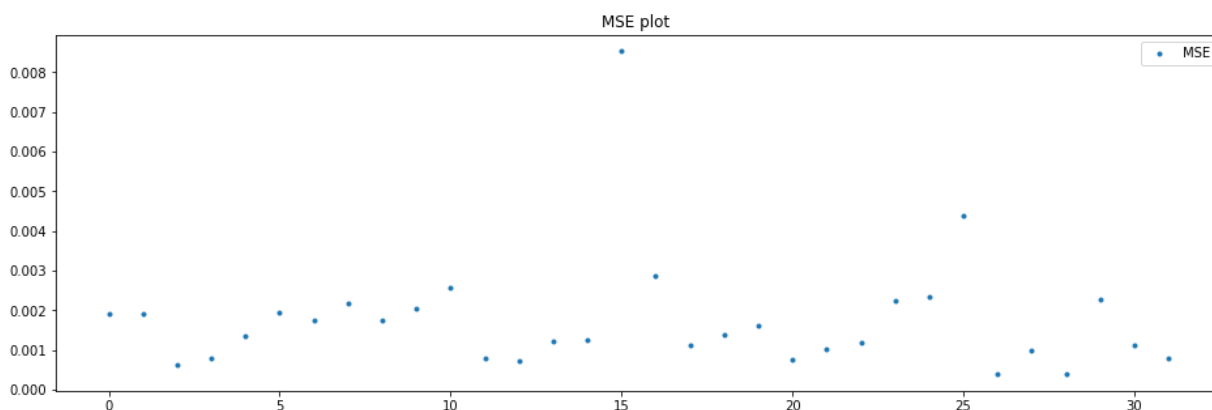5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 33
mean=0.0014978125,median=0.00111 ,max=0.00749,min=0.00027,variance=1.7198e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 2.420
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
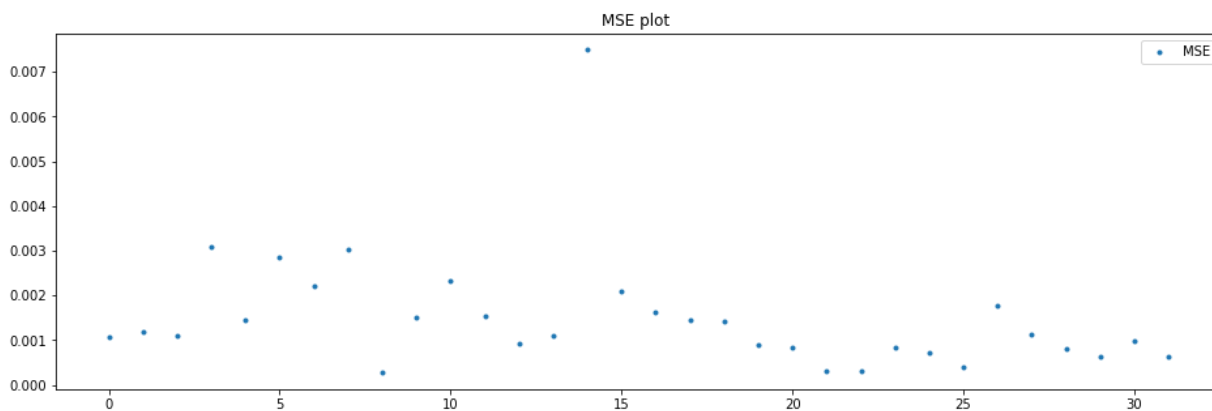5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 34
mean=0.00155875,median=0.001055 ,max=0.00666,min=0.00028,variance=1.6962e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 1.722
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 35
mean=0.0019365625,median=0.001295 ,max=0.009,min=0.00016,variance=3.614e-06
```
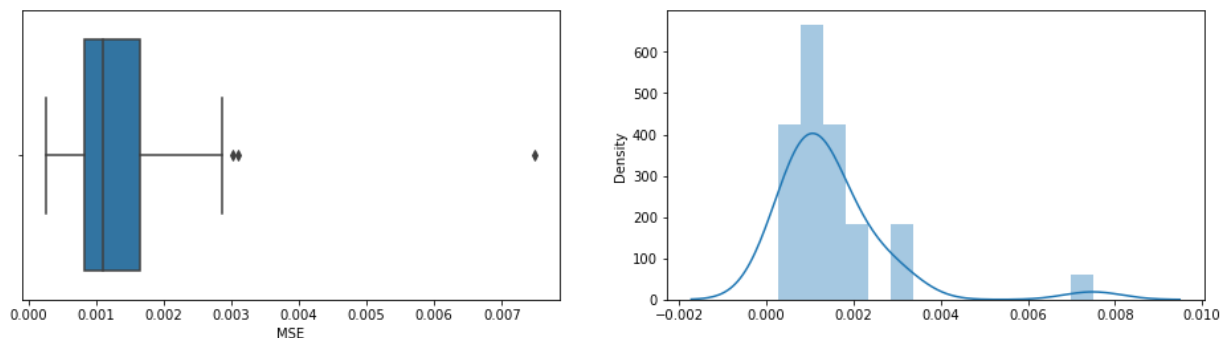
Boxplots and Distribution plot for Reconstruction Error

```
Anderson_Darling Test
Statistic: 2.196
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 36
mean=0.00258125,median=0.001415 ,max=0.01357,min=0.0003,variance=9.3491e-06
```
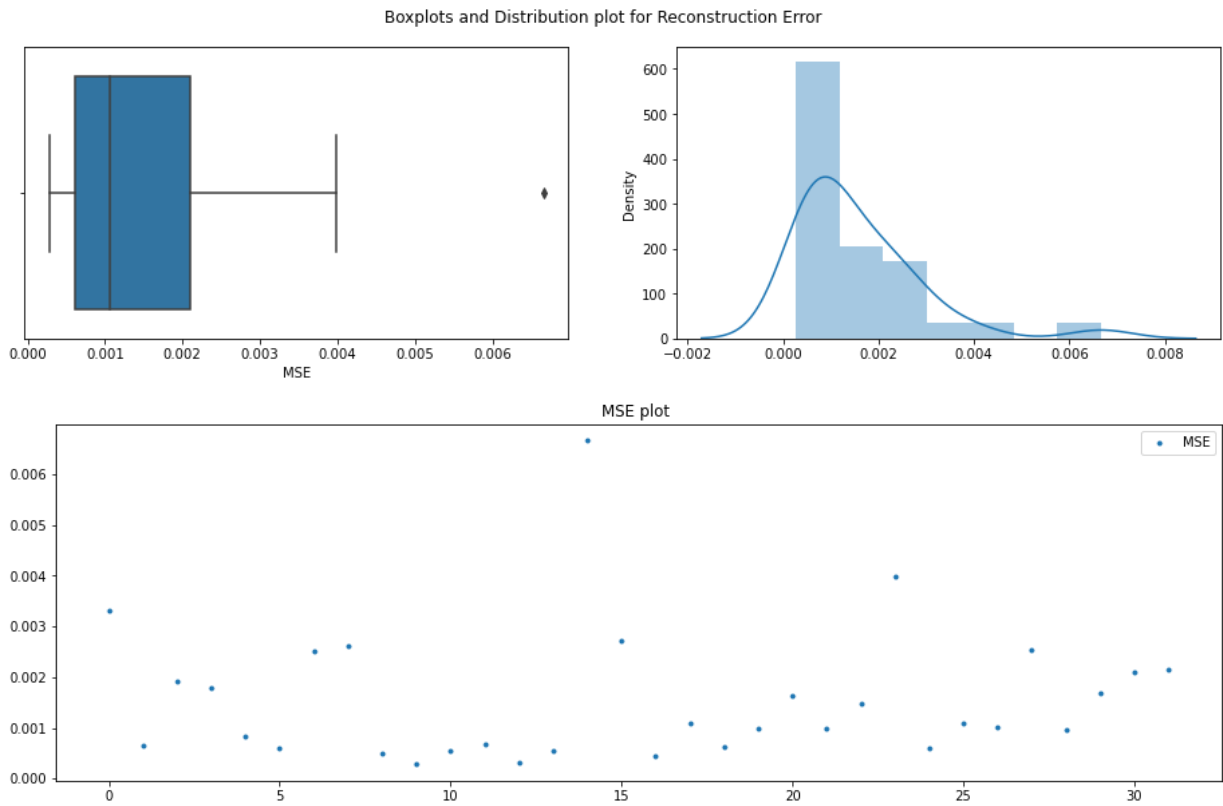

Boxplots and Distribution plot for Reconstruction Error


```
Anderson_Darling Test
Statistic: 3.571
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 37
mean=0.0025,median=0.001475 ,max=0.01185,min=0.00023,variance=6.6829e-06
```
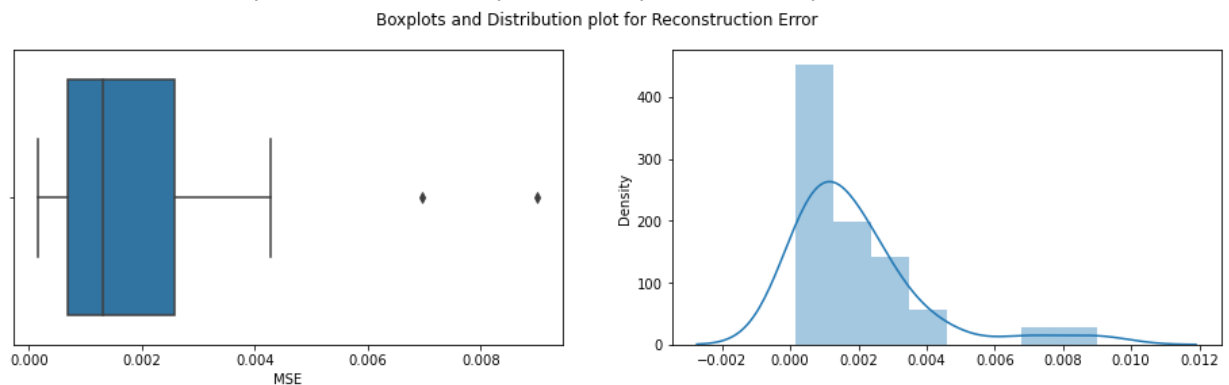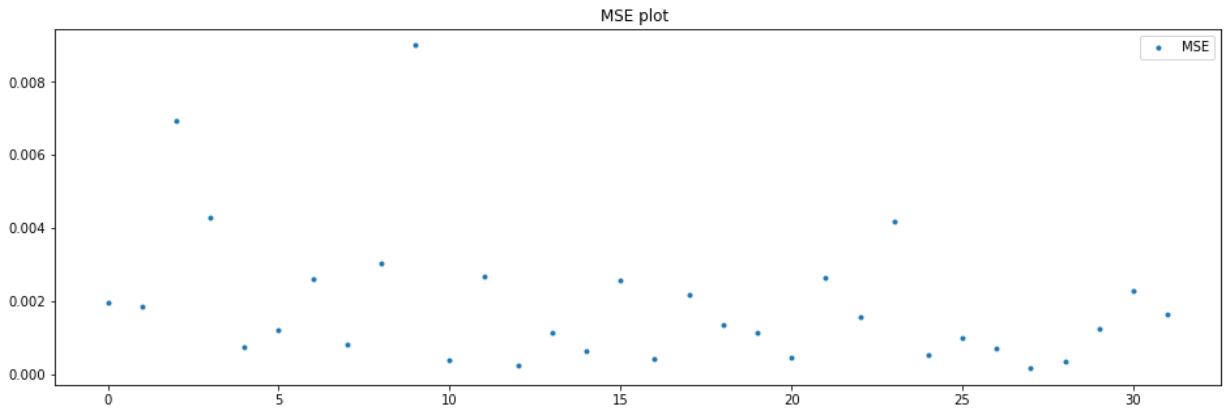
Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 2.630
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 38
mean=0.0029559375,median=0.00246 ,max=0.01516,min=0.00027,variance=7.8619e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 2.559
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
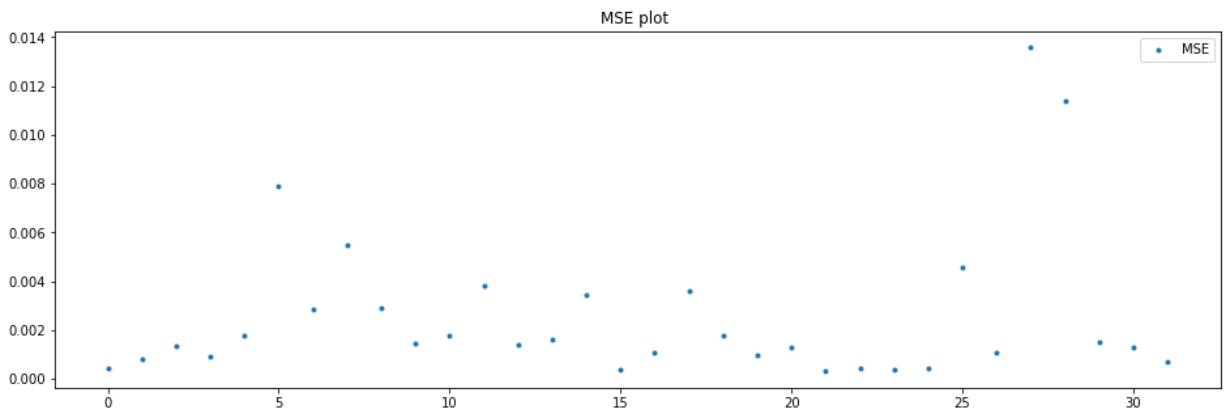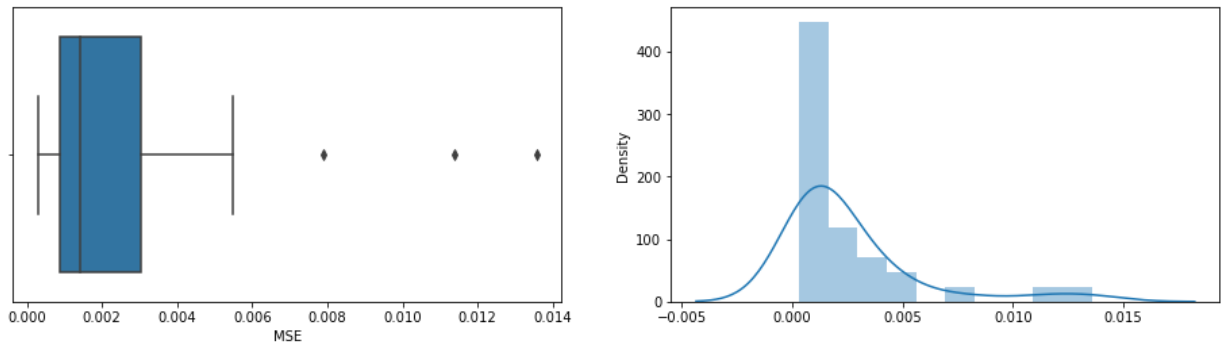5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 39
mean=0.0023725,median=0.001705 ,max=0.0075,min=0.00027,variance=3.2316e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.053
15.000: 0.523, data does not look normal (reject H0)
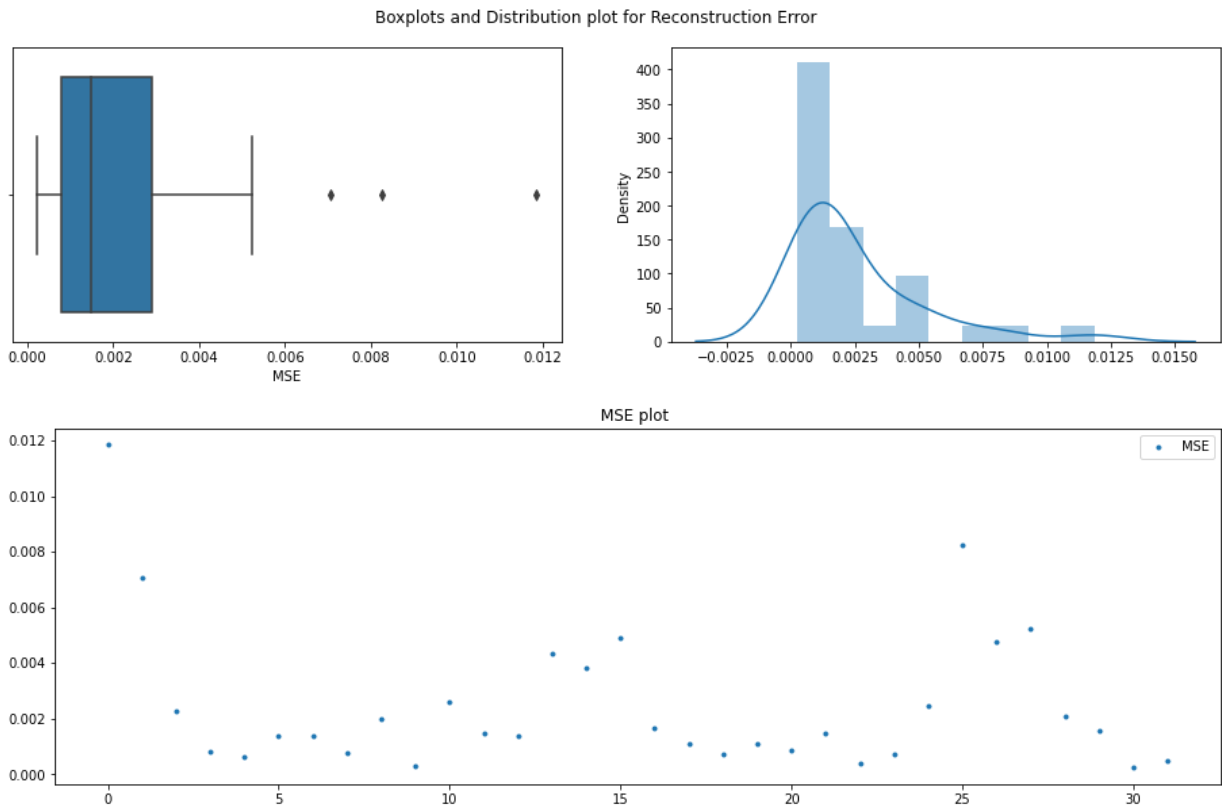10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 40
mean=0.0013959375,median=0.001065 ,max=0.00522,min=0.00017,variance=1.2954e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 1.502
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 41
mean=0.00166625,median=0.00141 ,max=0.0054,min=0.00029,variance=1.2598e-06
```
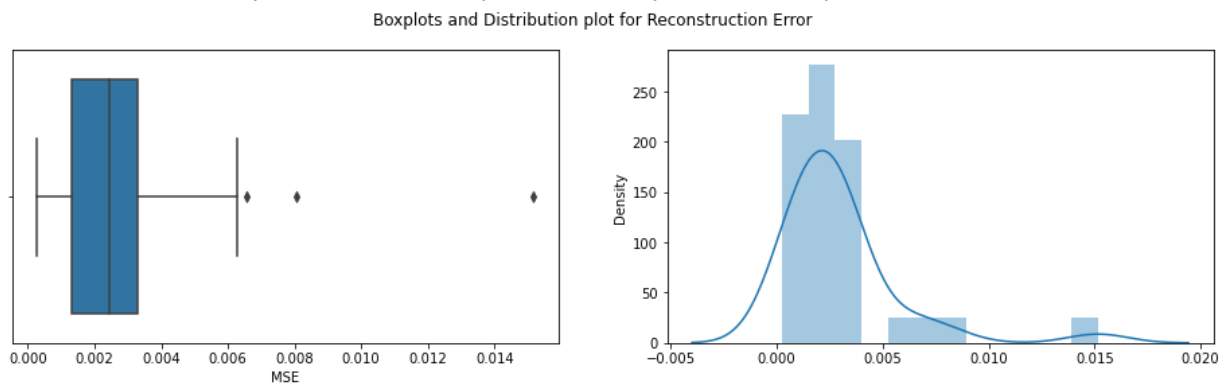
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 0.993
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 42
mean=0.0016140625,median=0.00154 ,max=0.00636,min=0.00012,variance=1.662e-06
```
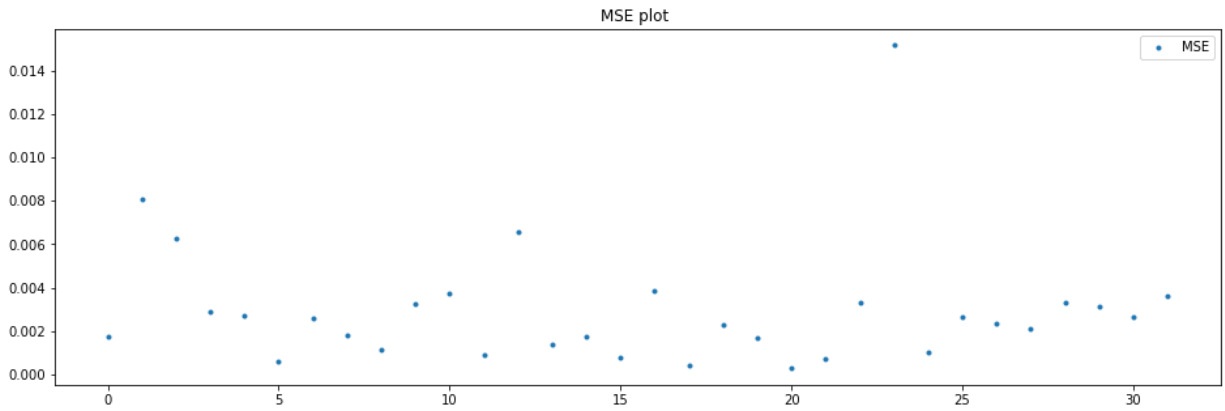
Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 1.232
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 43
mean=0.001886875,median=0.00115 ,max=0.00903,min=0.00023,variance=4.2864e-06
```
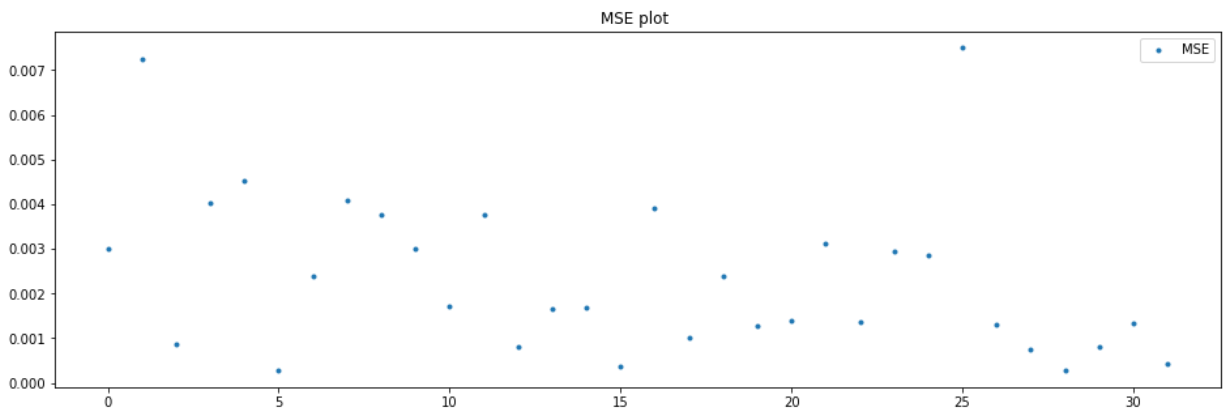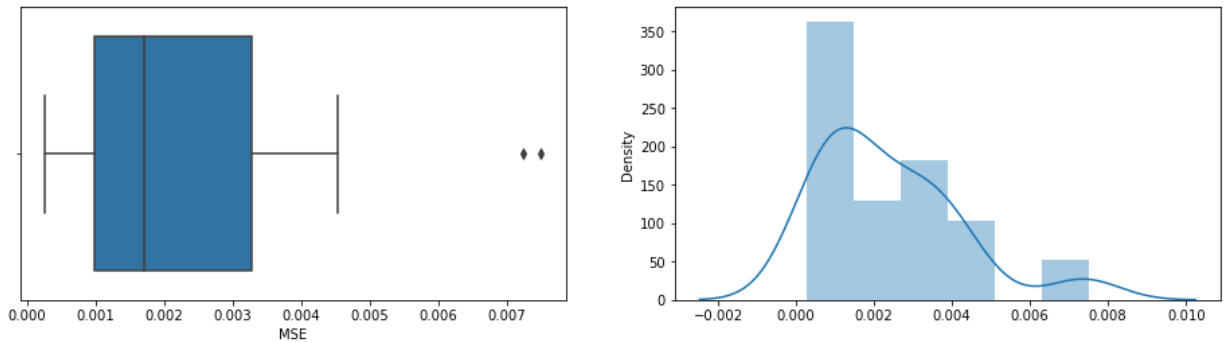
Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 3.727
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 44
mean=0.004908125,median=0.00229 ,max=0.02056,min=0.00064,variance=3.0921e-05
```
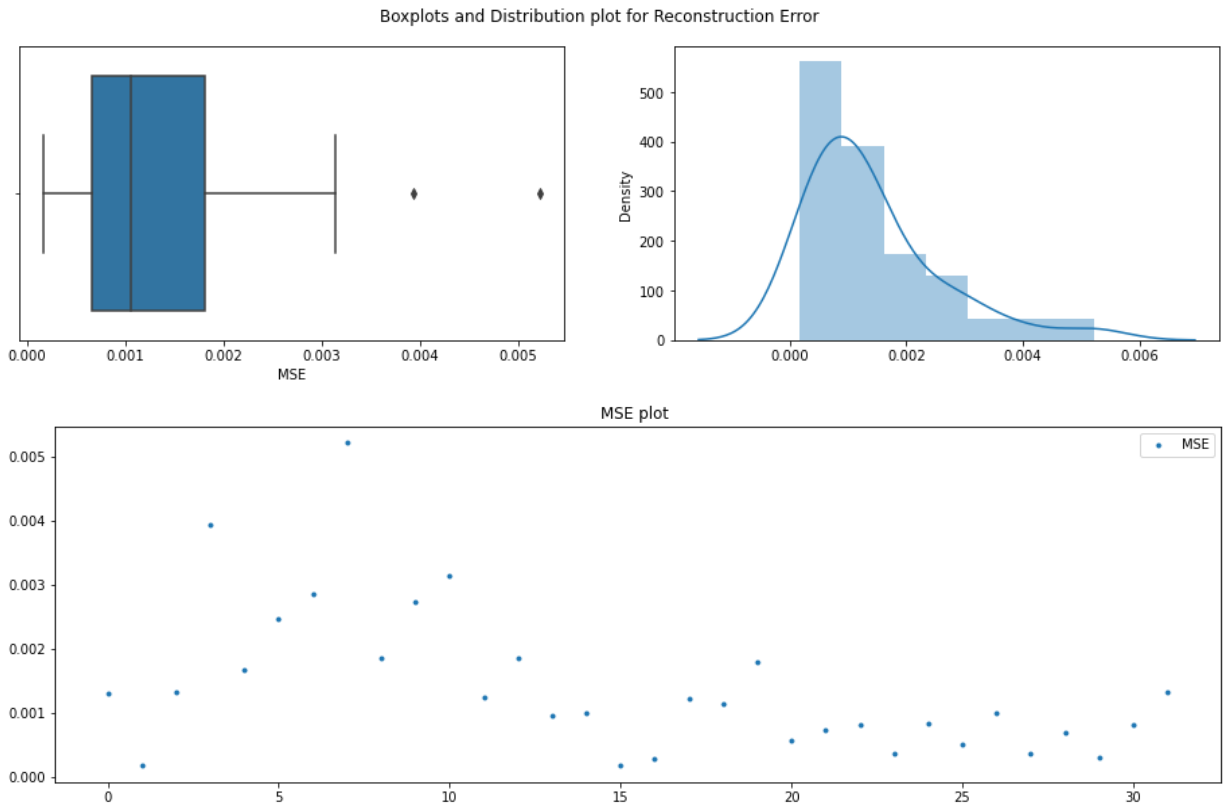
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 3.141
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 45
mean=0.0024178125,median=0.001 ,max=0.0146,min=0.00018,variance=1.30961e-05
```
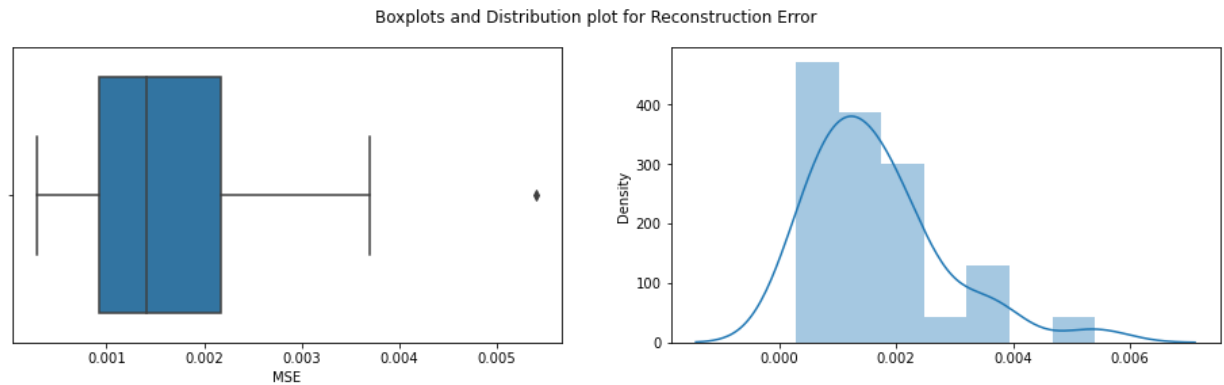

Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 5.251
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 46
mean=0.0025146875,median=0.001875 ,max=0.01886,min=0.00025,variance=9.8205e-06
```
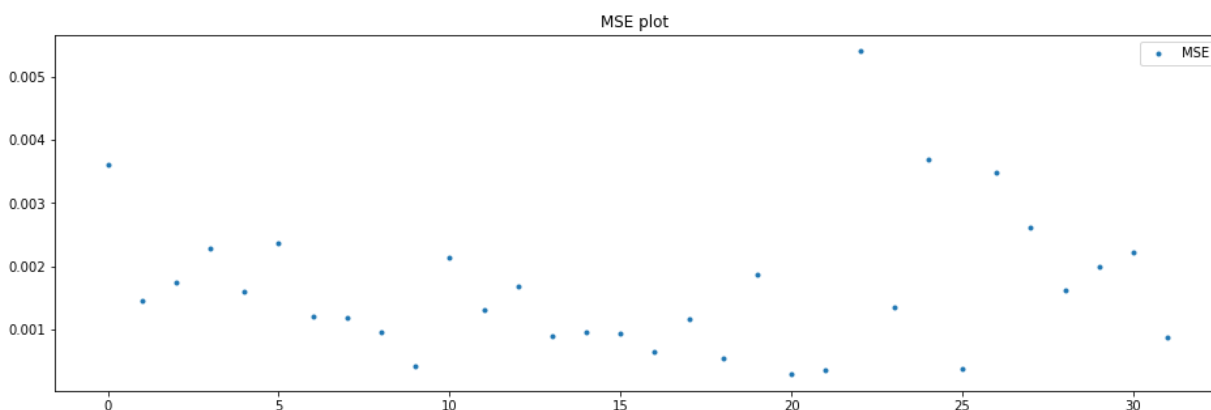
Boxplots and Distribution plot for Reconstruction Error

MSE plot
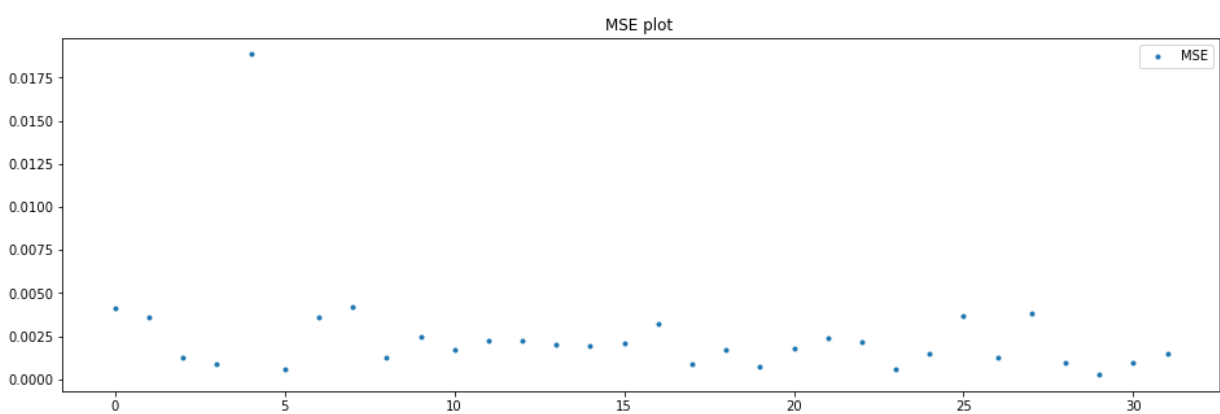

```
Anderson_Darling Test
Statistic: 4.636
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 47
mean=0.0020353125,median=0.0011  ,max=0.01216,min=0.00015,variance=6.5725e-06
```
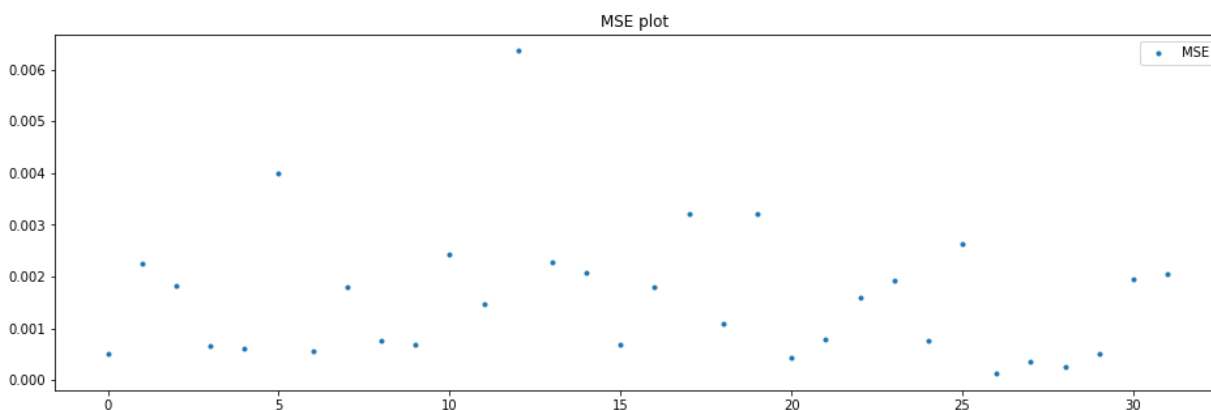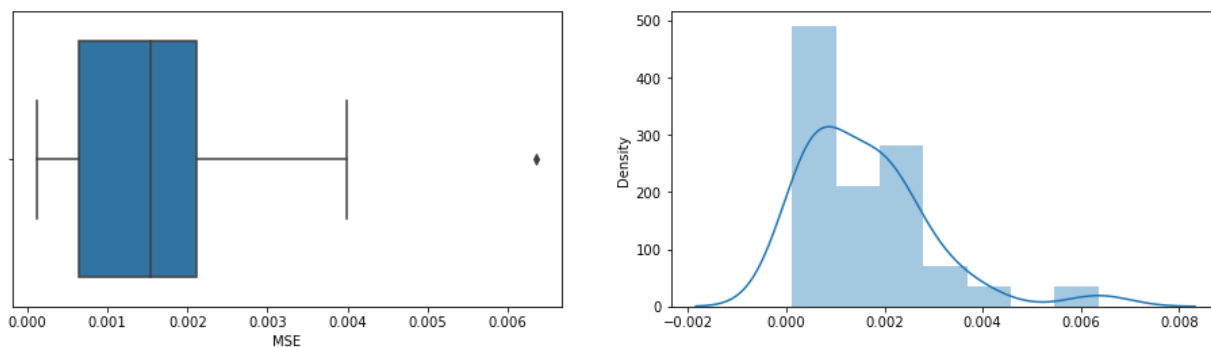
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 3.760
15.000: 0.523, data does not look normal (reject H0)
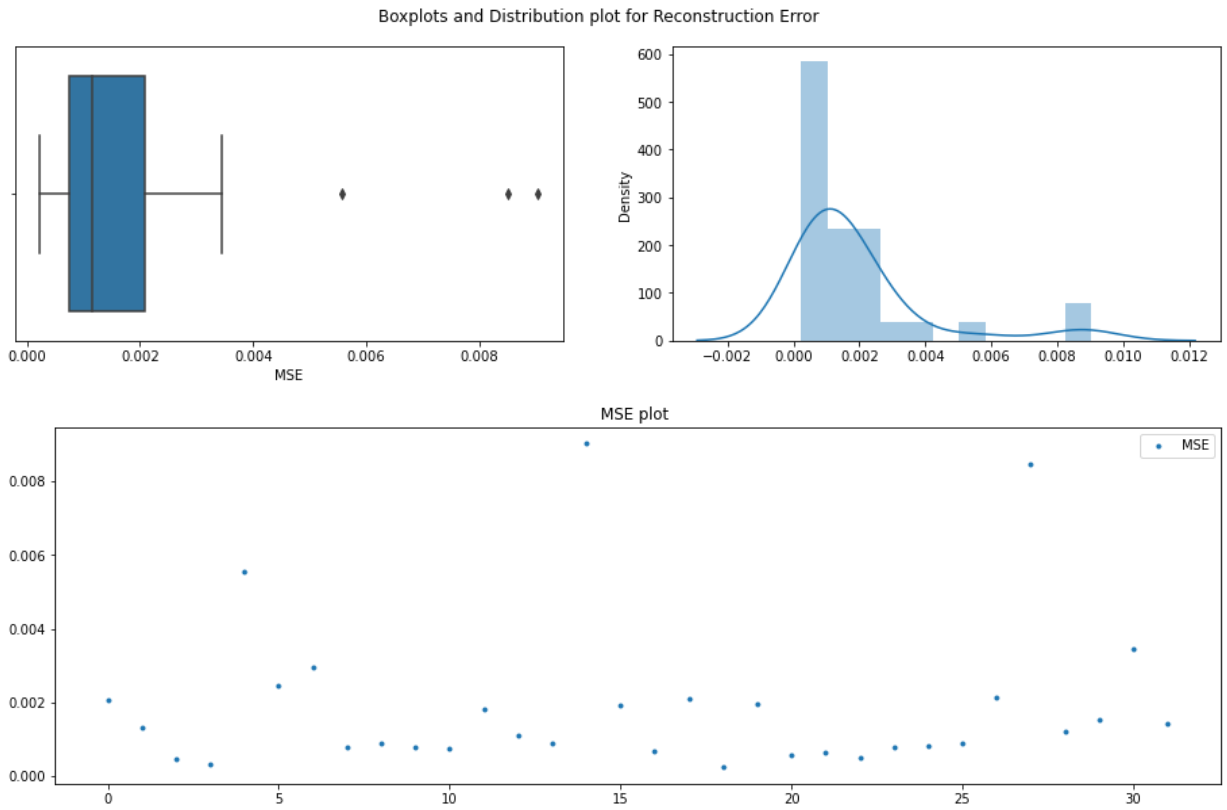10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 48
mean=0.001975,median=0.00141 ,max=0.00971,min=0.00025,variance=4.1911e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
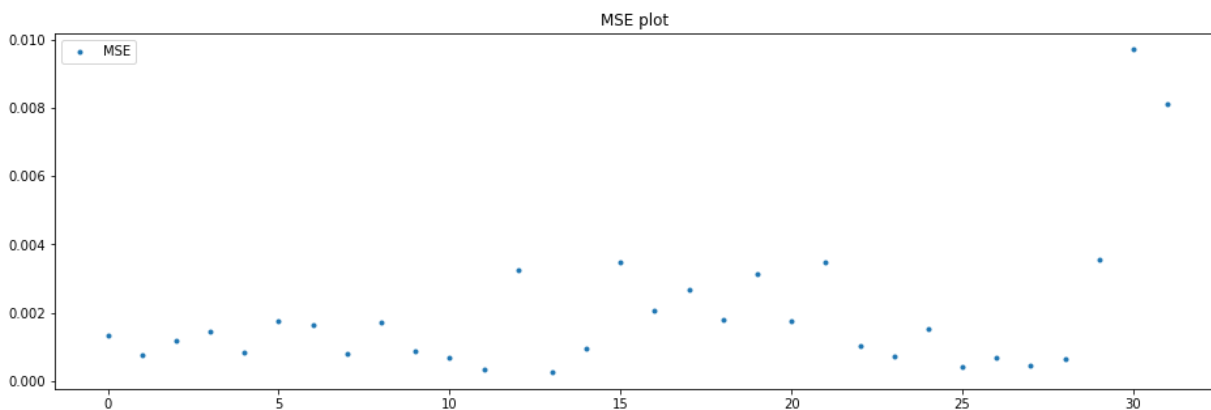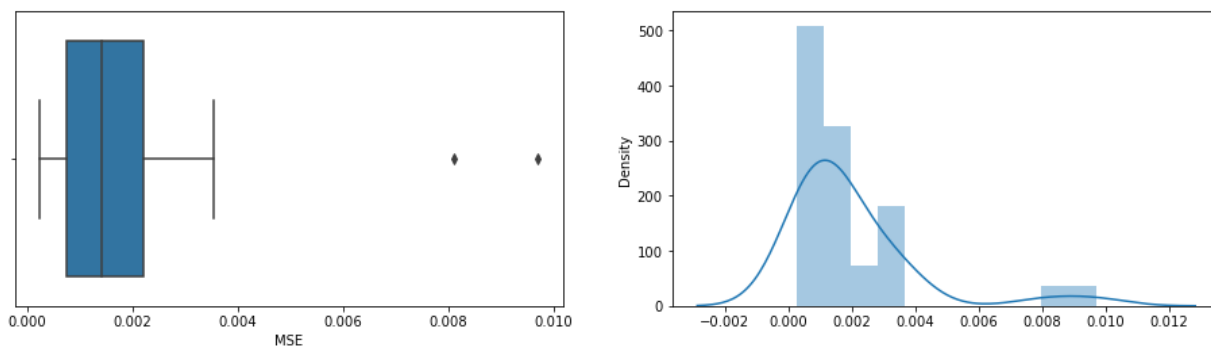
Anderson_Darling Test
Statistic: 3.070
15.000: 0.523, data does not look normal (reject H0)
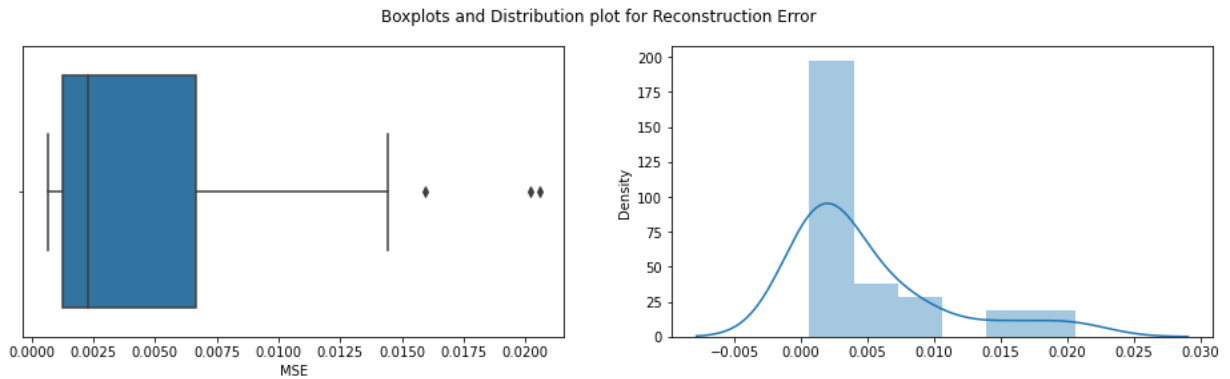10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 49
mean=0.001925625,median=0.00118 ,max=0.00756,min=0.0004,variance=2.7237e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
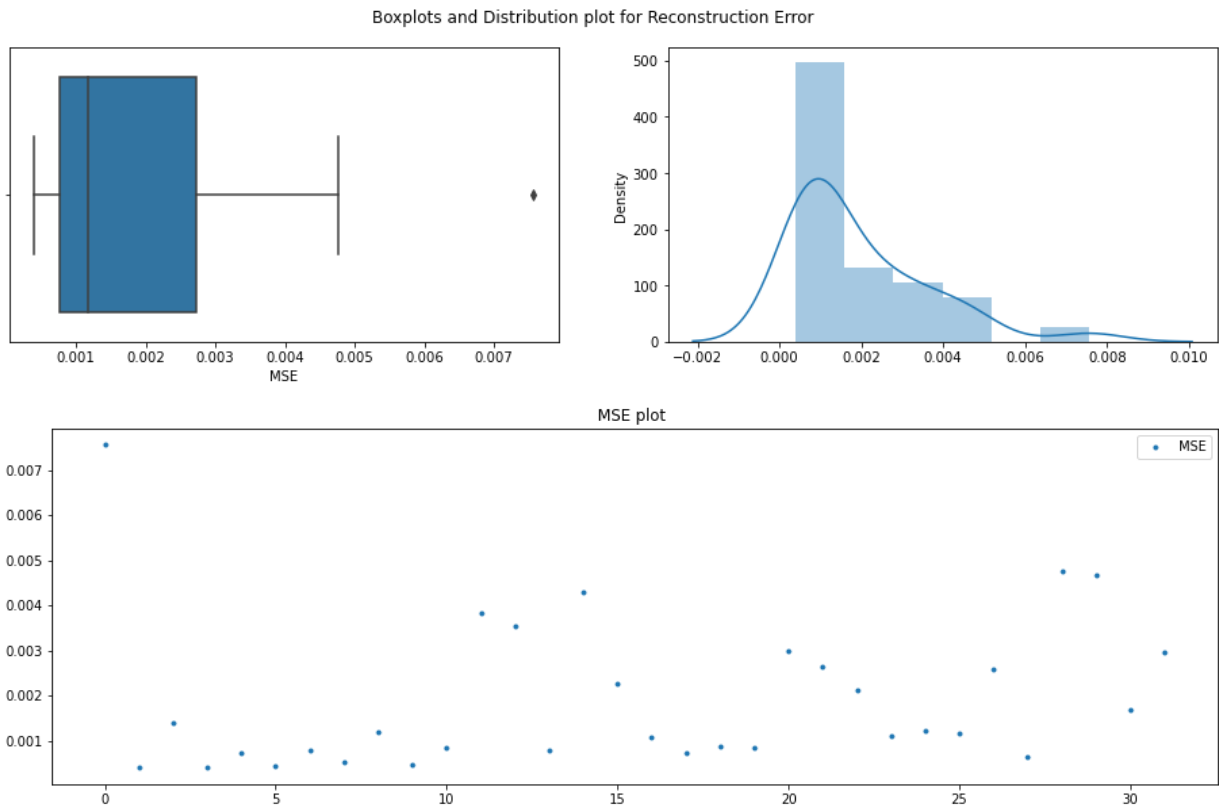

```
Anderson_Darling Test
Statistic: 1.945
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 50
mean=0.0023846875,median=0.00147 ,max=0.0102,min=0.00019,variance=6.3562e-06
```
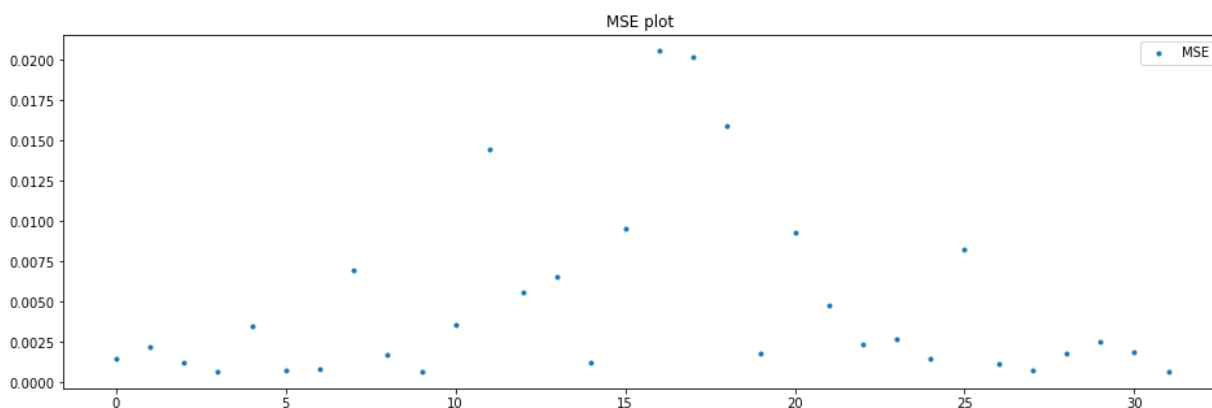
Boxplots and Distribution plot for Reconstruction Error

```
Anderson_Darling Test
Statistic: 2.774
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 51
mean=0.0047003125,median=0.001975 ,max=0.02943,min=0.00017,variance=4.51612e-05
```
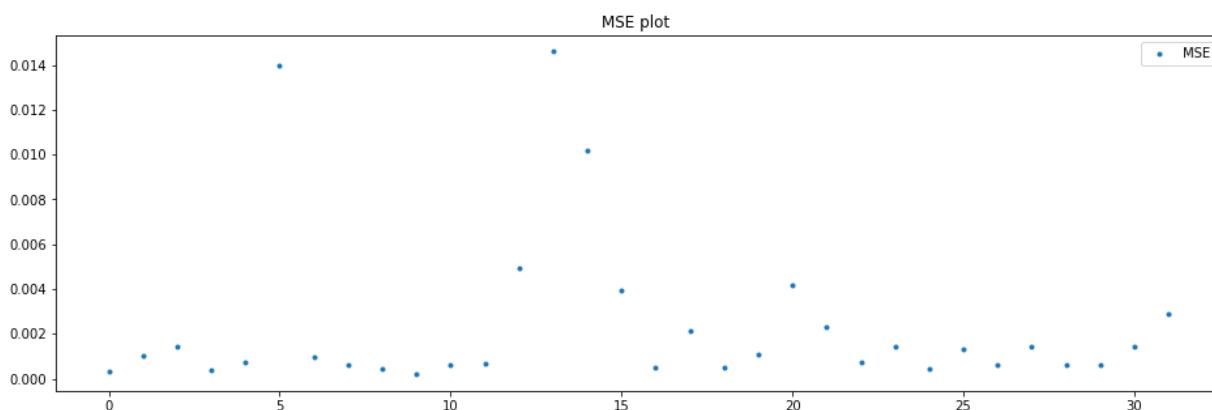


```
Anderson_Darling Test
Statistic: 3.715
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 52
mean=0.0030159375,median=0.00215 ,max=0.01721,min=0.00032,variance=1.24666e-05
```
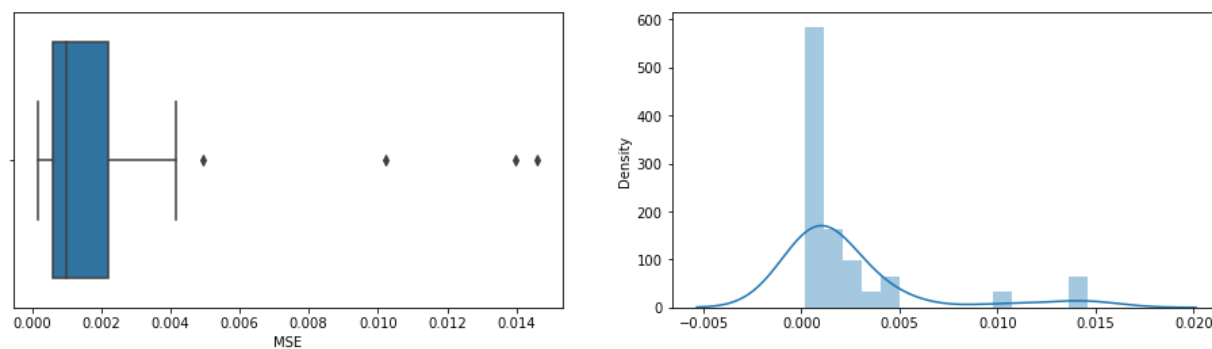
Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 3.991
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************

Batch: 53
mean=0.0026378125,median=0.002525 ,max=0.00655,min=0.00016,variance=3.0569e-06
```
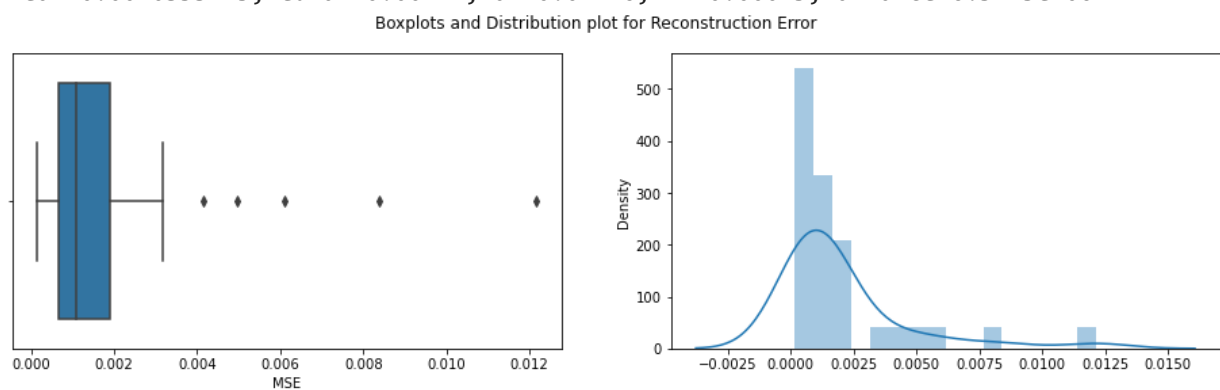
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 0.454
15.000: 0.523, data looks normal (fail to reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

 ****
Batch: 54
mean=0.001243125,median=0.001 ,max=0.00448,min=0.00013,variance=8.339e-07

Boxplots and Distribution plot for Reconstruction Error

MSE plot
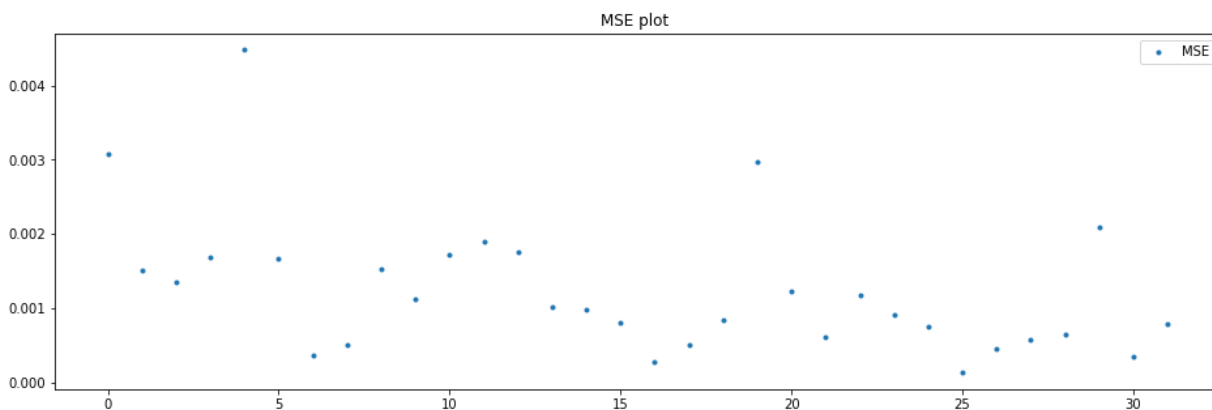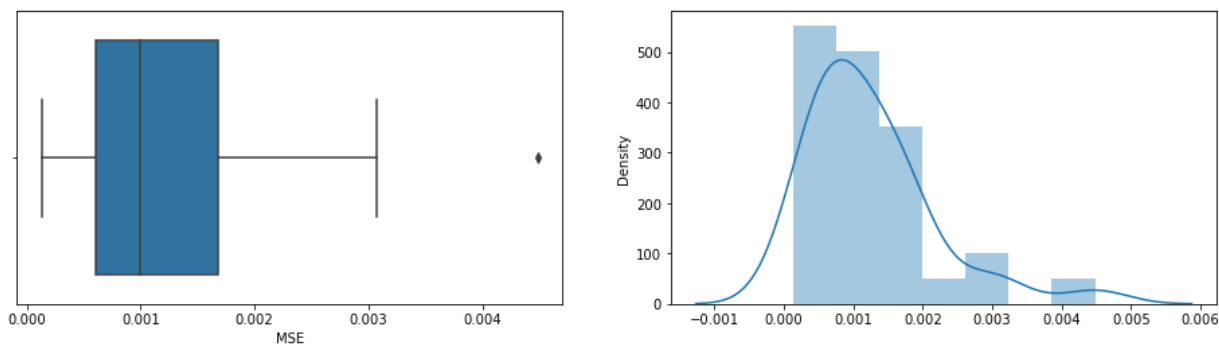
Anderson_Darling Test
Statistic: 1.284
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
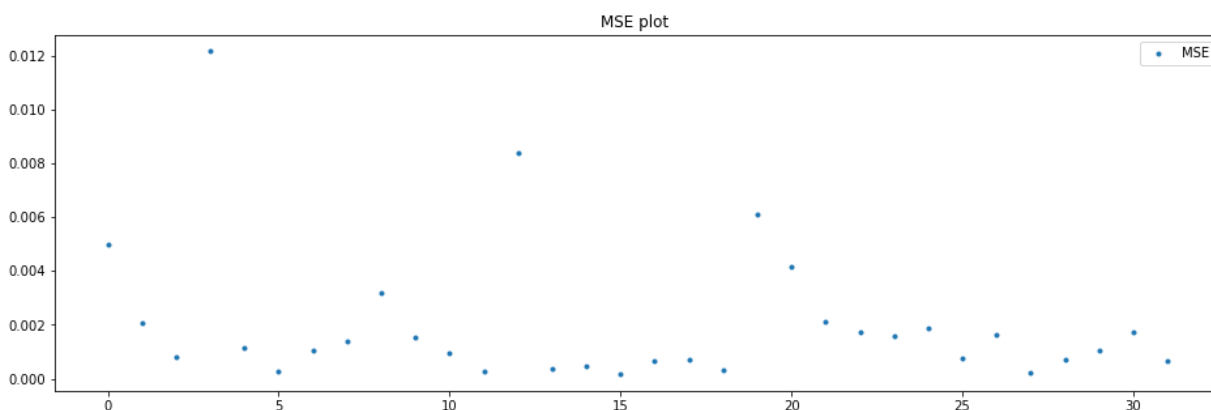5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 55
mean=0.00145375,median=0.00084 ,max=0.00848,min=0.00016,variance=2.8576e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 3.879
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


  ********************
Batch: 56
mean=0.0017284375,median=0.001755 ,max=0.00483,min=0.00042,variance=1.0707e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 0.586
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 *******************
Batch: 57
mean=0.00229875,median=0.00178 ,max=0.00804,min=0.0003,variance=4.282e-06
```


Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 2.113
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 58
mean=0.0038365625,median=0.0022 ,max=0.01278,min=0.00042,variance=1.18317e-05
```
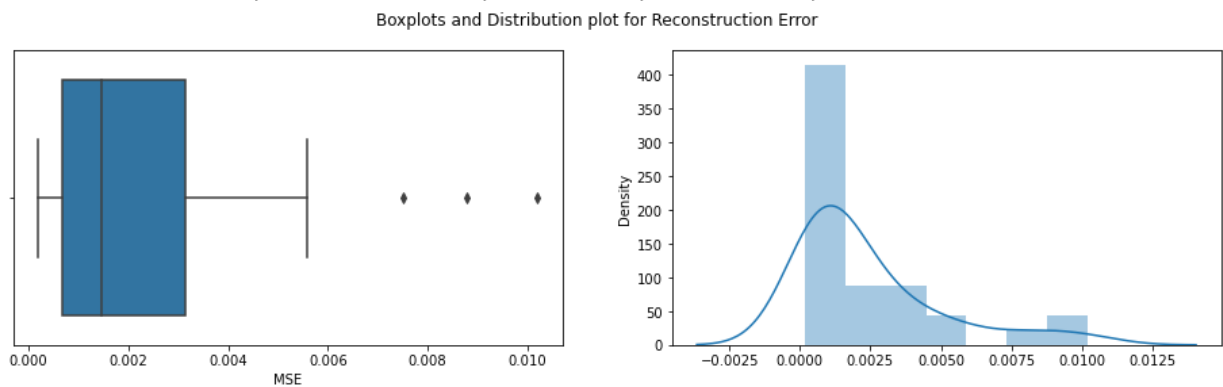
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.903
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
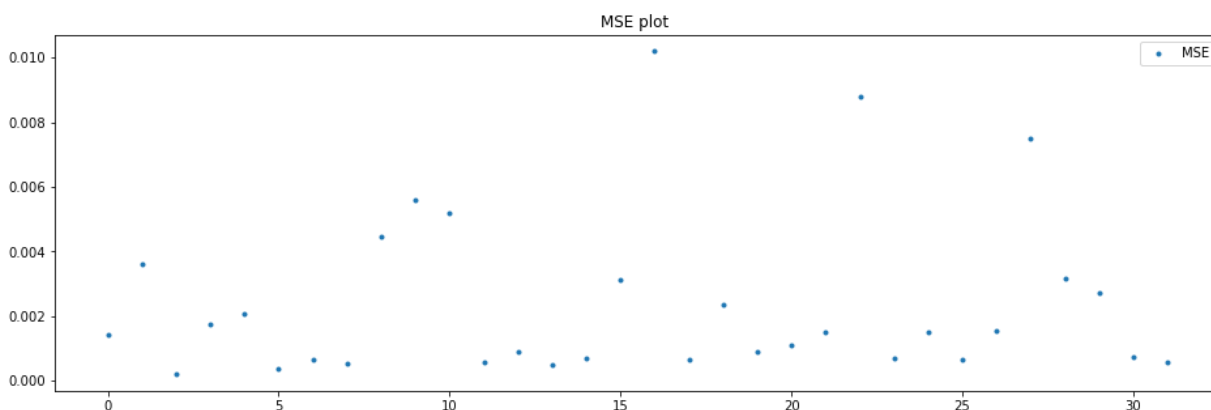2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

  ****
Batch: 59
mean=0.0058840625,median=0.002175 ,max=0.03879,min=0.00018,variance=9.25276e-05

Boxplots and Distribution plot for Reconstruction Error

```
Anderson_Darling Test
Statistic: 5.499
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 60
mean=0.0037996875,median=0.00237 ,max=0.0209,min=0.00023,variance=2.00629e-05
```
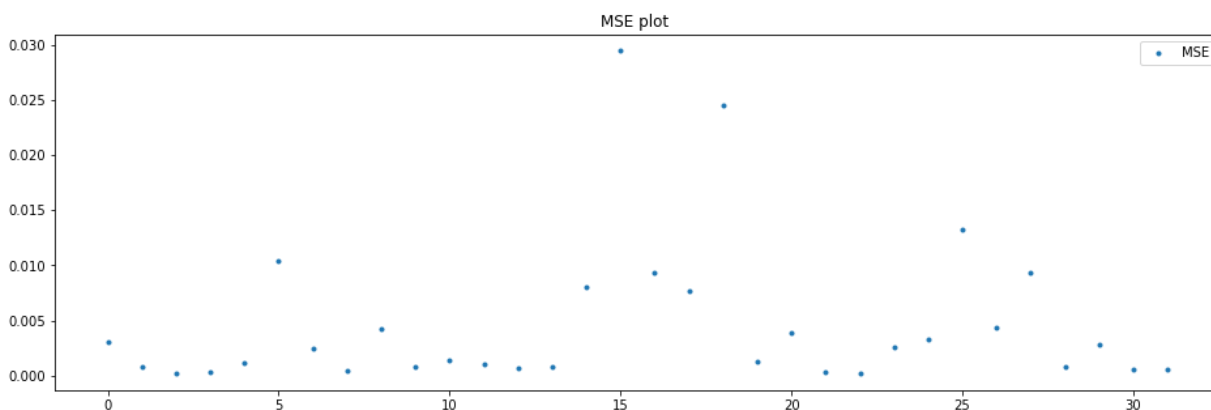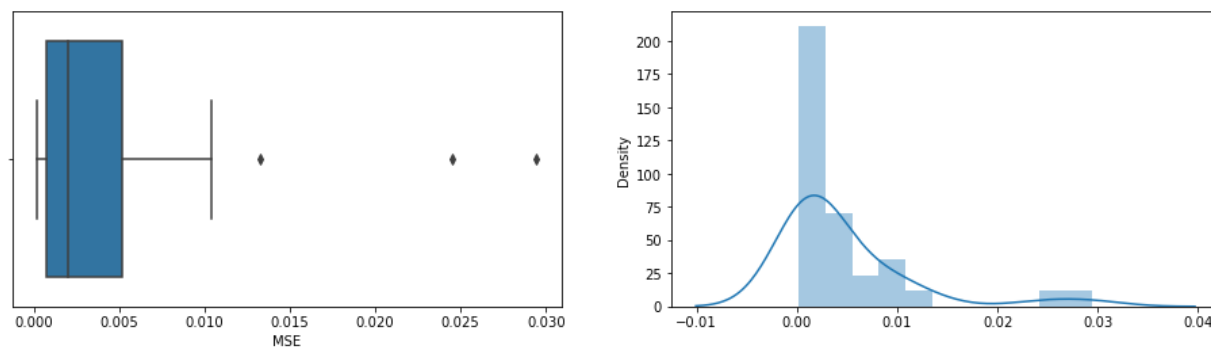

Boxplots and Distribution plot for Reconstruction Error


```
Anderson_Darling Test
Statistic: 3.316
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 61
mean=0.00179625,median=0.00106 ,max=0.01101,min=0.0001,variance=4.5062e-06
```
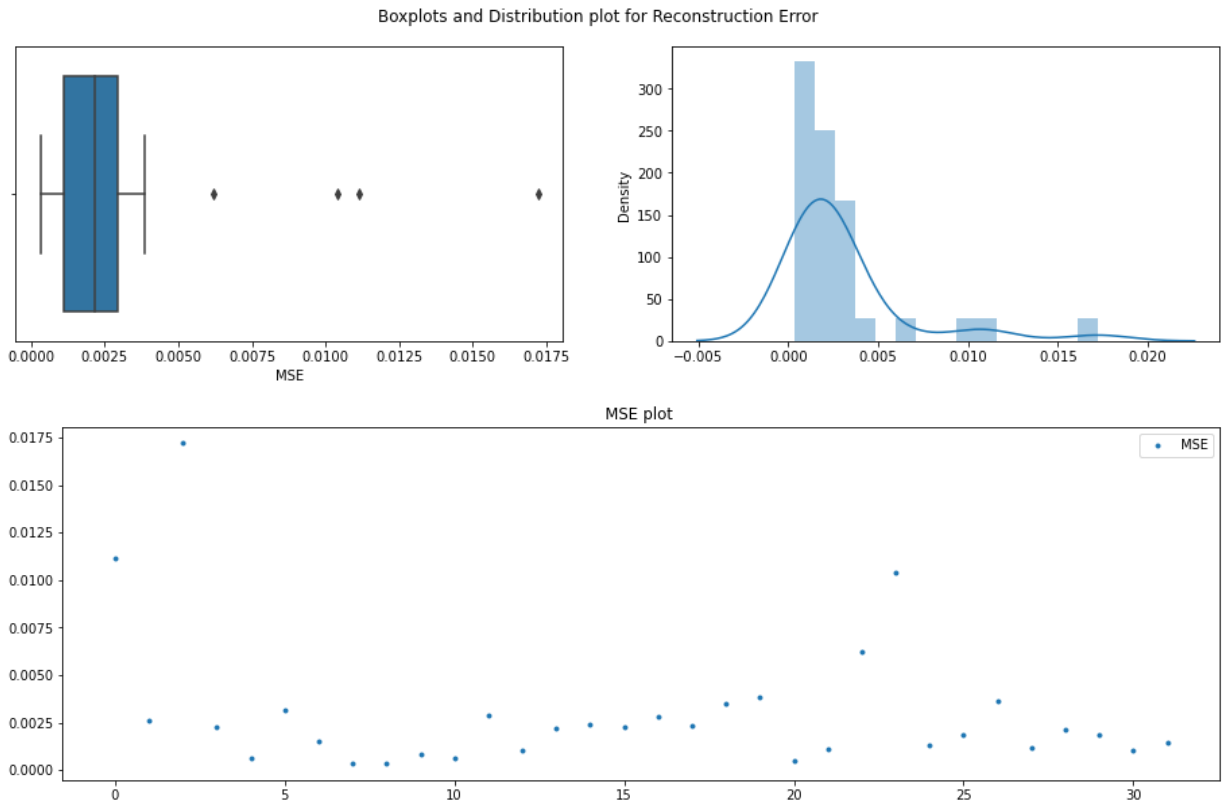
Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 3.192
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 62
mean=0.0015875,median=0.001315 ,max=0.00899,min=0.00014,variance=2.2325e-06
```
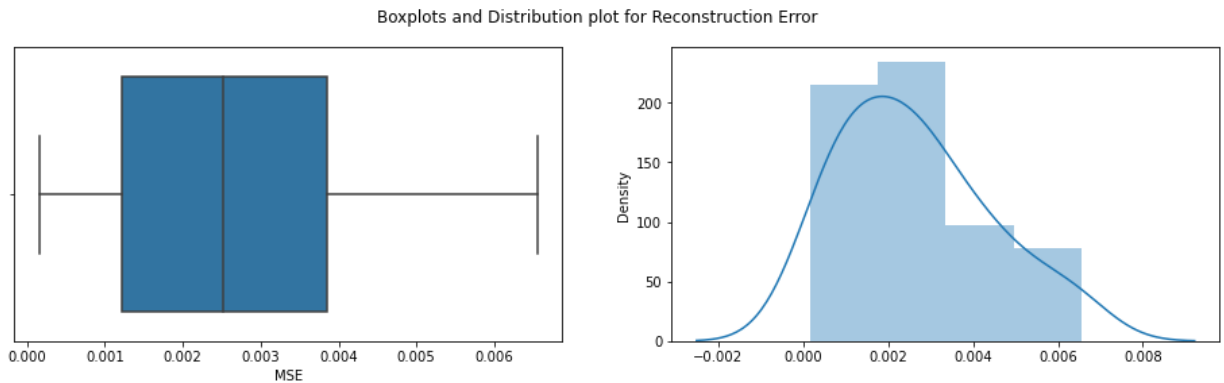
Boxplots and Distribution plot for Reconstruction Error

```
Anderson_Darling Test
Statistic: 3.048
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 63
mean=0.002380625,median=0.001325 ,max=0.01721,min=0.00017,variance=1.02989e-05
```
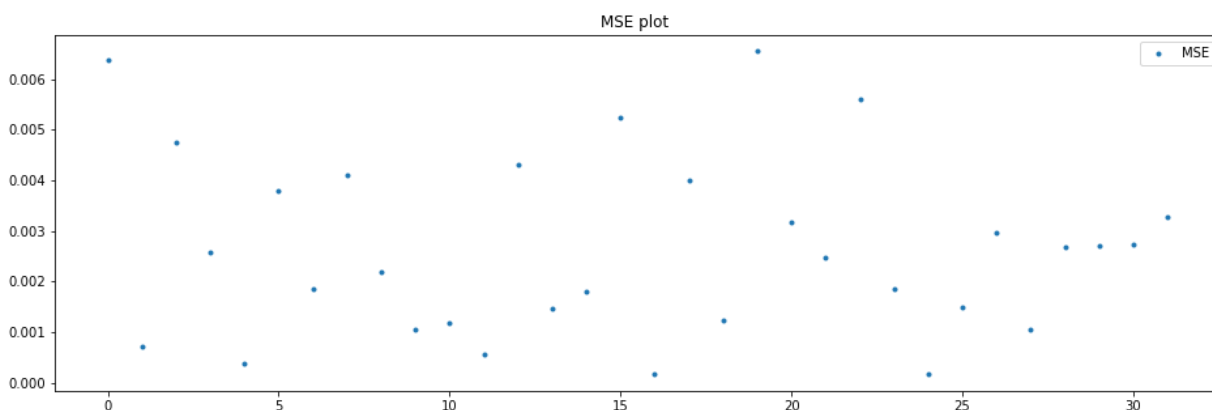

Boxplots and Distribution plot for Reconstruction Error
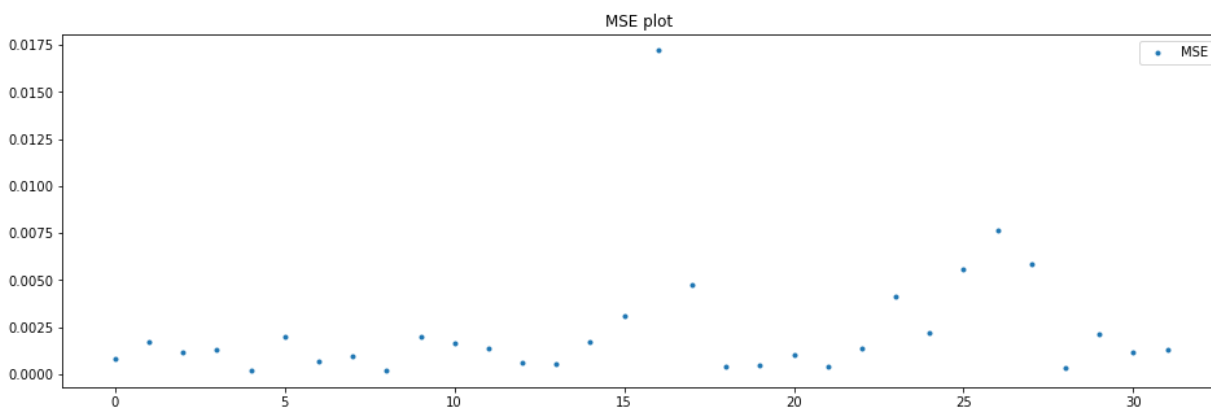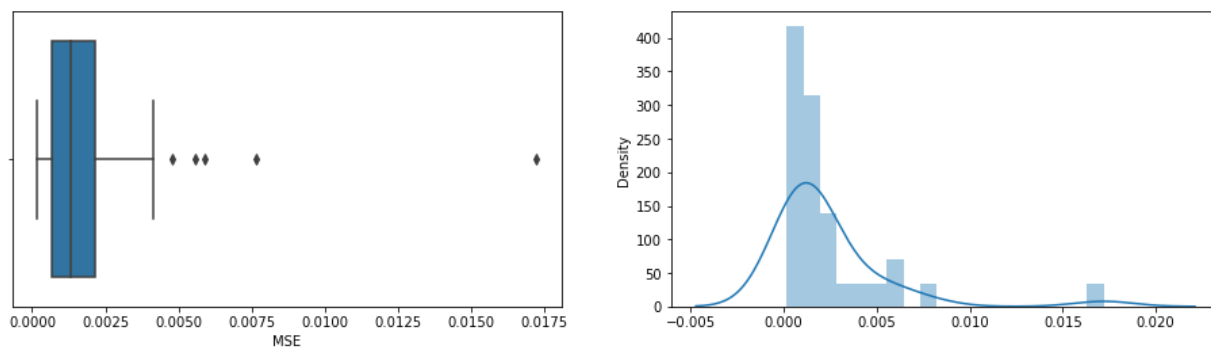

```
Anderson_Darling Test
Statistic: 3.853
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 64
mean=0.0028159375,median=0.002015 ,max=0.01122,min=0.00017,variance=6.3986e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
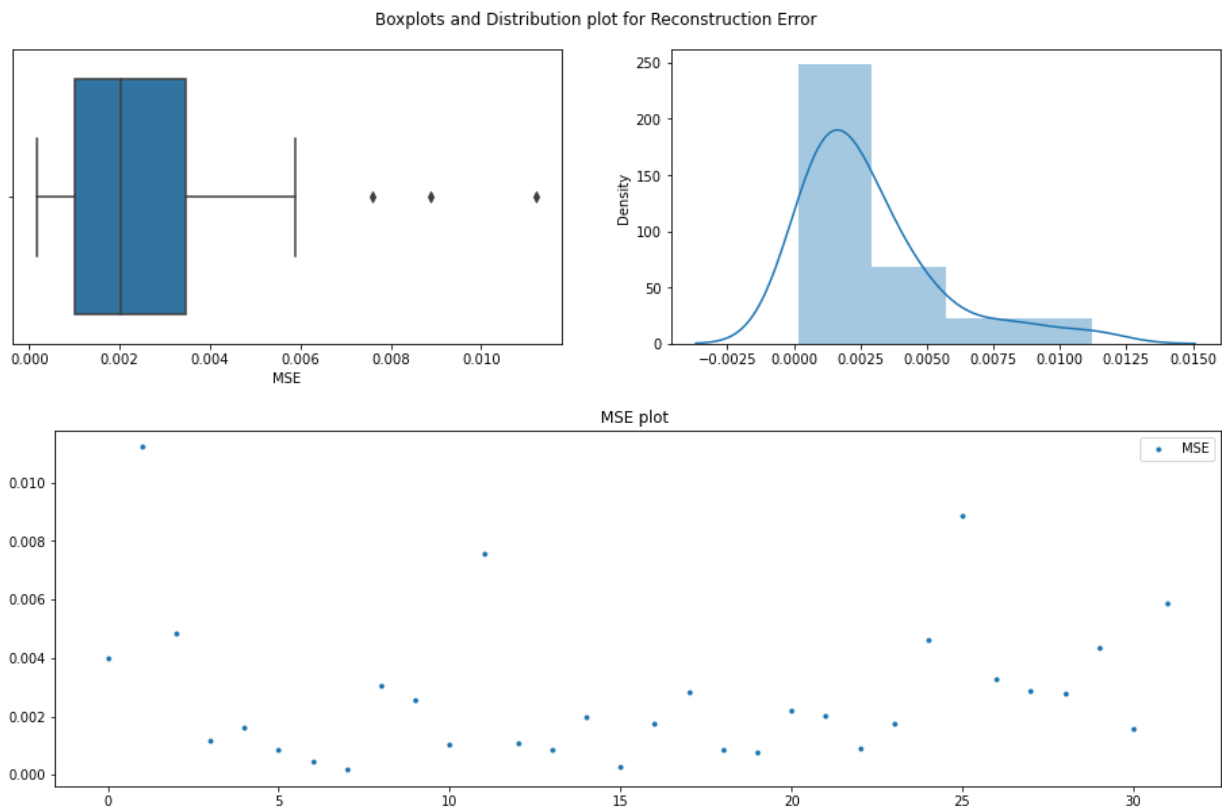
Anderson_Darling Test
Statistic: 1.826
15.000: 0.523, data does not look normal (reject H0)
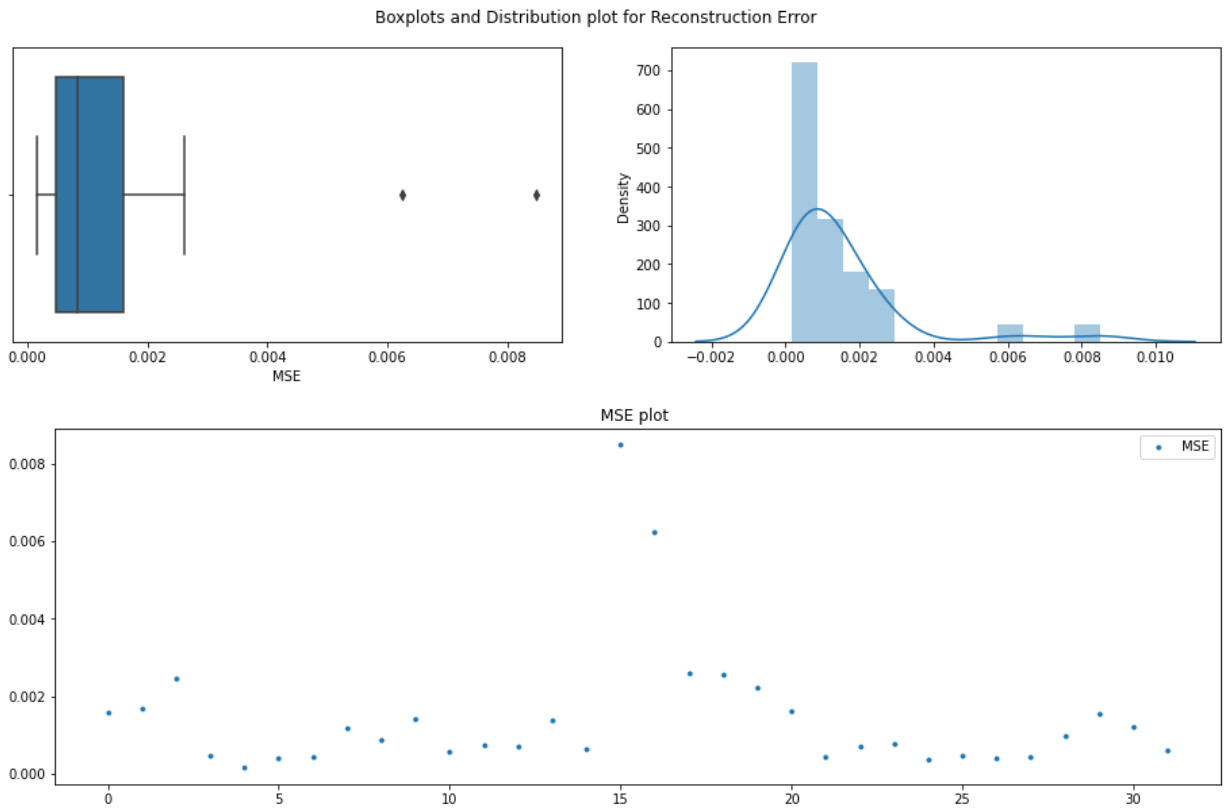10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

   ****
Batch: 65
mean=0.0027259375,median=0.00177 ,max=0.01666,min=0.0002,variance=9.7369e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
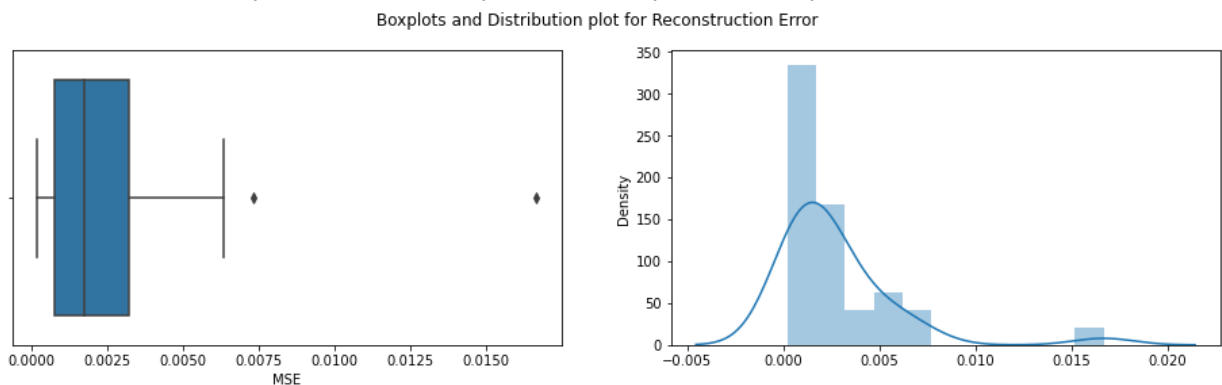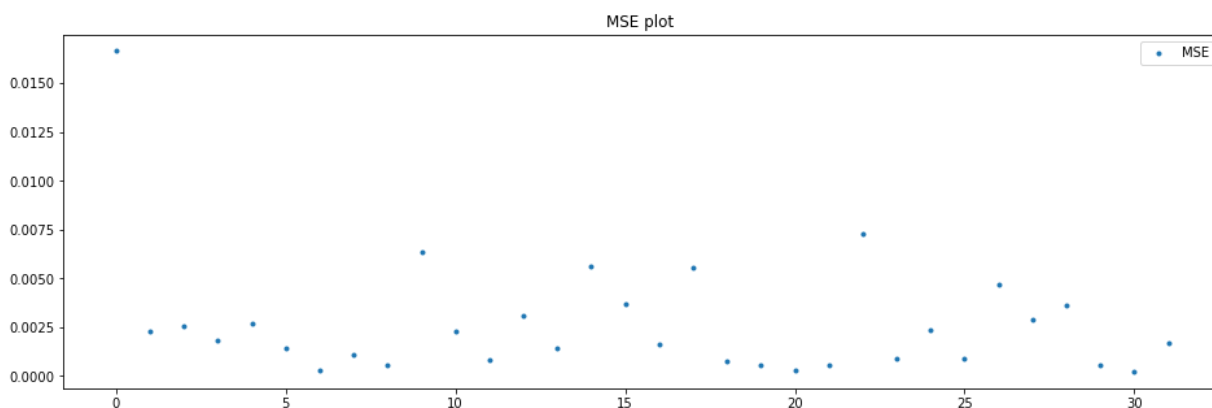
```
Anderson_Darling Test
Statistic: 2.551
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 66
mean=0.0016878125,median=0.00103 ,max=0.00628,min=0.00022,variance=2.2348e-06
```
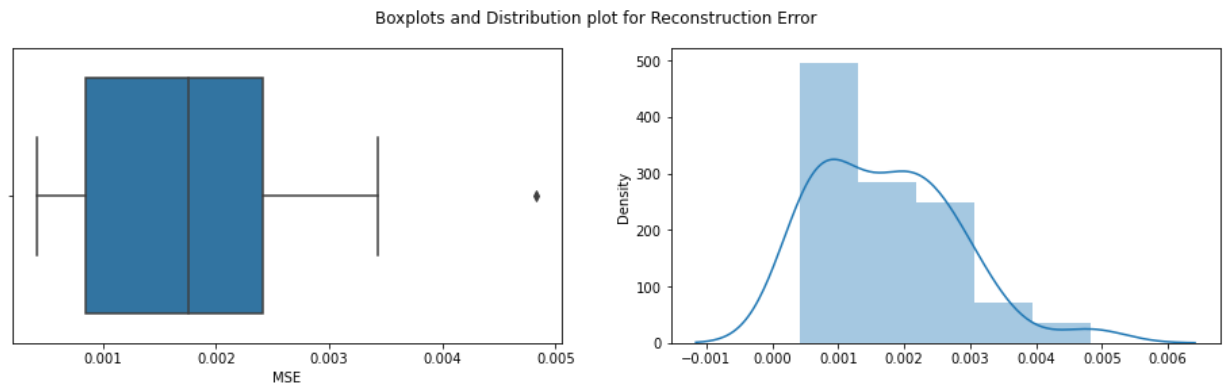

Boxplots and Distribution plot for Reconstruction Error

MSE plot
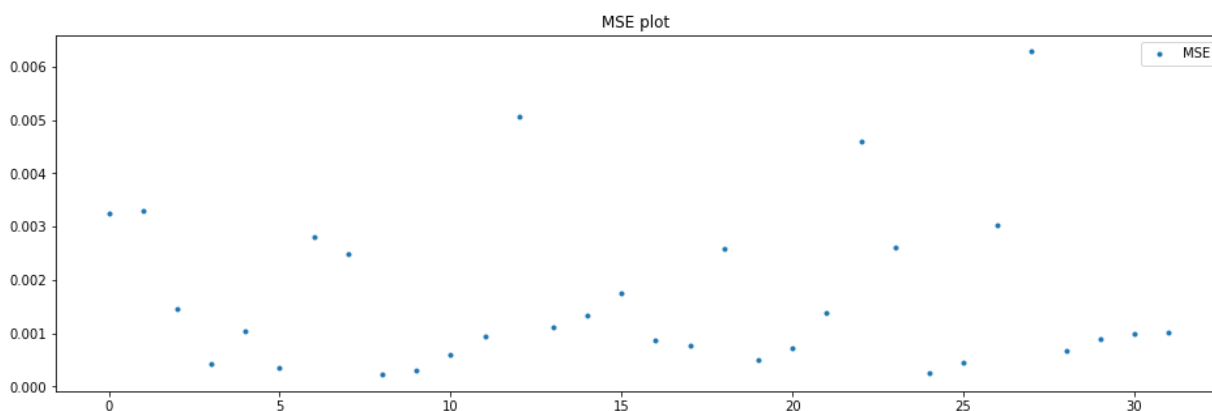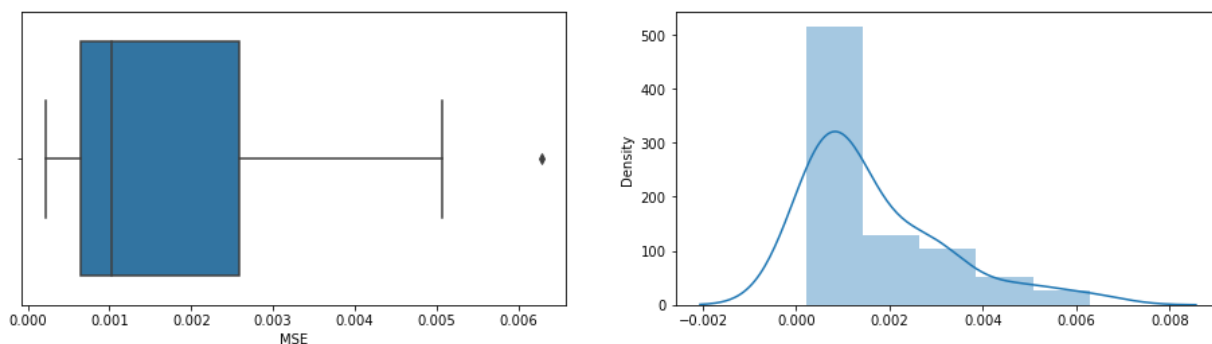
```
Anderson_Darling Test
Statistic: 1.927
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 67
mean=0.0024428125,median=0.001475 ,max=0.01315,min=0.00034,variance=8.1944e-06
```
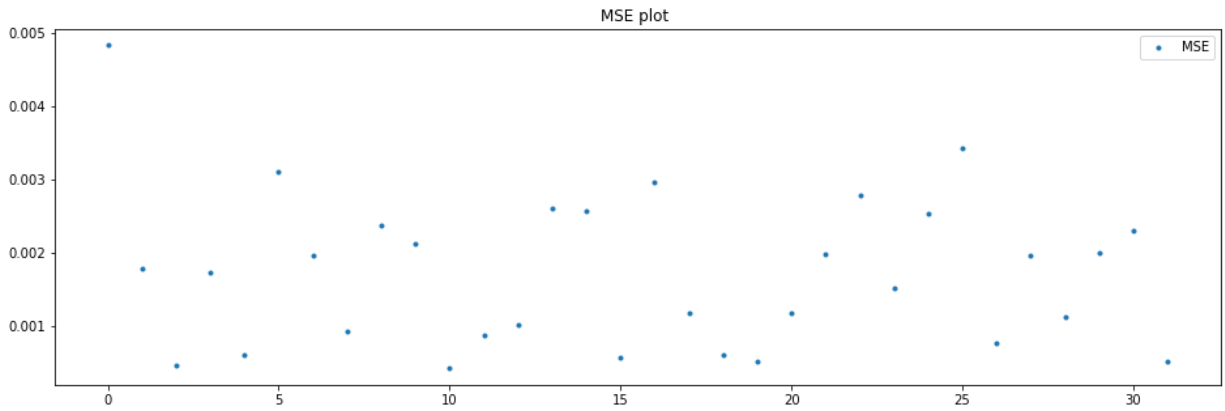
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 3.499
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 68
mean=0.002510625,median=0.001985 ,max=0.0137,min=0.00051,variance=5.7776e-06
```
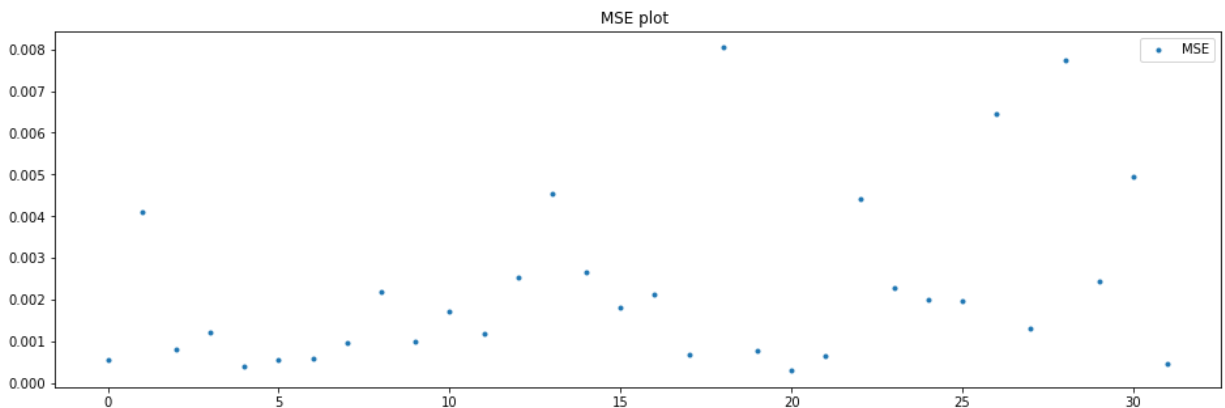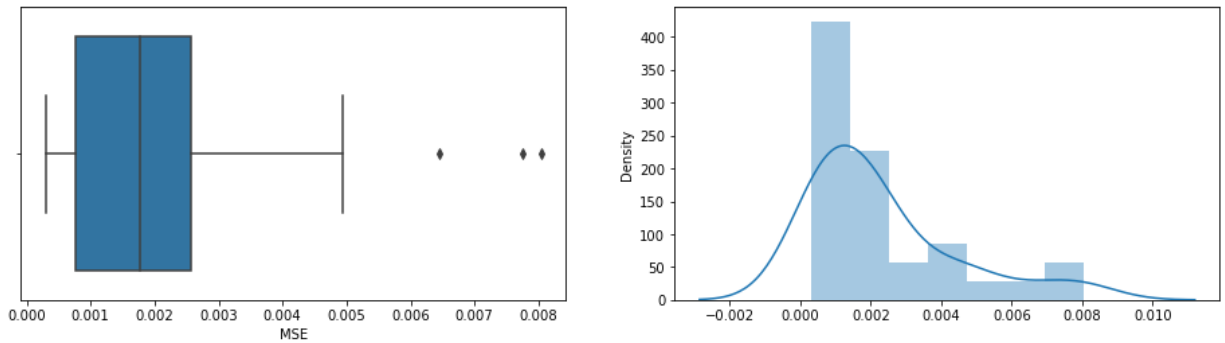
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 2.918
15.000: 0.523, data does not look normal (reject H0)
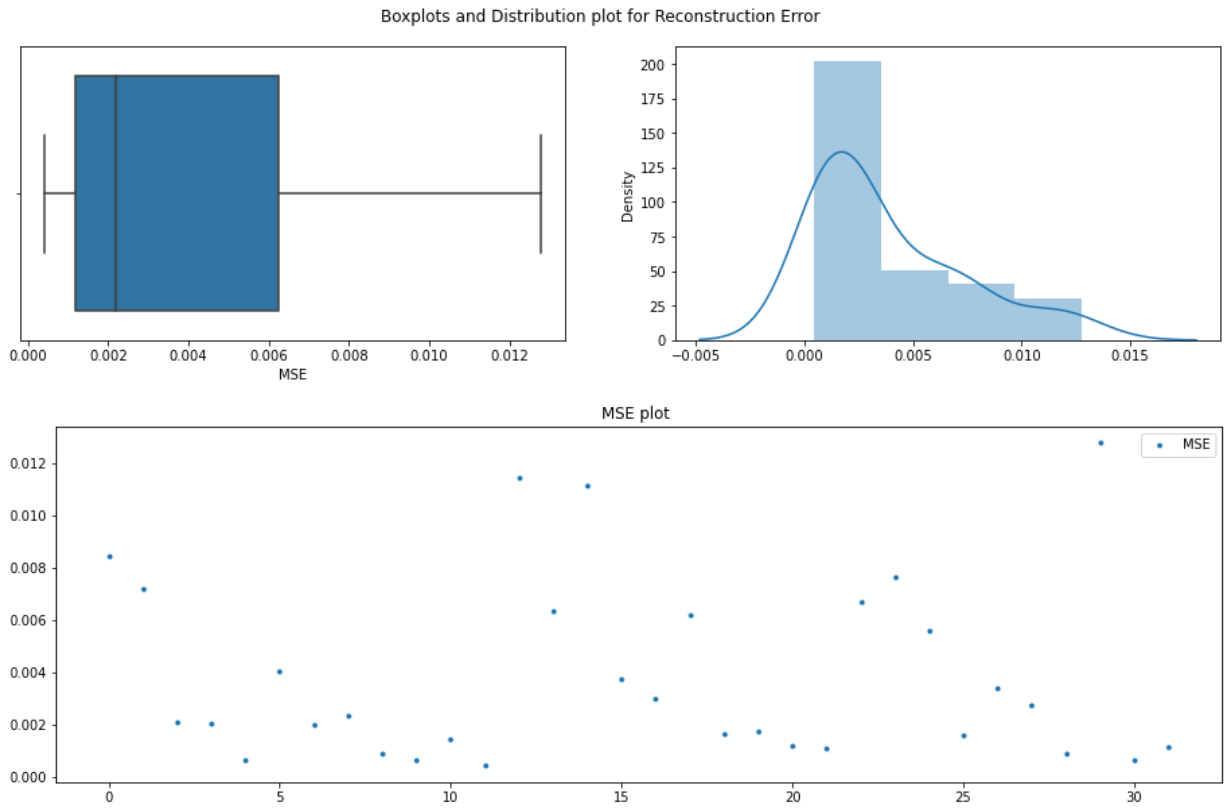10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 69
mean=0.003276875,median=0.002195 ,max=0.0213,min=0.00041,variance=1.41802e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 4.186
15.000: 0.523, data does not look normal (reject H0)
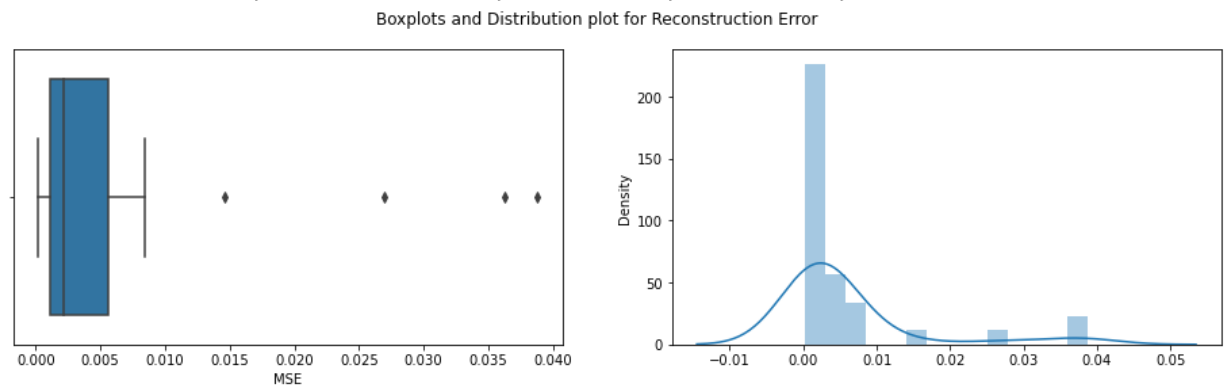10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 70
mean=0.0024225,median=0.00195 ,max=0.00683,min=0.00044,variance=2.7467e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 0.870
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
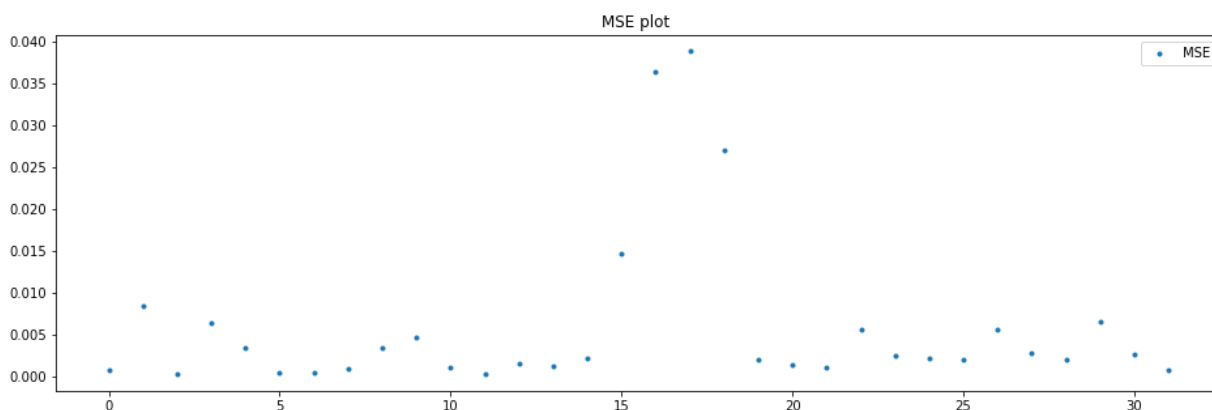5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

  ****
Batch: 71
mean=0.0019959375,median=0.00099 ,max=0.01238,min=0.00029,variance=5.9793e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 3.548
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
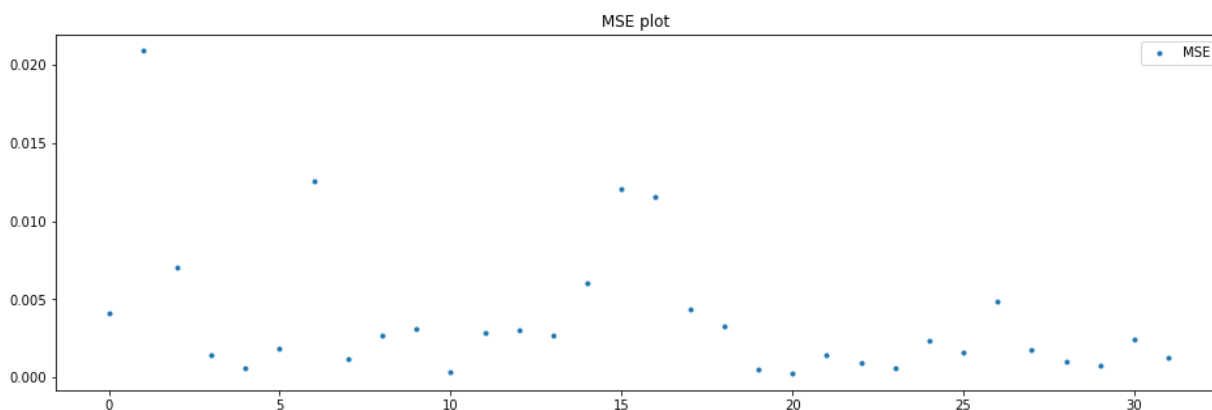5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 72
mean=0.0074609375,median=0.002465 ,max=0.03468,min=0.00036,variance=9.03912e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 3.350
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
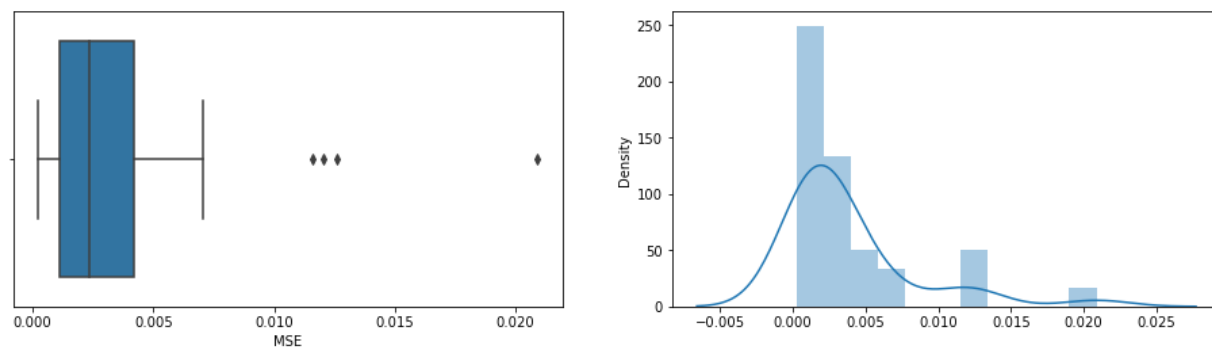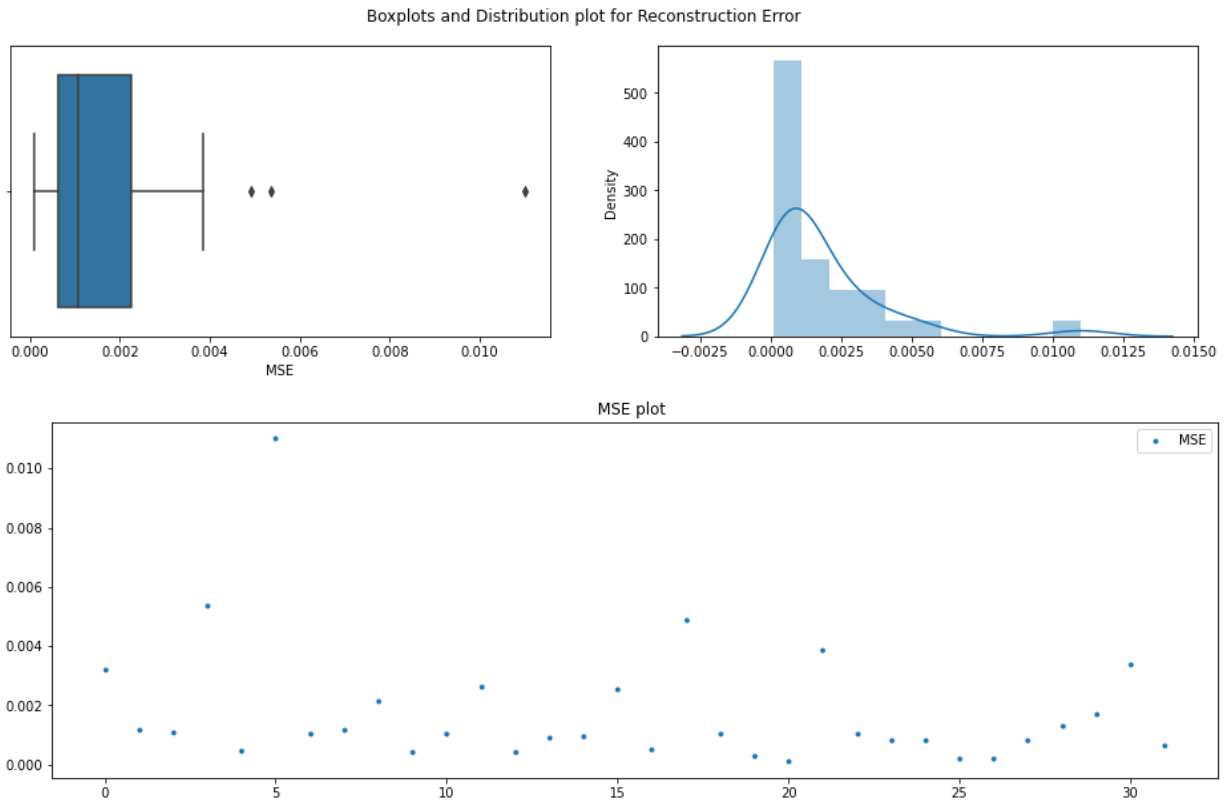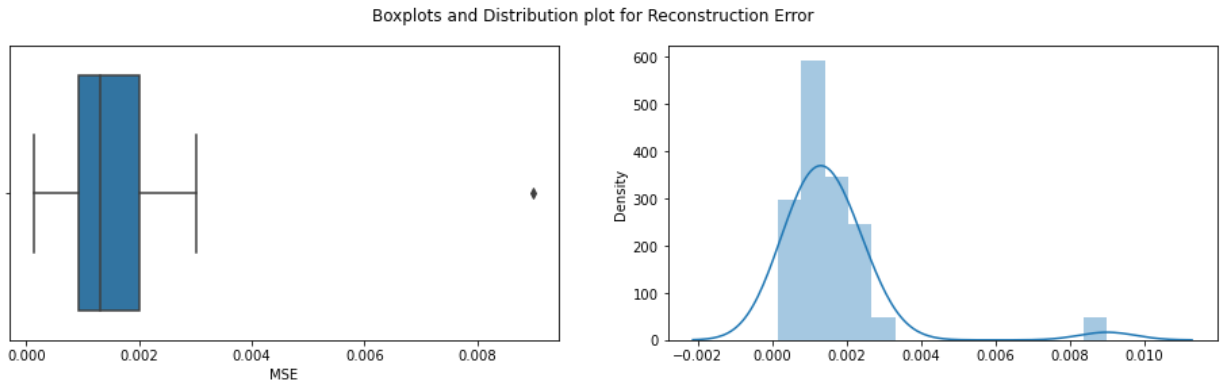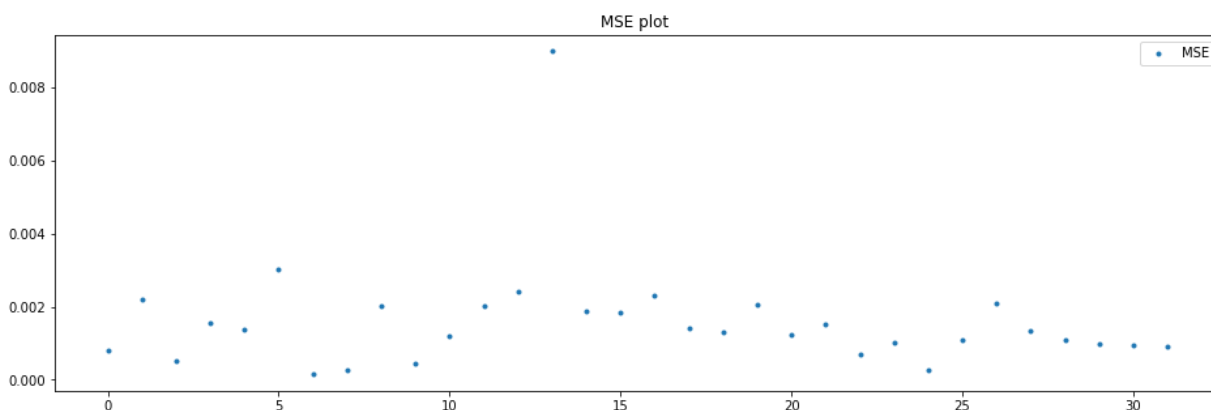5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 73
mean=0.003824,median=0.00131 ,max=0.01383,min=0.00076,variance=2.52656e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 0.955
15.000: 0.720, data does not look normal (reject H0)
10.000: 0.820, data does not look normal (reject H0)
5.000: 0.984, data looks normal (fail to reject H0)
2.500: 1.148, data looks normal (fail to reject H0)
1.000: 1.365, data looks normal (fail to reject H0)
```

Intance Threshold Computation

In [32]:
```python
# This function computes instance threshold from first N batches
def compute_instance_threshold_firstN_batches(batch_avg_mse_values,N):
    zscore_list=[]
    #value_list=[]
    for k in range(0,N):
        value_list=batch_avg_mse_values[k]
         #Z_SCORE
        mean=np.mean(value_list)
        sigma=np.std(value_list)
        thres_zscore=(mean+3*sigma).round(4)
        zscore_list.append(thres_zscore)
        #print (value_list)
        #print(zscore_list)
    return (np.mean(zscore_list).round(4)) , zscore_list
```

In [33]:
```python
instance_thresh_neg,zscore_list_neg=compute_instance_threshold_firstN_batches(batch_
```

In [34]:
```python
instance_thresh_neg
```

Out[34]: 0.0102

Batch Threshold Computation

In [35]:
```python
## computes loss threshold uisng IQR as well as ZScore from batch average recon. erro
def compute_batch_threshold_testdata(batch_avg_mse):
    #val_loss=history['val_loss']
    ## Quartile Method
    Q1=np.quantile(batch_avg_mse,0.25)
    Q3=np.quantile(batch_avg_mse,0.75)
    IQR=Q3-Q1
    thres_iqr=(Q3 + 1.5*IQR).round(4)
    #Z_SCORE
    mean=np.mean(batch_avg_mse)
    sigma=np.std(batch_avg_mse)
    thres_zscore=(mean+3*sigma).round(4)

    return thres_iqr, thres_zscore
```

In [36]:
```python
thres_iqr_batch_neg, thres_zscore_batch_neg =compute_batch_threshold_testdata(batch_
```

In [37]:
```python
thres_zscore_batch_neg
```

Out[37]: 0.0062

Count Threshold Computation

In [38]:
```python
# This function computes how many instances in a batch exceed instance threshold
def threshold_exceed_count(batch_mse_values, thr):
    exceed_count={}
    for key in batch_mse_values.keys():
        count=0
        list=batch_mse_values[key]
        for a in range(0,len(list)):
            if list[a]>thr:
                count+=1
        exceed_count[key]=count
    values = exceed_count.values()
    total = sum(values)
    return exceed_count,total
```

In [39]:
```python
# Counts the MSE values exceeding threshold in each batch
exceed_count_neg_en_neg,total_neg_en_neg=threshold_exceed_count(batch_mse_values_neg_
```

In [40]:
```python
# Get a list of excced count values . Above function returens a dic where key is batc
exceed_list_neg_en_neg=[]
for key in exceed_count_neg_en_neg.keys():
    exceed_list_neg_en_neg.append(exceed_count_neg_en_neg[key])
```

In [41]:
```
plot_results(exceed_list_neg_en_neg)
```

mean=1.1891891892,median=1.0 ,max=8,min=0,variance=2.7479912345

Boxplots and Distribution plot for Reconstruction Error
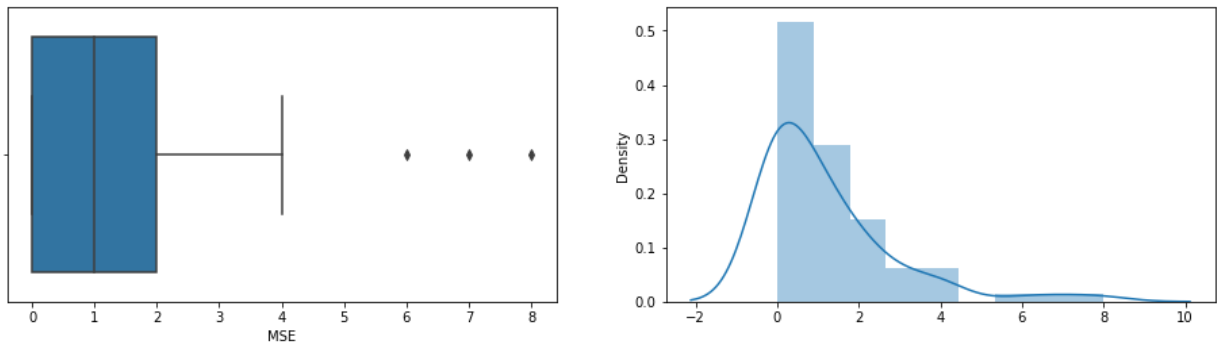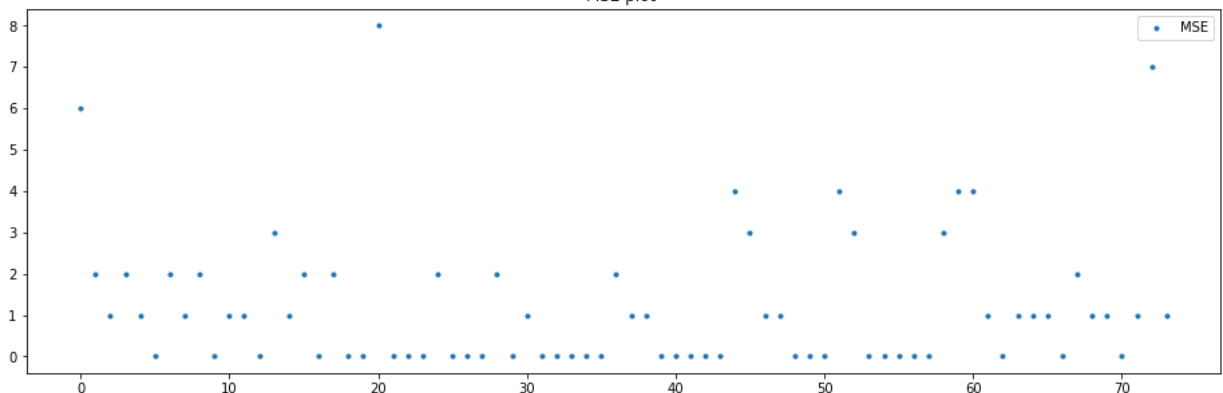
Count Threshold is ataken as median value

In [42]:
```
count_thresh_neg=np.median(exceed_list_neg_en_neg)
```

In [43]:
```
count_thresh_neg
```

Out[43]: 1.0

5. B) Positive Class Data

In [44]:
```
predictions_pos=mse_predictions(test_pos_class,encoder_pos_class)
```

In [45]:
```
test_pos_class
```

Out[45]:

	attribute1	attribute2	attribute3	attribute4	attribute5	attribute6	attribute7	attribute8
12721	0.357	0.473	0.011	0.206	0.054	0.064	0.322	0.431
12743	0.387	0.481	0.008	0.339	0.201	0.149	0.347	0.468
12748	0.475	0.552	0.006	0.597	0.215	0.297	0.457	0.525
12750	0.399	0.450	0.009	0.589	0.552	0.722	0.406	0.479

	attribute1	attribute2	attribute3	attribute4	attribute5	attribute6	attribute7	attribute8
12763	0.499	0.574	0.005	0.395	0.168	0.195	0.526	0.553
...	...	...	...	...	...	...	...	...
16317	0.402	0.506	0.009	0.198	0.093	0.149	0.397	0.418
16318	0.454	0.541	0.009	0.258	0.100	0.191	0.397	0.515
16322	0.454	0.563	0.007	0.290	0.036	0.108	0.448	0.504
16323	0.461	0.586	0.009	0.105	0.075	0.130	0.405	0.534
16332	0.445	0.539	0.010	0.258	0.054	0.149	0.381	0.523

1291 rows × 8 columns

In [46]:
```python
plot_results(predictions_pos)
```

mean=0.0032805926,median=0.002137 ,max=0.022418,min=6e-05,variance=1.05887e-05
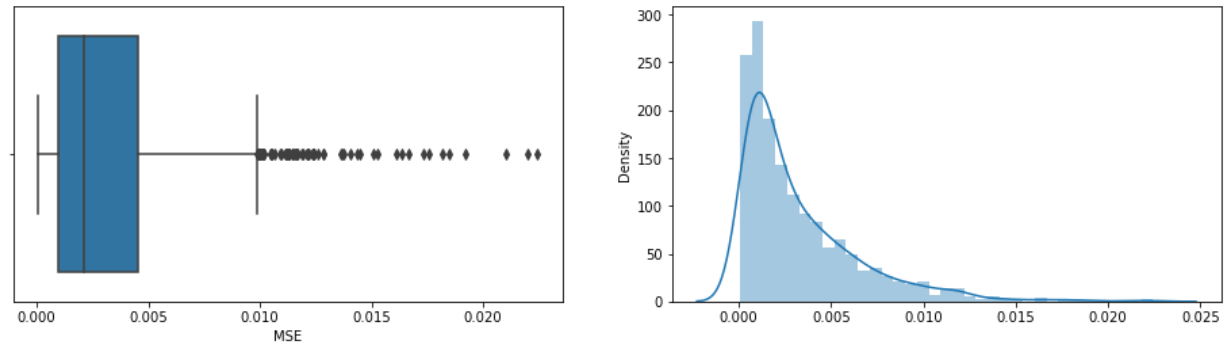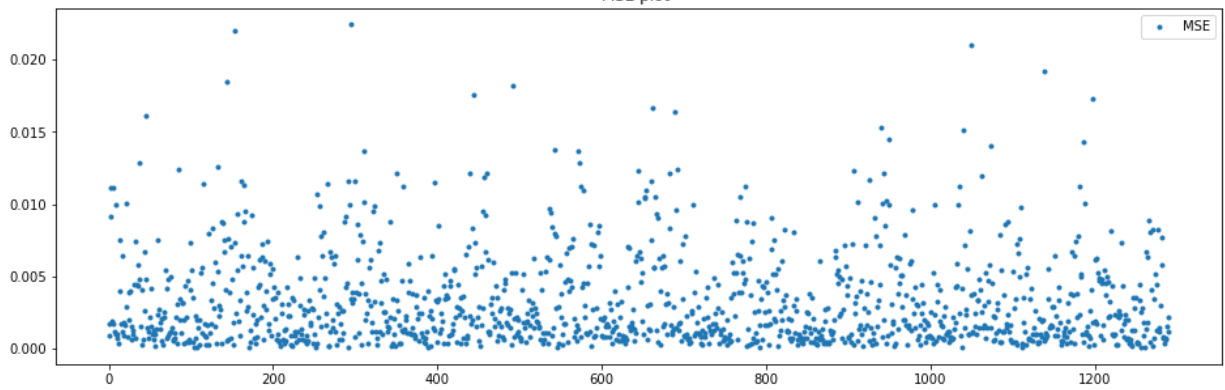
In [47]:
```python
batches_pos=make_batches(test_pos_class)
```

In [48]:
```python
batch_avg_mse_pos,batch_mse_values_pos=check_all_batch_normality(batches_pos,encoder_
```

```
*********************
Batch: 0
mean=0.0034334375,median=0.001735 ,max=0.01116,min=0.00039,variance=1.13696e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
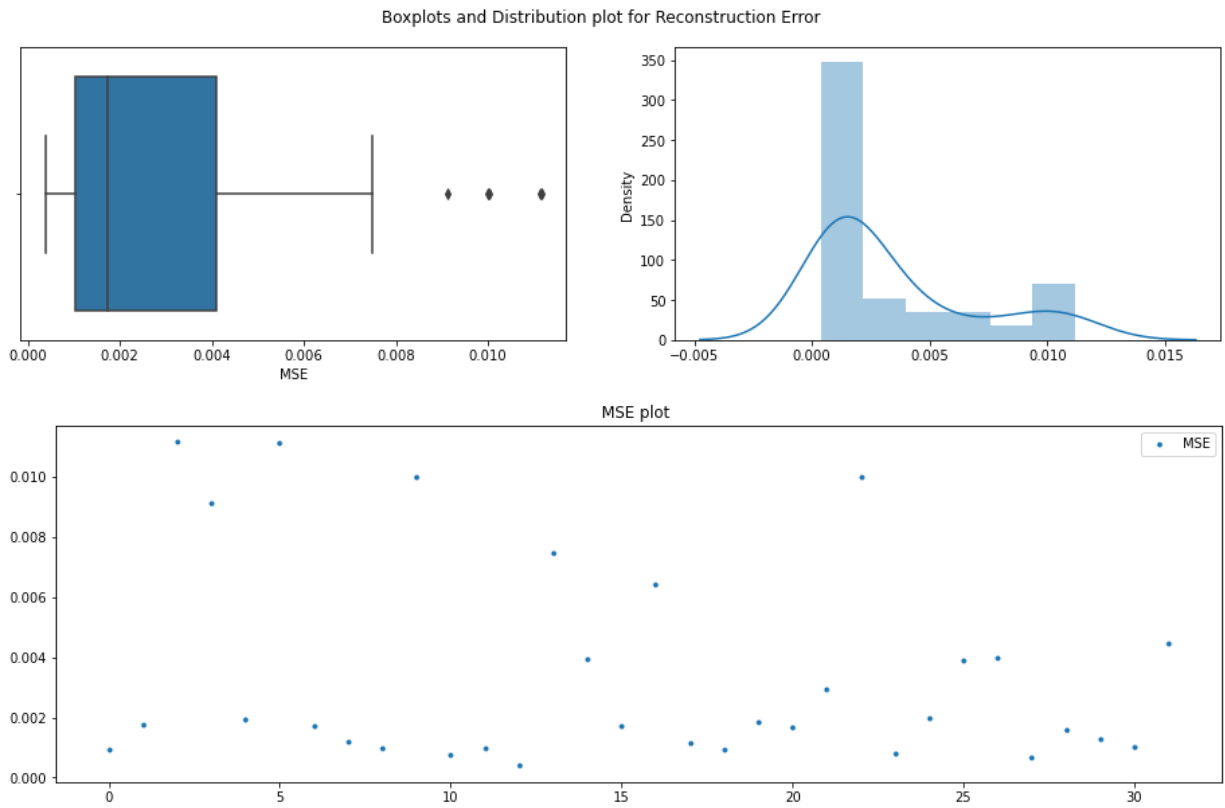

```
Anderson_Darling Test
Statistic: 3.176
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************

Batch: 1
mean=0.0034234375,median=0.001975 ,max=0.01611,min=0.00017,variance=1.26187e-05
```
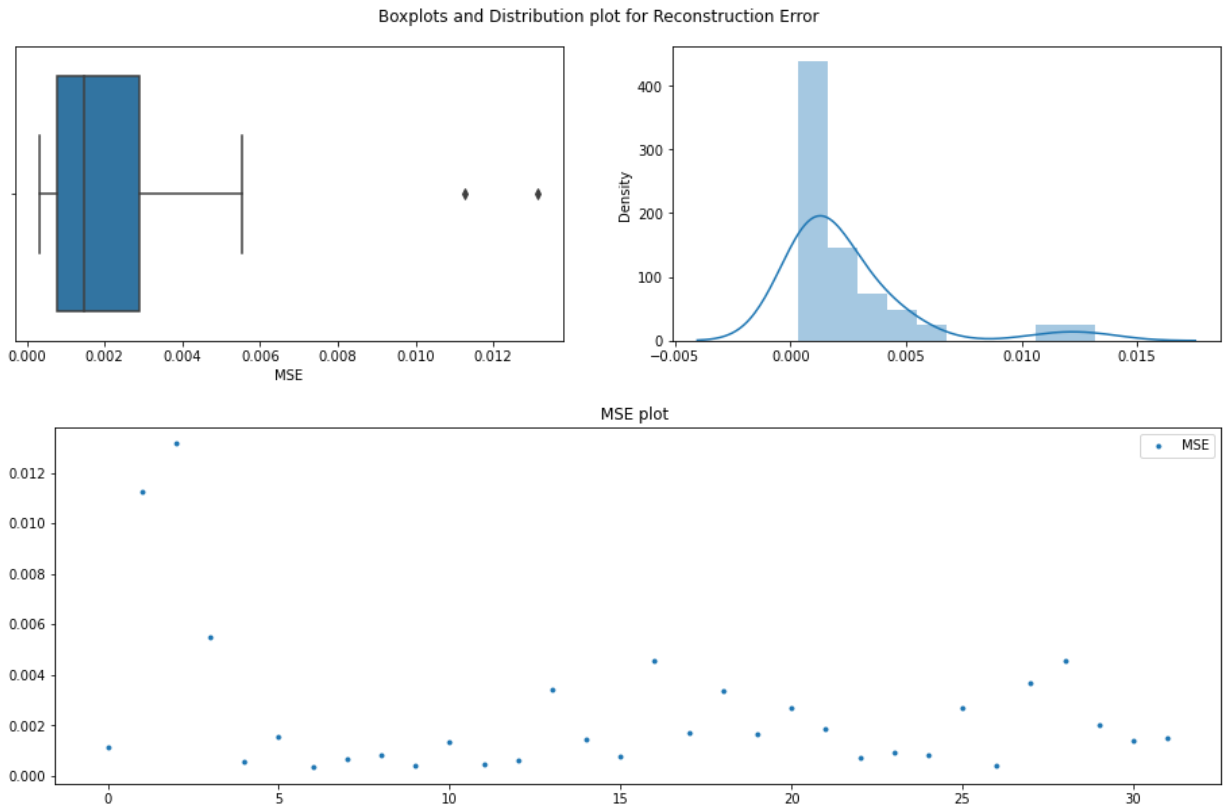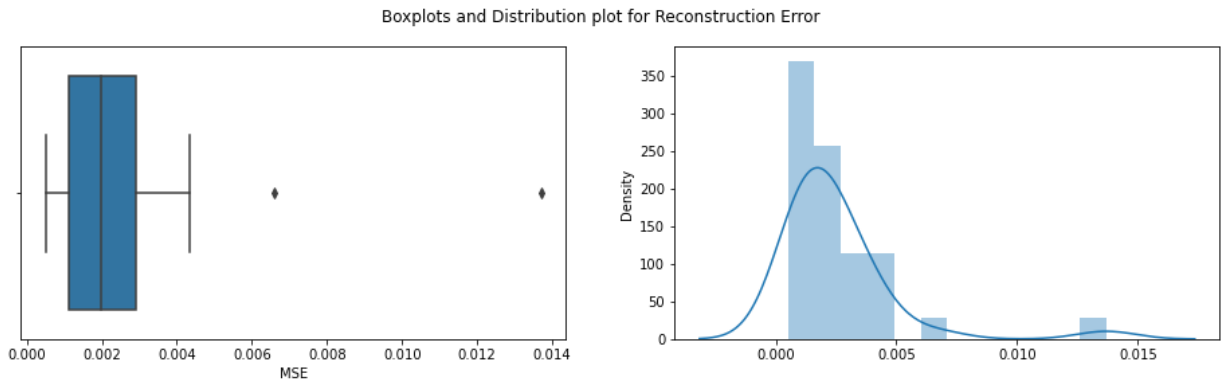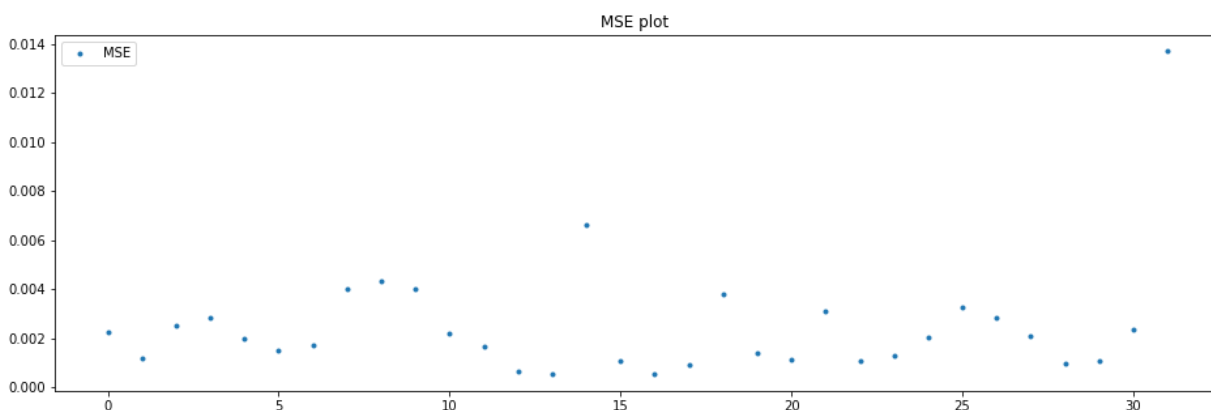
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 2.279
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
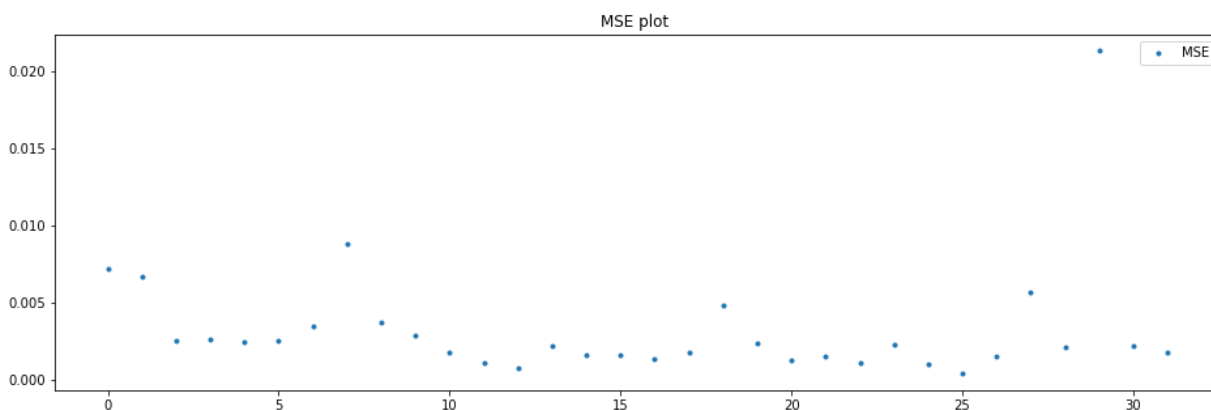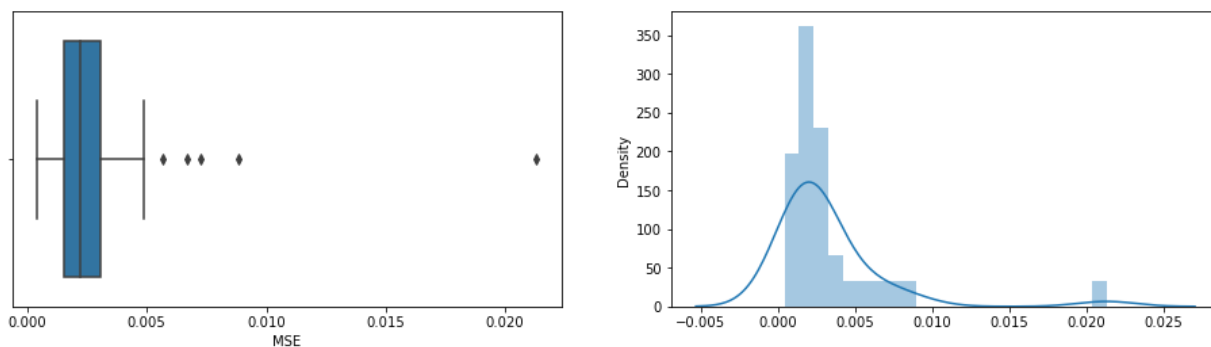5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

  ****
Batch: 2
mean=0.0023696875,median=0.00198 ,max=0.0124,min=0.0003,variance=5.4433e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.911
15.000: 0.523, data does not look normal (reject H0)
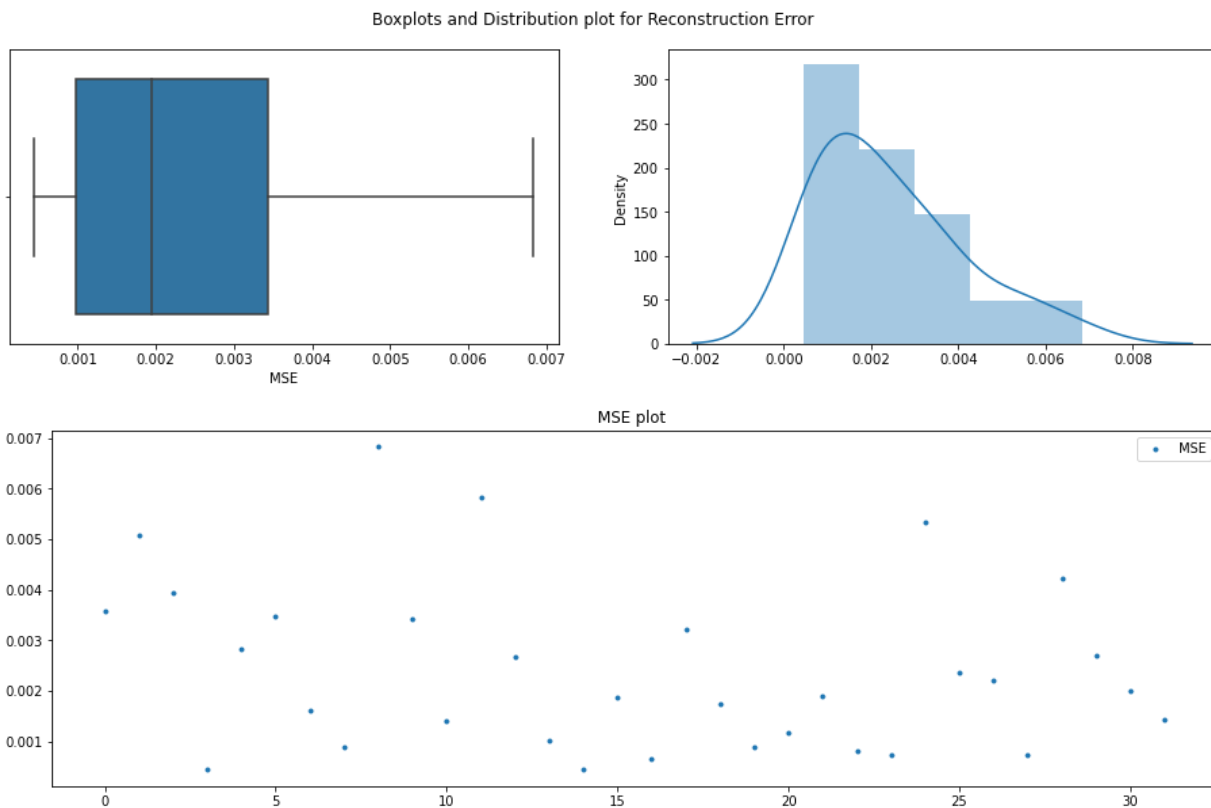10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

  ****
Batch: 3
mean=0.0028709375,median=0.00173 ,max=0.01142,min=0.0001,variance=7.9692e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 1.672
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


   ********************
Batch: 4
mean=0.005328125,median=0.003995 ,max=0.022,min=0.00028,variance=2.45135e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.448
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
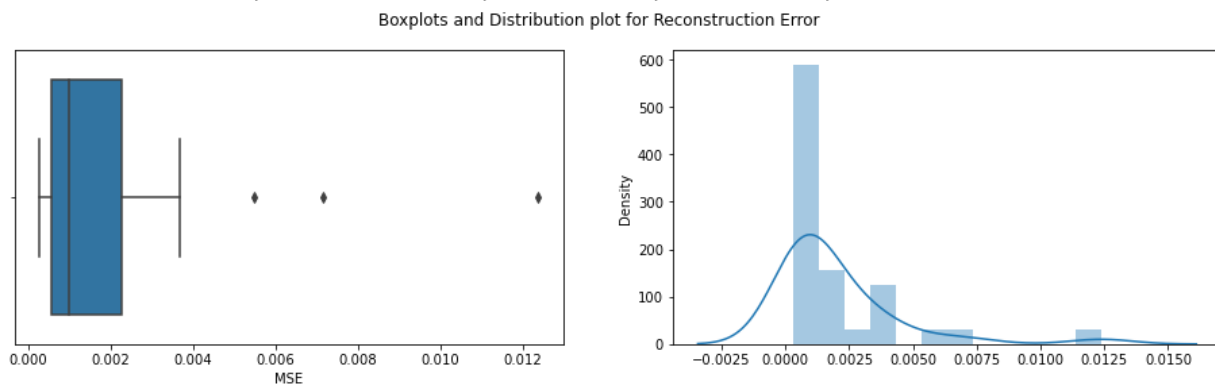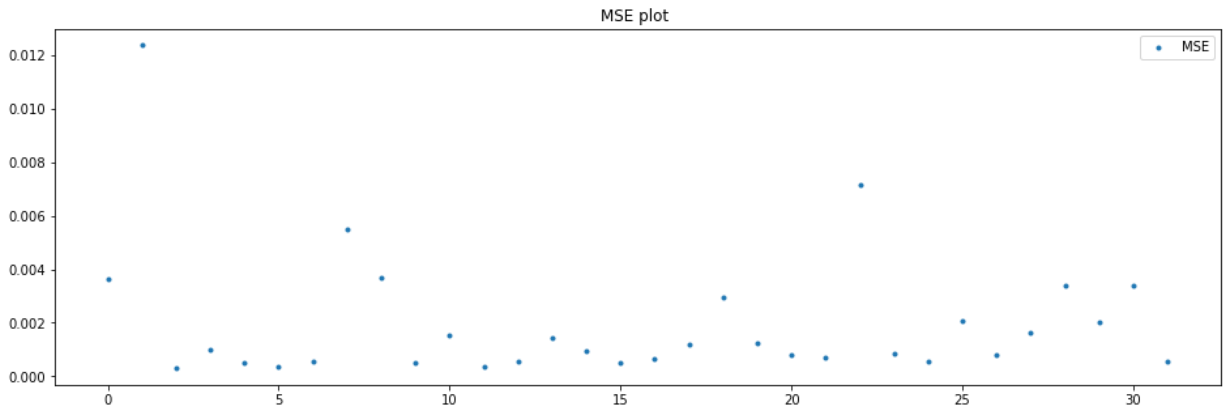5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 5
mean=0.00431,median=0.003455 ,max=0.01162,min=7e-05,variance=1.0743e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 0.755
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
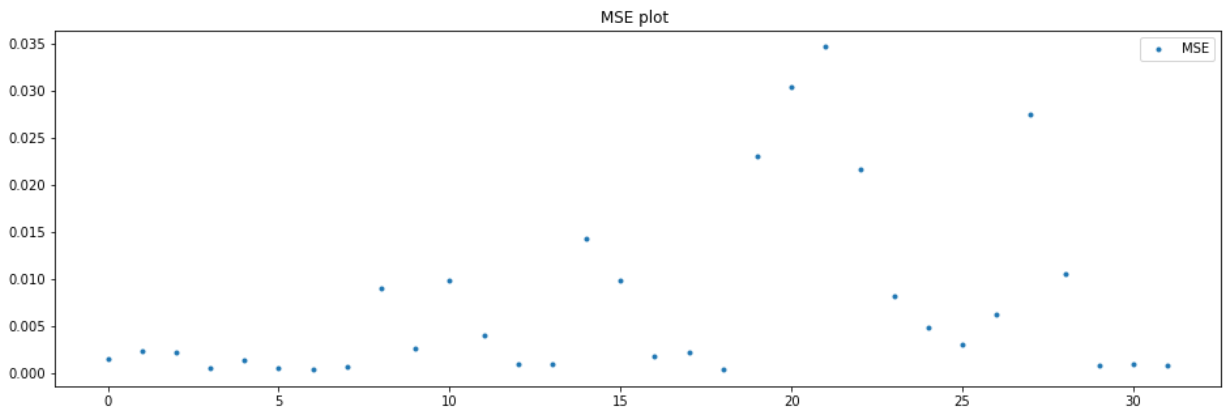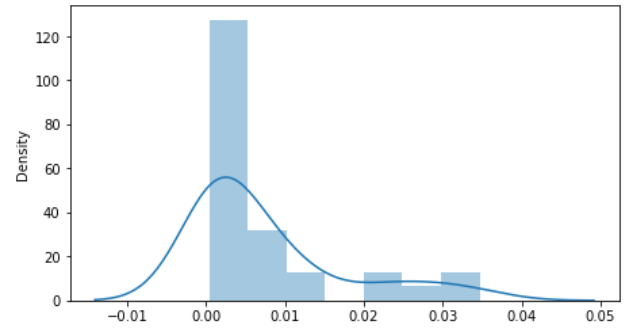5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

 ****
Batch: 6
mean=0.002450625,median=0.002145 ,max=0.00739,min=0.00018,variance=3.5167e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 0.868
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 7
mean=0.0021046875,median=0.001295 ,max=0.01067,min=0.00012,variance=4.6586e-06
```
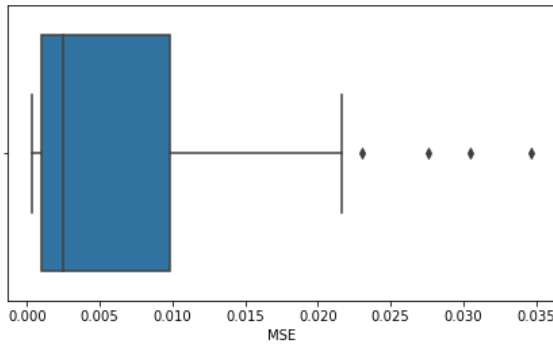
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 2.005
15.000: 0.523, data does not look normal (reject H0)
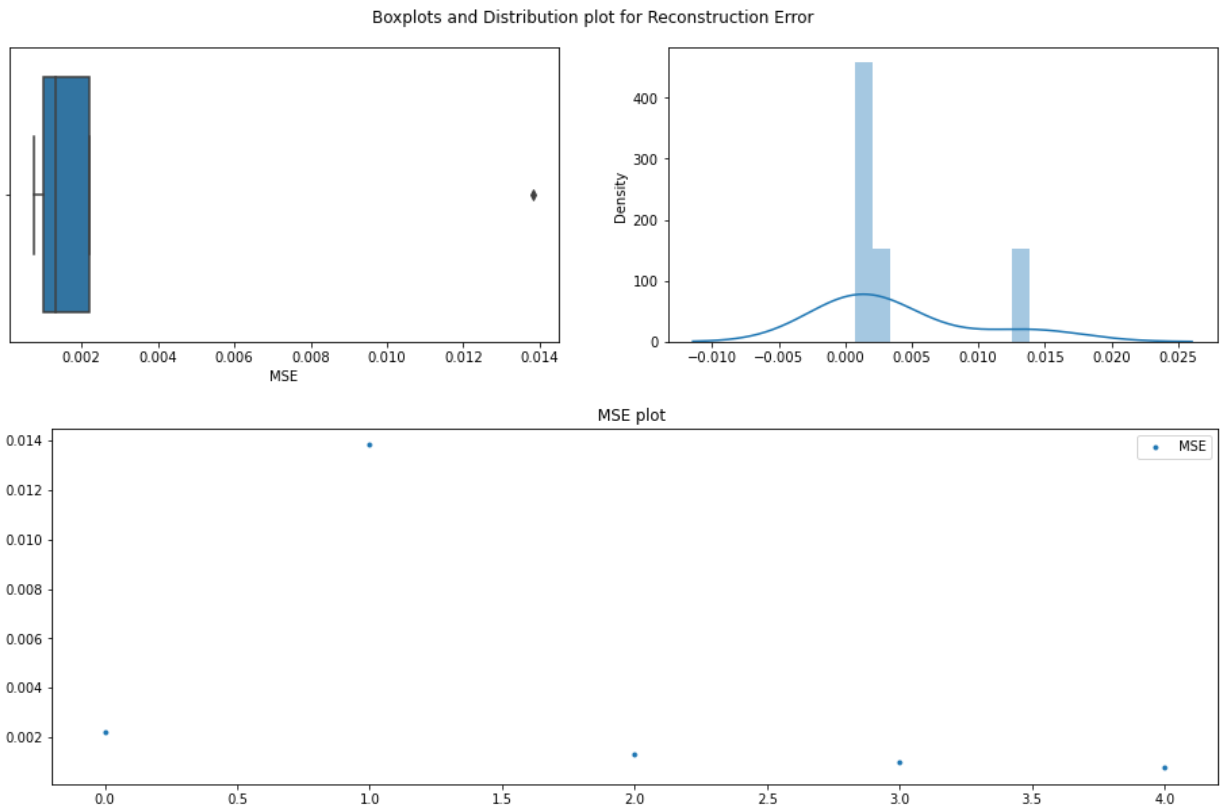10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 8
mean=0.0037584375,median=0.00264 ,max=0.01142,min=0.00015,variance=9.3118e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.173
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 9
mean=0.0057046875,median=0.00412 ,max=0.02242,min=0.00011,variance=2.14104e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.131
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 10
mean=0.003343125,median=0.002135 ,max=0.01215,min=0.00019,variance=9.8128e-06

Boxplots and Distribution plot for Reconstruction Error

Anderson_Darling Test
Statistic: 1.955
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 11
mean=0.0025178125,median=0.00182 ,max=0.01119,min=0.00036,variance=4.8888e-06

Anderson_Darling Test
Statistic: 1.810
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 12
mean=0.002724375,median=0.00218 ,max=0.01148,min=0.00011,variance=6.2701e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot


```
Anderson_Darling Test
Statistic: 1.319
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *********************
Batch: 13
mean=0.0039259375,median=0.00274 ,max=0.01756,min=0.00034,variance=1.31405e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.619
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 14
mean=0.003563125,median=0.002525 ,max=0.01212,min=0.0002,variance=1.01678e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 2.093
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 15
mean=0.00281,median=0.00195 ,max=0.01816,min=0.00028,variance=9.8251e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
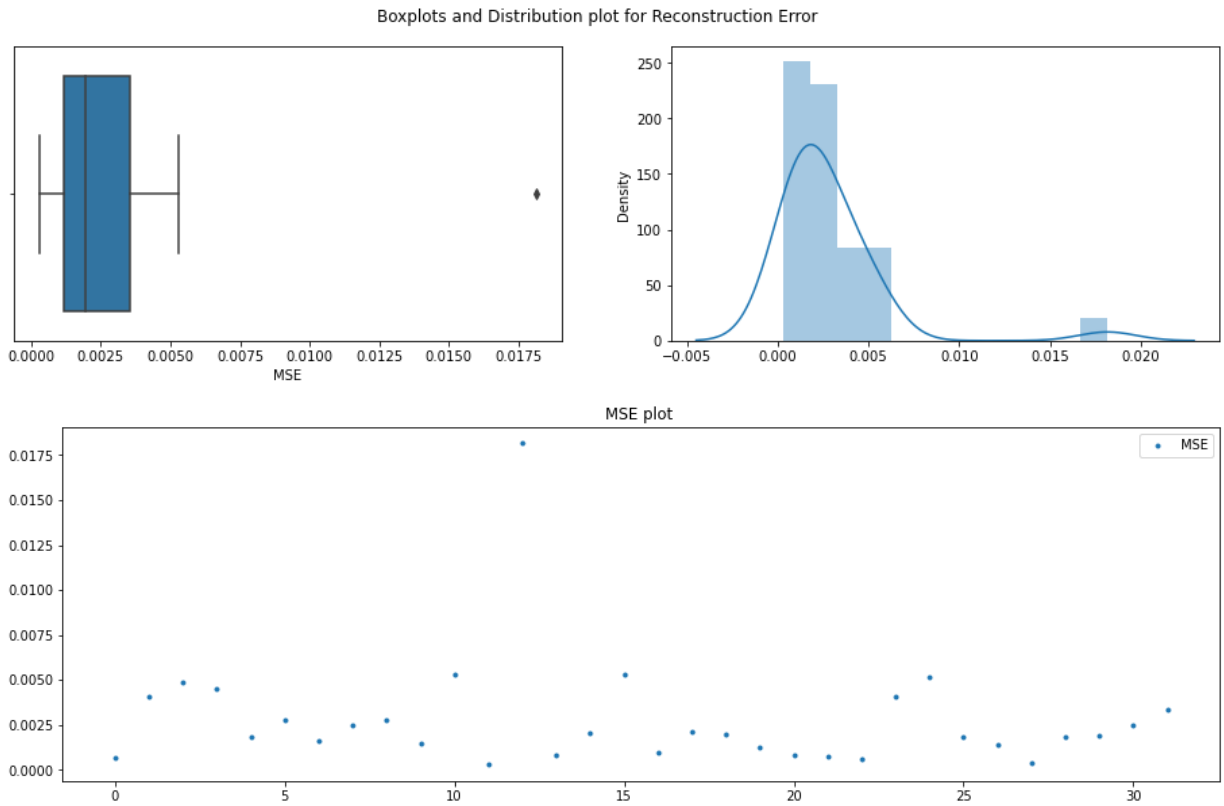

```
Anderson_Darling Test
Statistic: 3.169
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 16
mean=0.00357375,median=0.002055 ,max=0.01374,min=0.0004,variance=1.08909e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
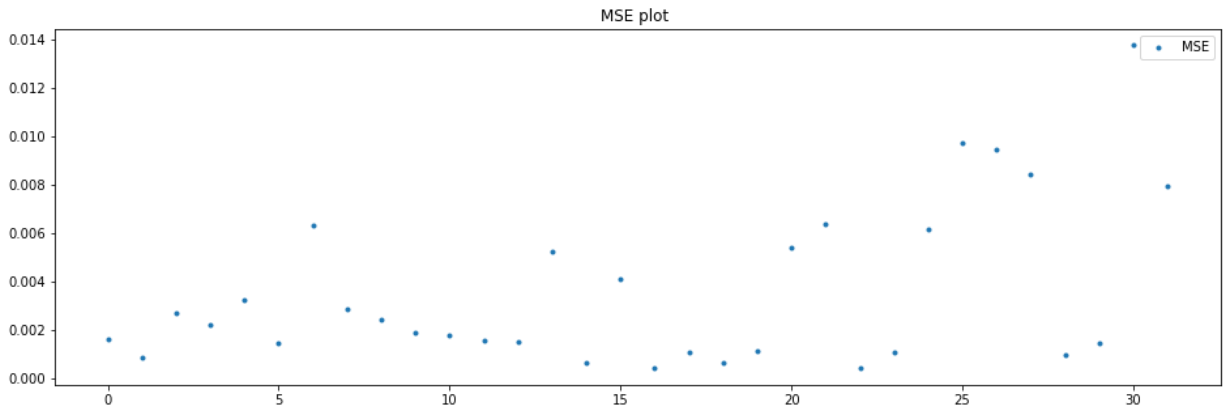
```
Anderson_Darling Test
Statistic: 1.990
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


  *******************

Batch: 17
mean=0.00399375,median=0.00285  ,max=0.01365,min=0.00014,variance=1.29799e-05
```


Boxplots and Distribution plot for Reconstruction Error

MSE plot
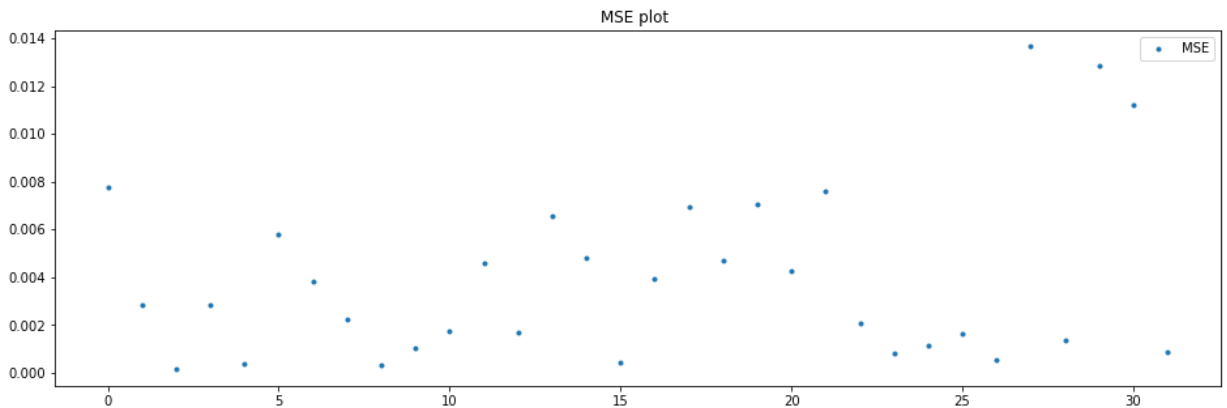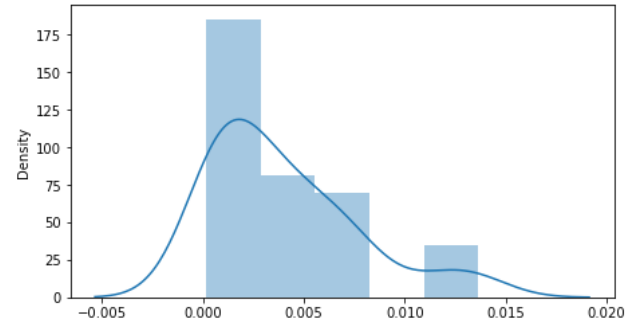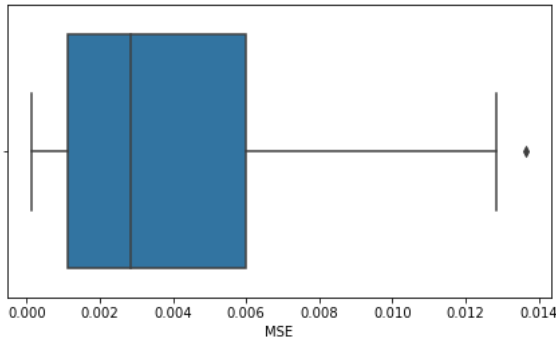
```
Anderson_Darling Test
Statistic: 1.316
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


  *******************

Batch: 18
mean=0.0035190625,median=0.002155  ,max=0.01092,min=0.00023,variance=8.2015e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
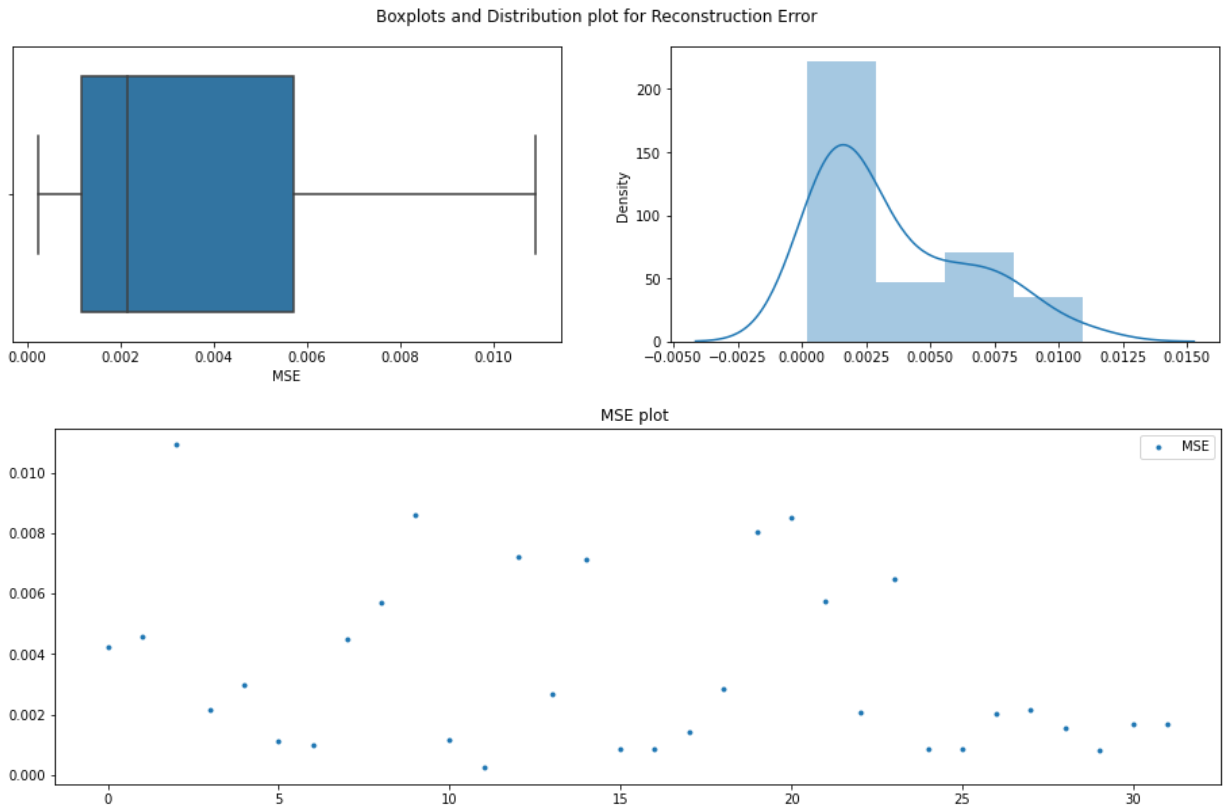

```
Anderson_Darling Test
Statistic: 1.664
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 19
mean=0.001934375,median=0.00145 ,max=0.00707,min=0.00039,variance=2.8108e-06
```
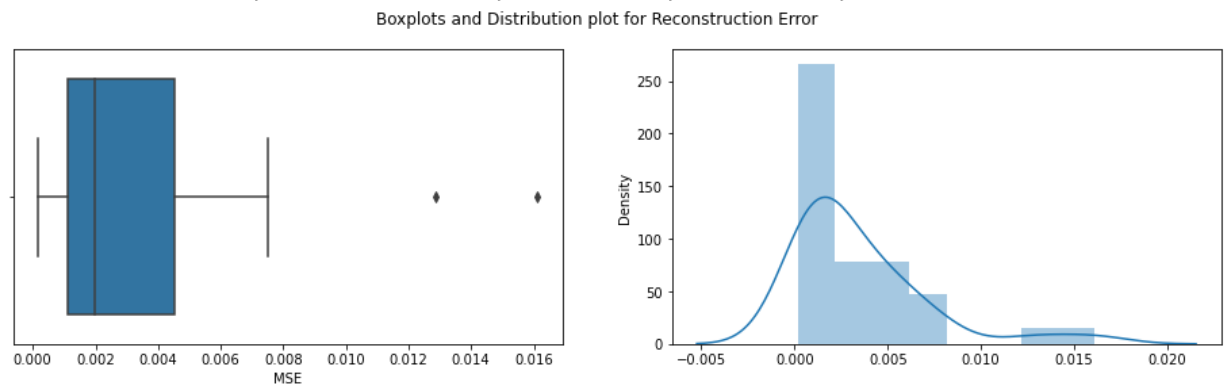
Boxplots and Distribution plot for Reconstruction Error

MSE plot
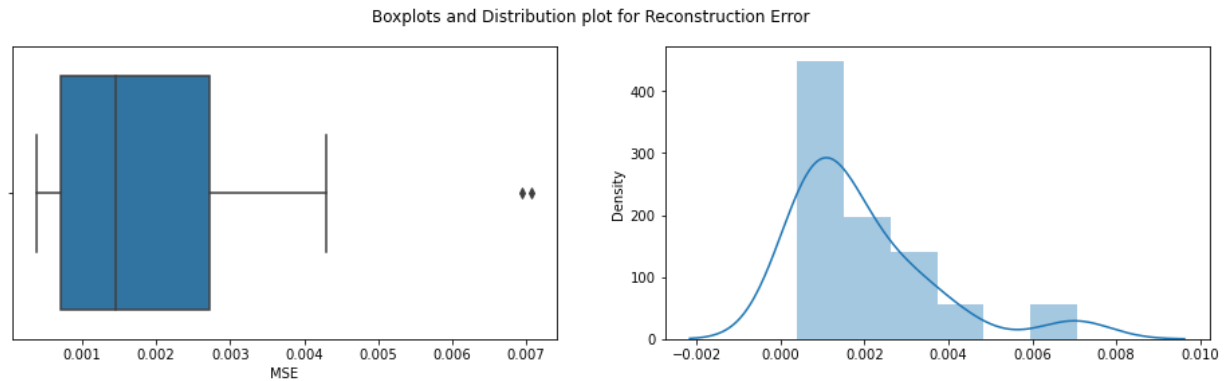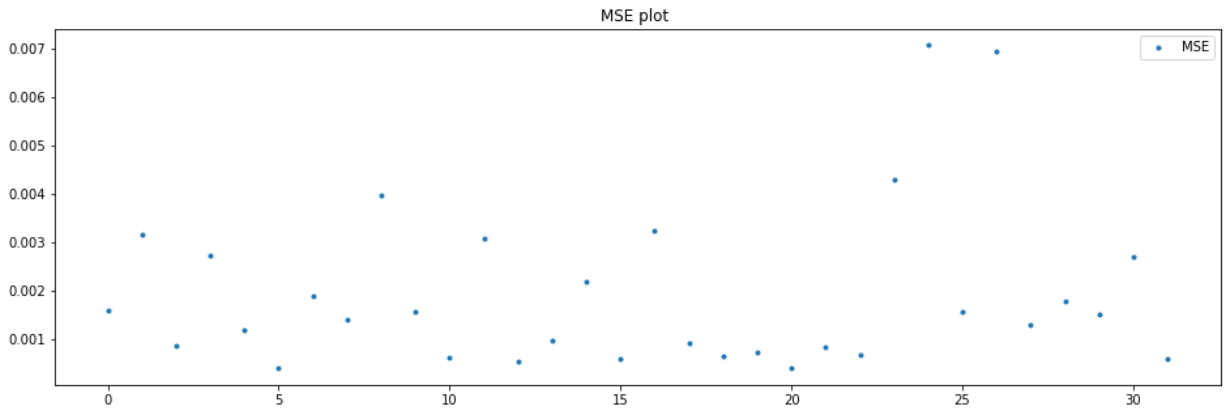
```
Anderson_Darling Test
Statistic: 2.132
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 20
mean=0.0058921875,median=0.00582 ,max=0.01666,min=0.00025,variance=1.80465e-05
```
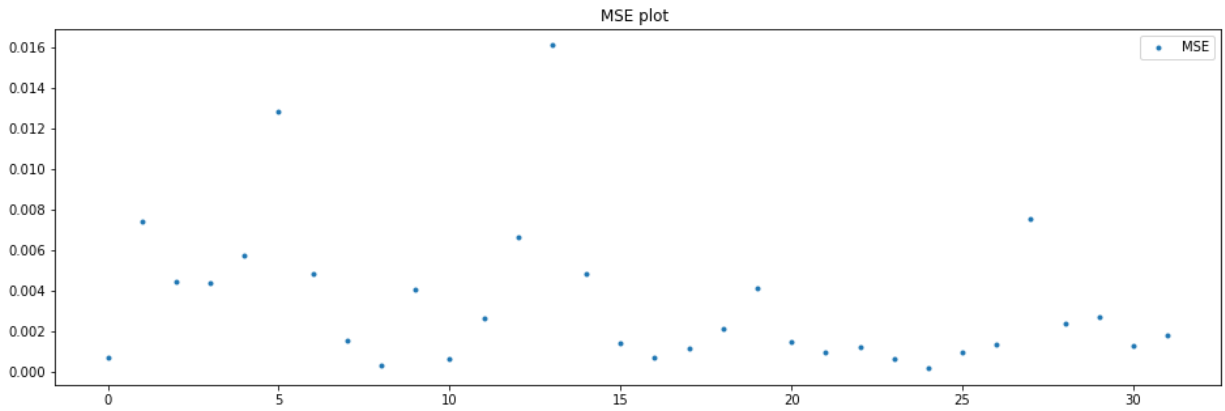

Boxplots and Distribution plot for Reconstruction Error

MSE plot
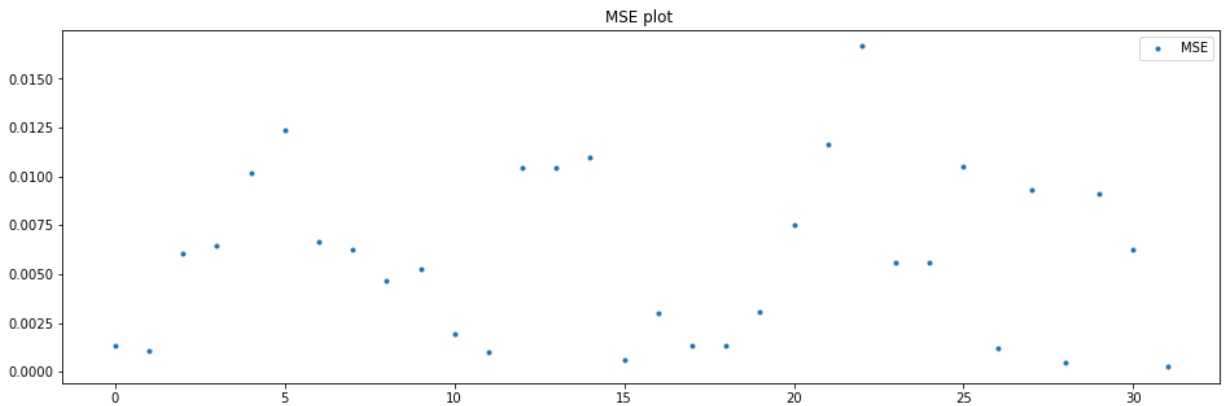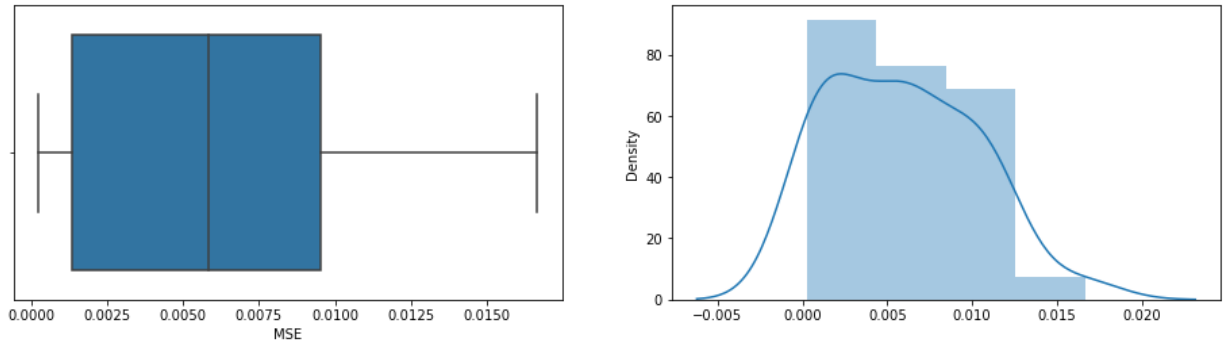
```
Anderson_Darling Test
Statistic: 0.722
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 *******************
Batch: 21
mean=0.0043296875,median=0.00299 ,max=0.01637,min=0.00052,variance=1.52694e-05
```
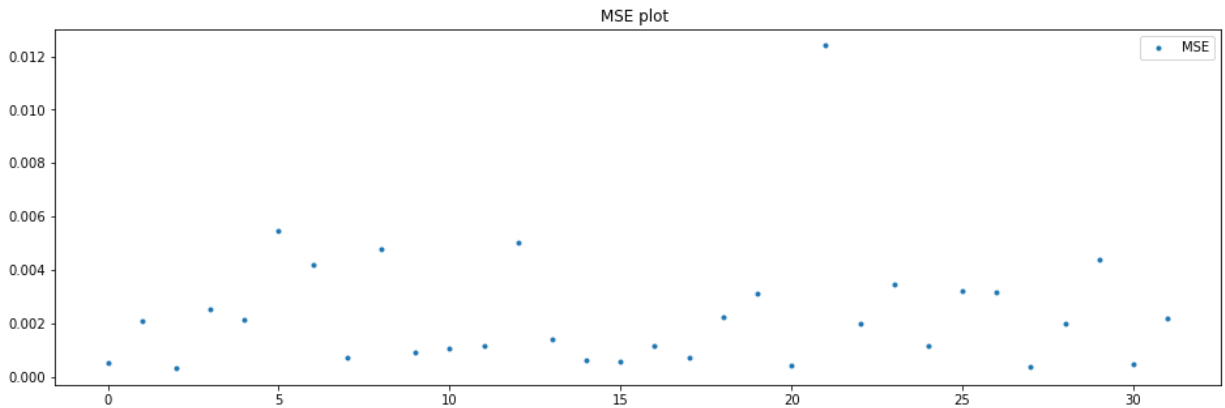
Boxplots and Distribution plot for Reconstruction Error

MSE plot
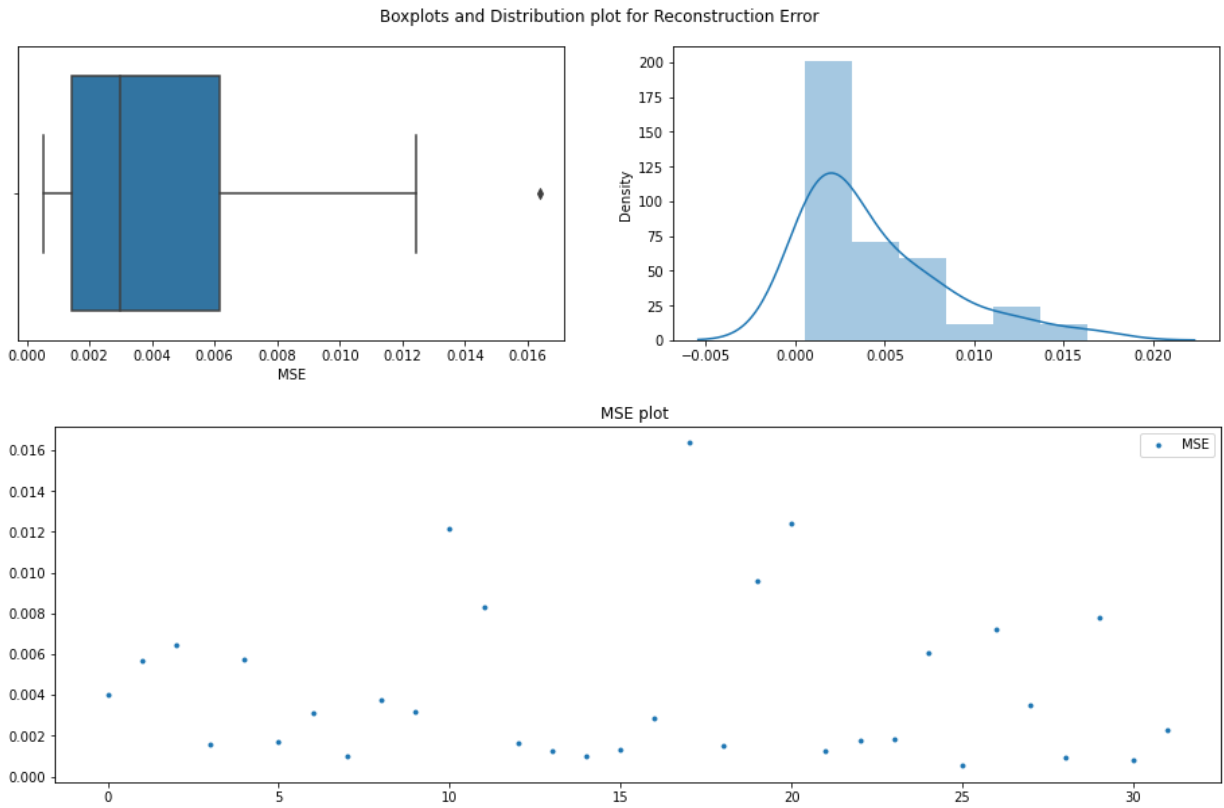

```
Anderson_Darling Test
Statistic: 1.886
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 22
mean=0.00187625,median=0.001175 ,max=0.00994,min=0.00028,variance=3.5638e-06
```
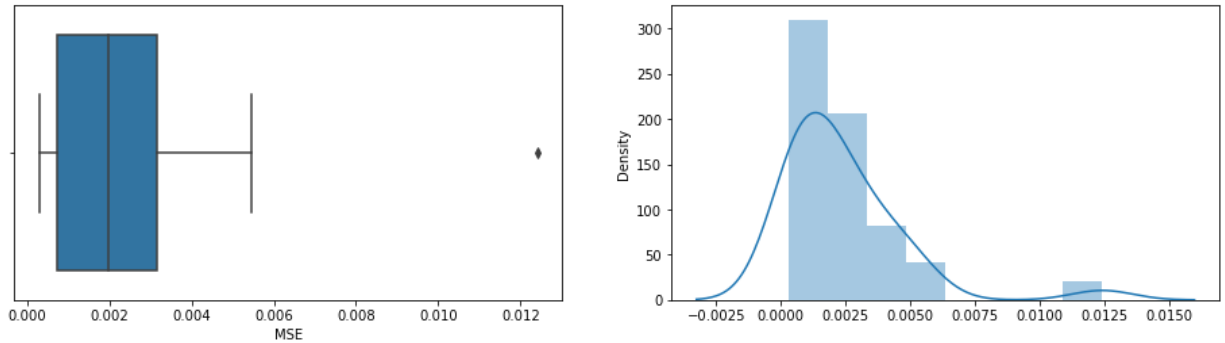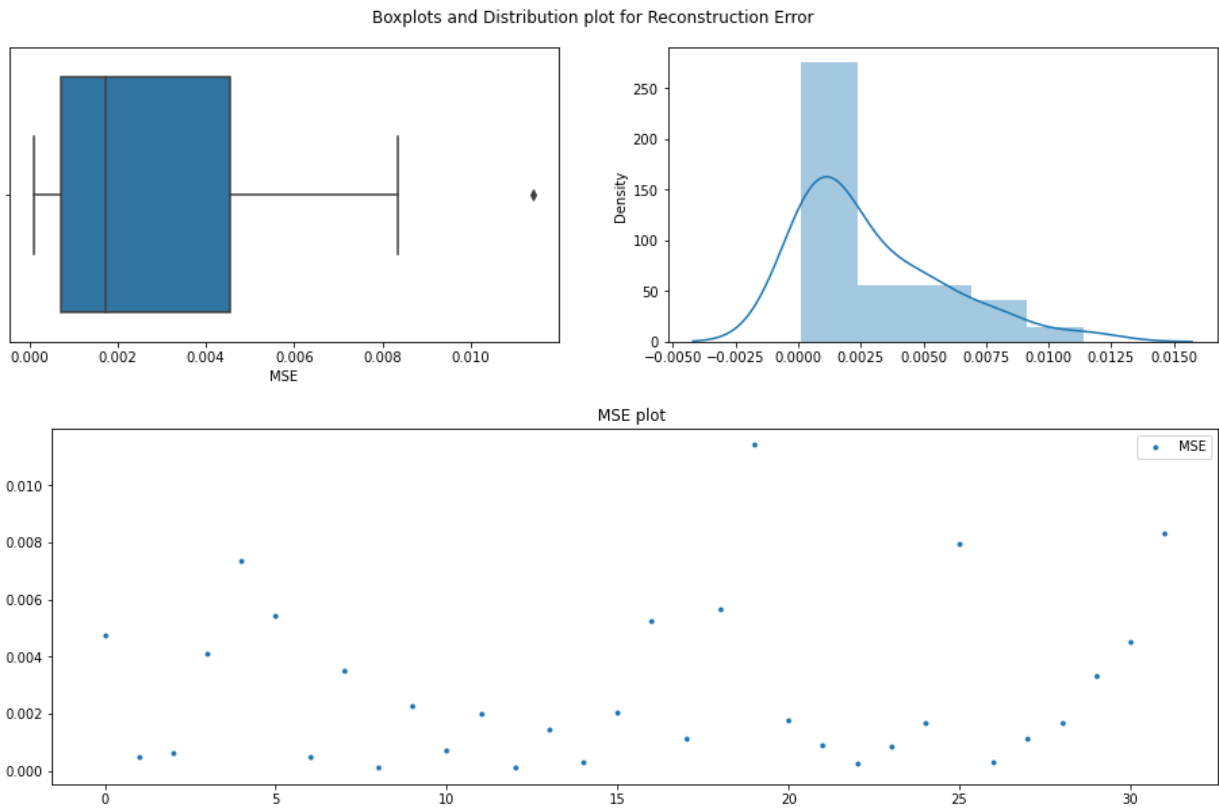
Boxplots and Distribution plot for Reconstruction Error

MSE plot
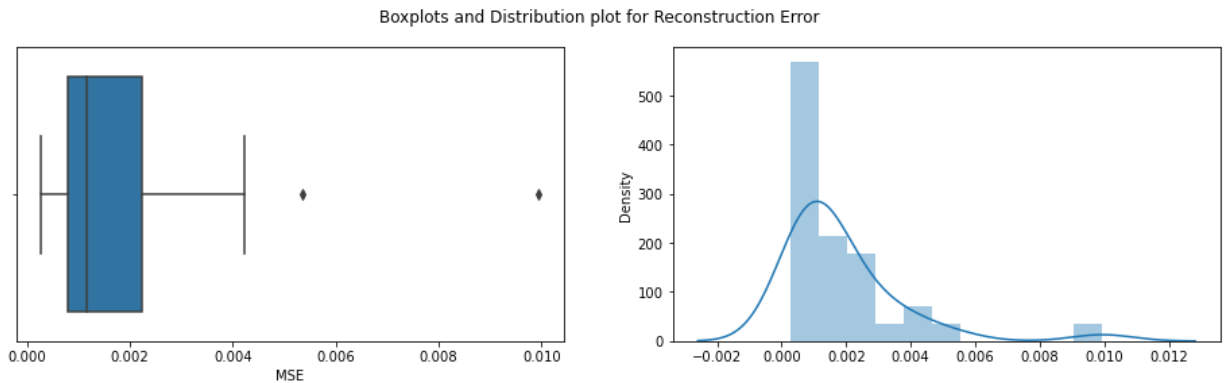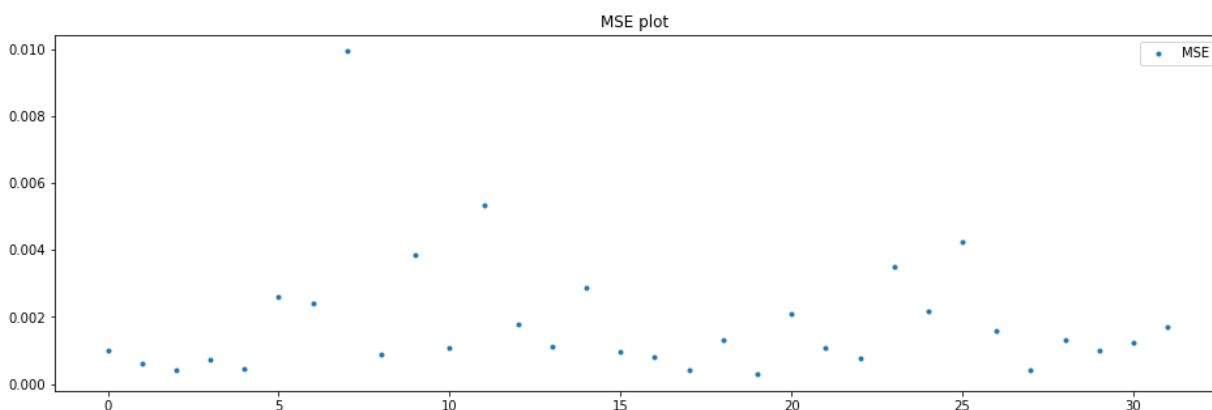
Anderson_Darling Test
Statistic: 2.665
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

  ****
Batch: 23
mean=0.002481875,median=0.00159 ,max=0.00888,min=0.00026,variance=4.5788e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
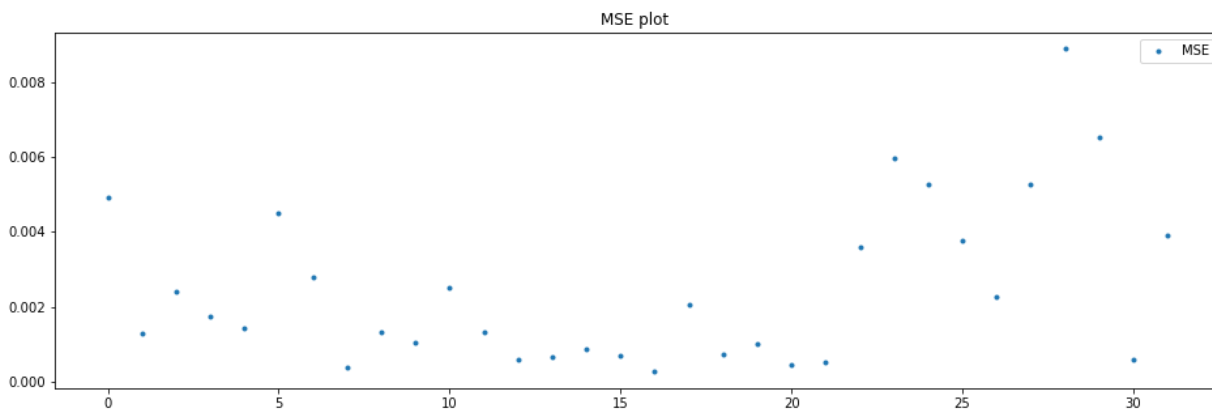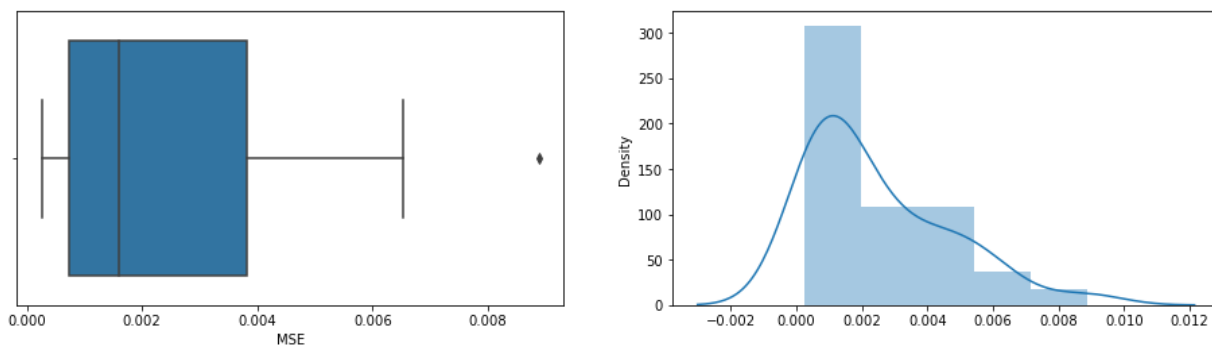
Anderson_Darling Test
Statistic: 1.516
15.000: 0.523, data does not look normal (reject H0)
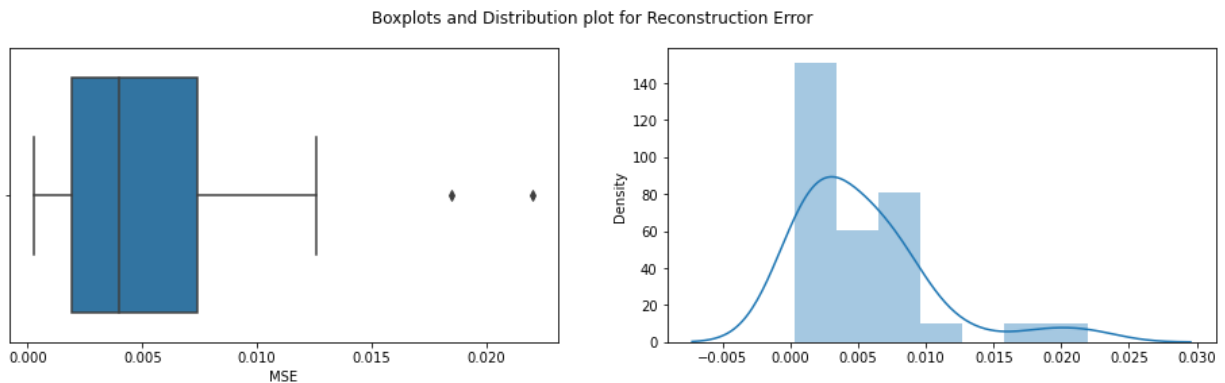10.000: 0.596, data does not look normal (reject H0)
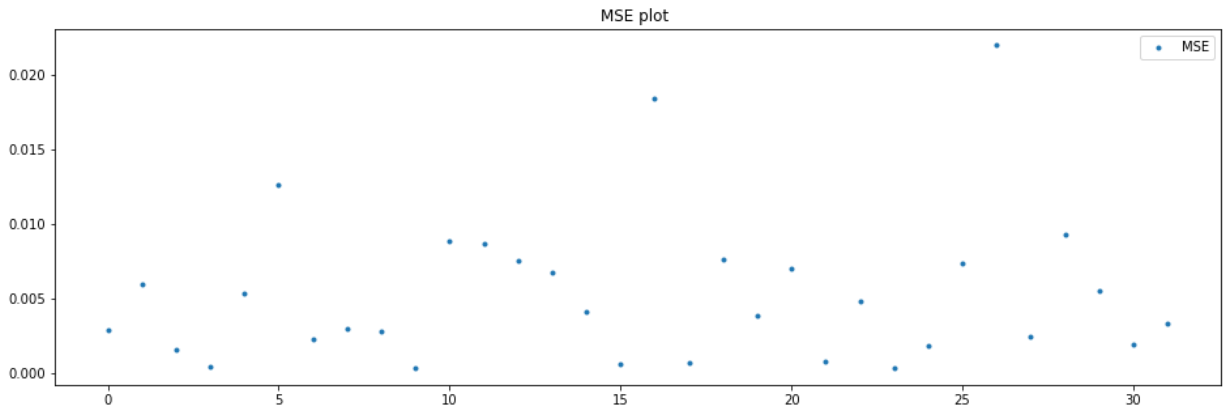5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

  ****
Batch: 24
mean=0.0037928125,median=0.003565 ,max=0.01127,min=0.00013,variance=9.5293e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
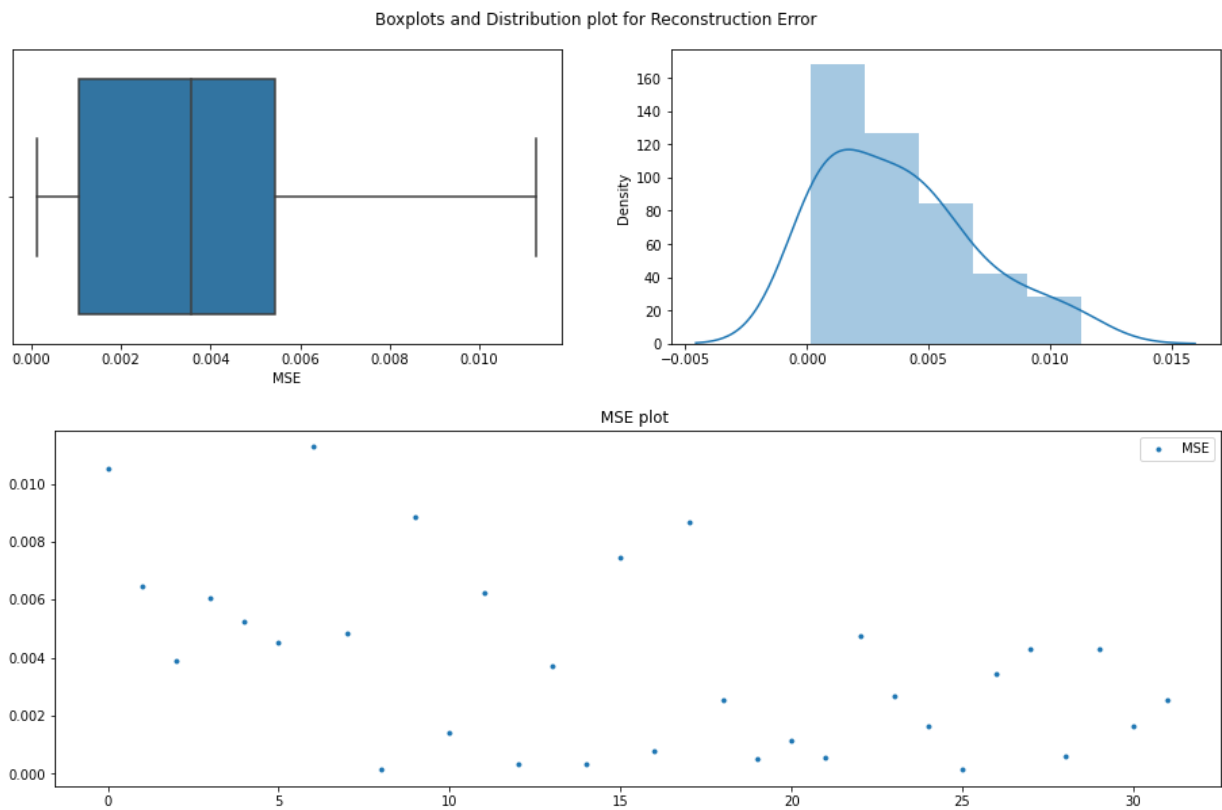

```
Anderson_Darling Test
Statistic: 0.753
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


  ********************
Batch: 25
mean=0.0032084375,median=0.00235 ,max=0.00907,min=0.00021,variance=5.6306e-06
```
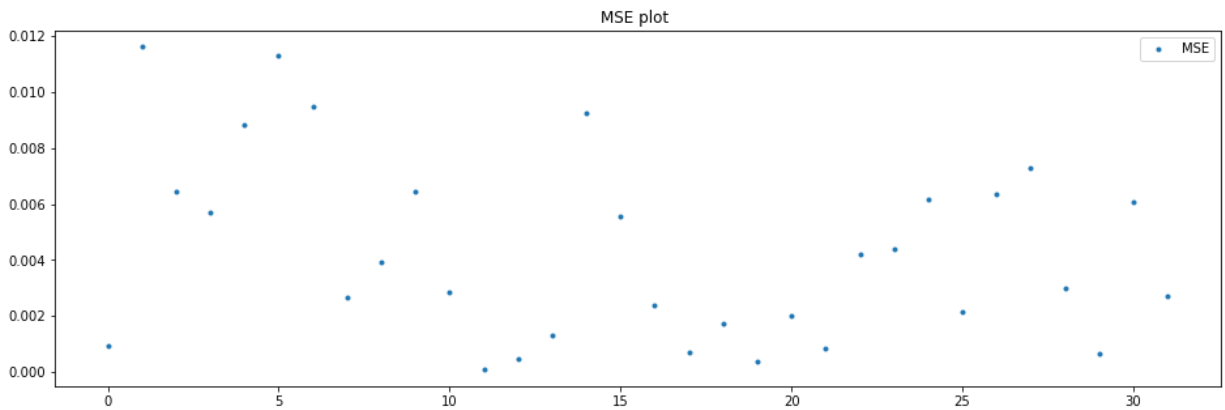
Boxplots and Distribution plot for Reconstruction Error

MSE plot
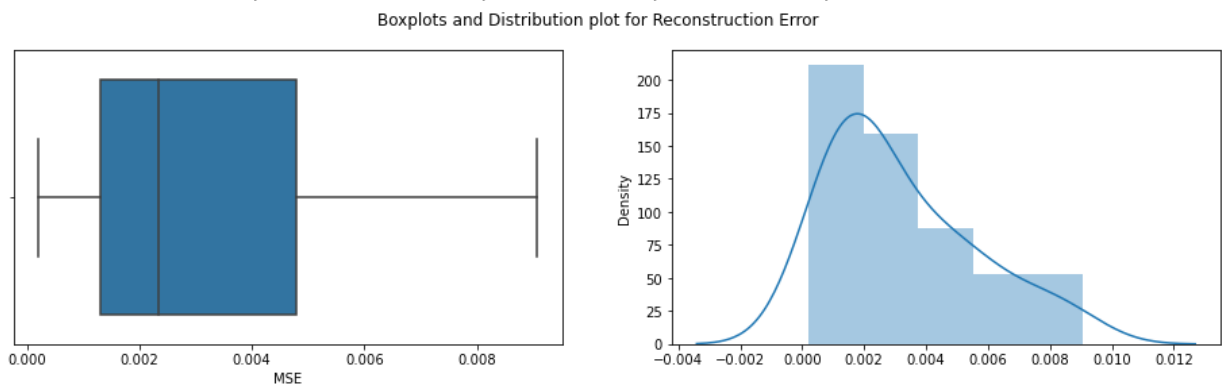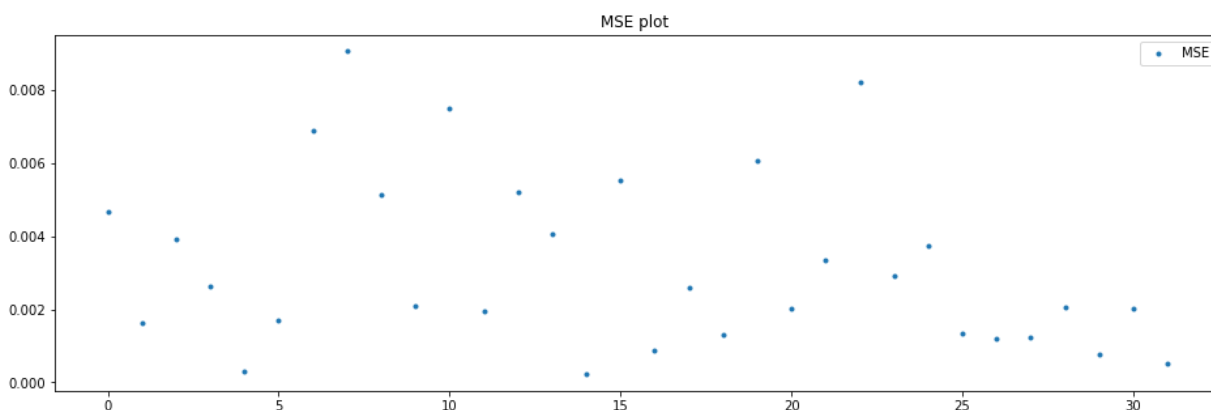
Anderson_Darling Test
Statistic: 0.997
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
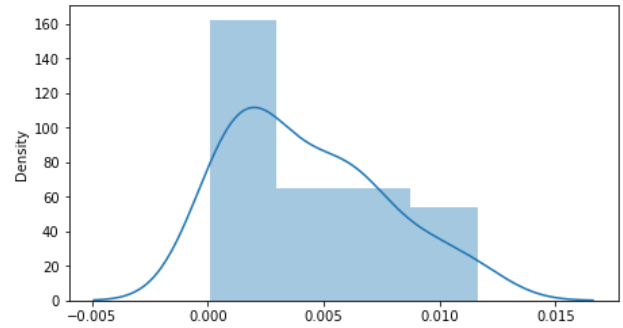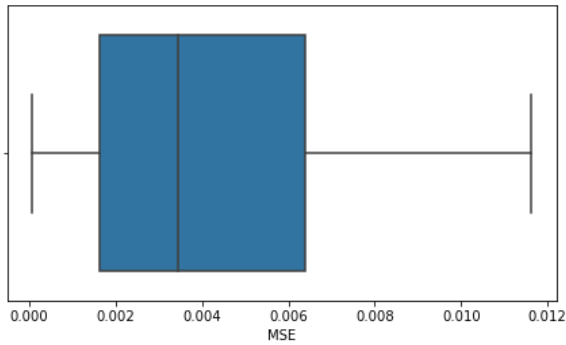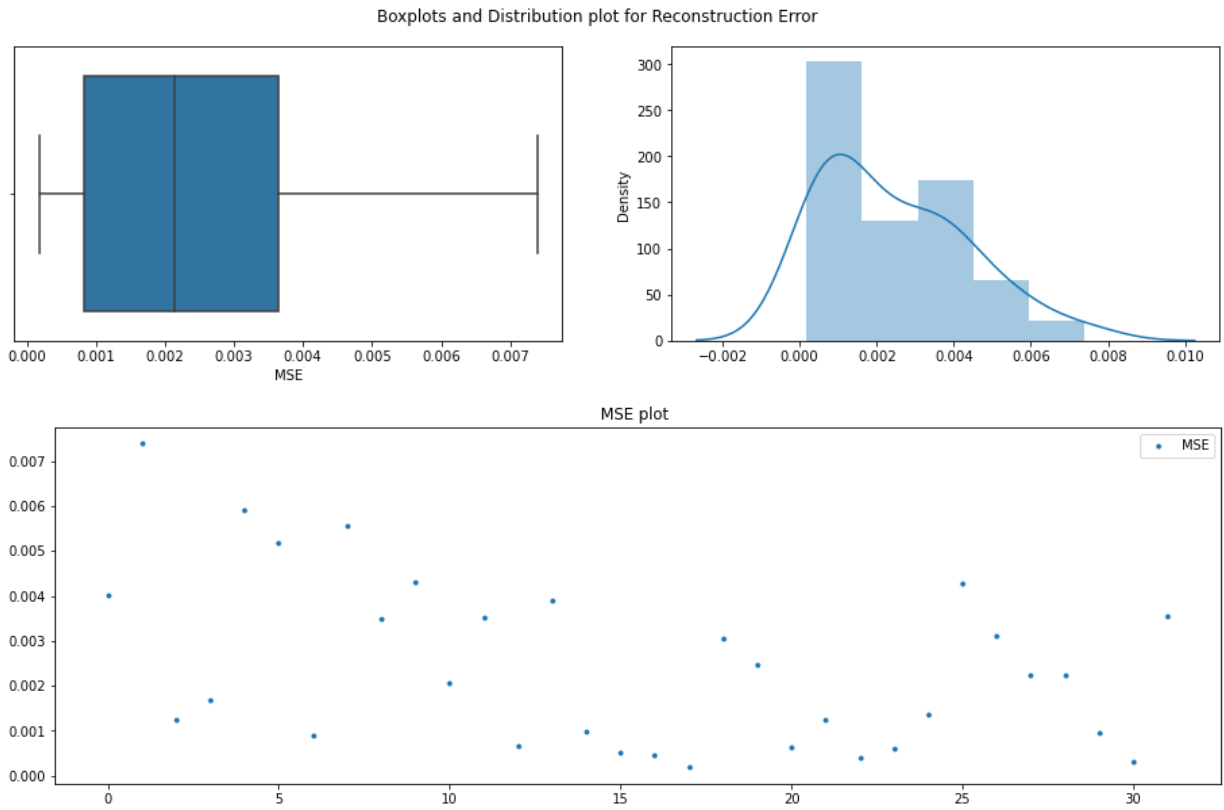5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 26
mean=0.001563125,median=0.00105 ,max=0.0081,min=0.00029,variance=2.413e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
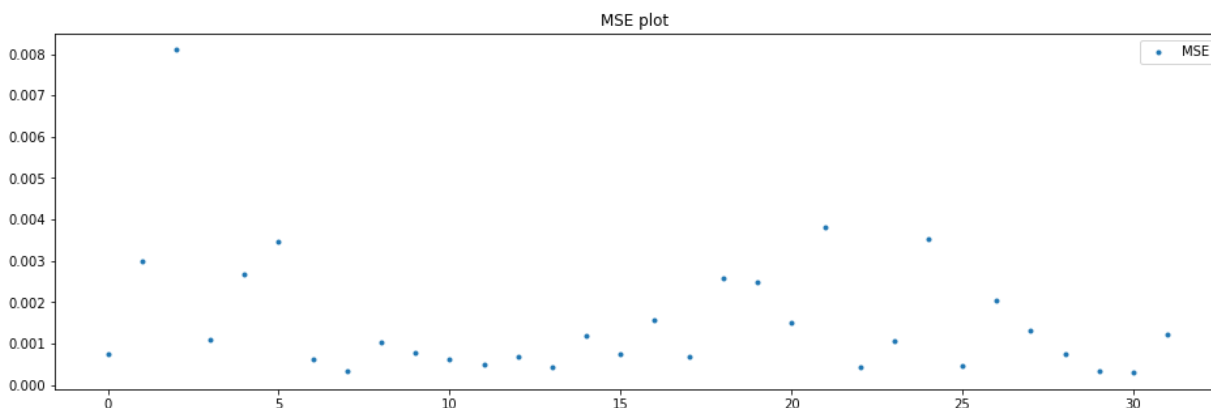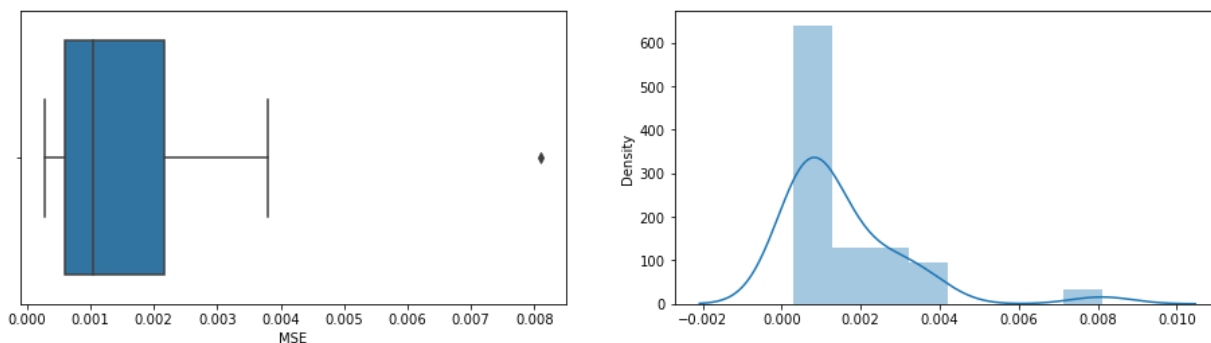
Anderson_Darling Test
Statistic: 2.513
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 27
mean=0.002515625,median=0.001635 ,max=0.00716,min=0.0004,variance=4.6668e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
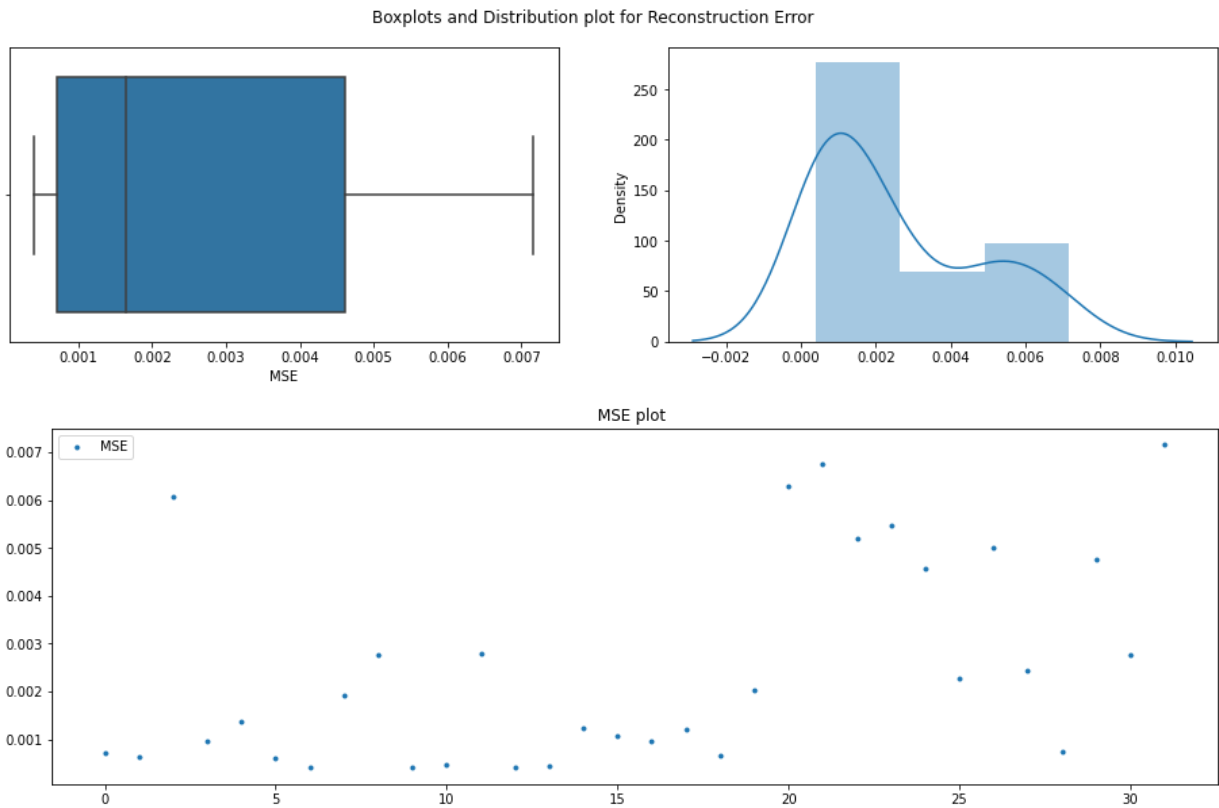

```
Anderson_Darling Test
Statistic: 1.952
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 28
mean=0.003371875,median=0.00251 ,max=0.01232,min=0.0002,variance=1.03672e-05
```
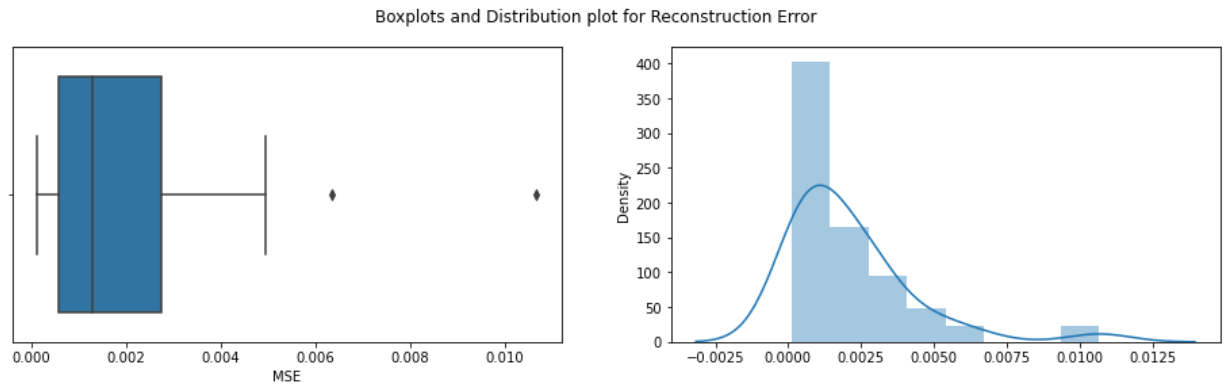
Boxplots and Distribution plot for Reconstruction Error

MSE plot
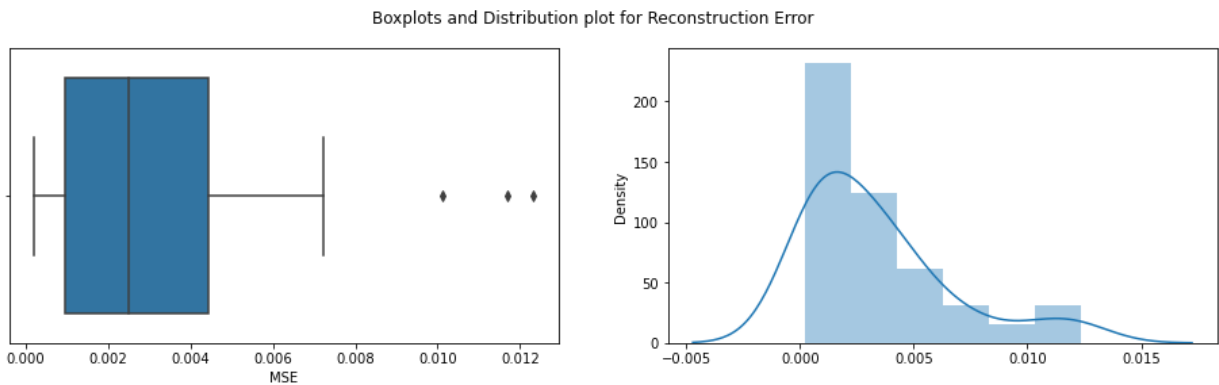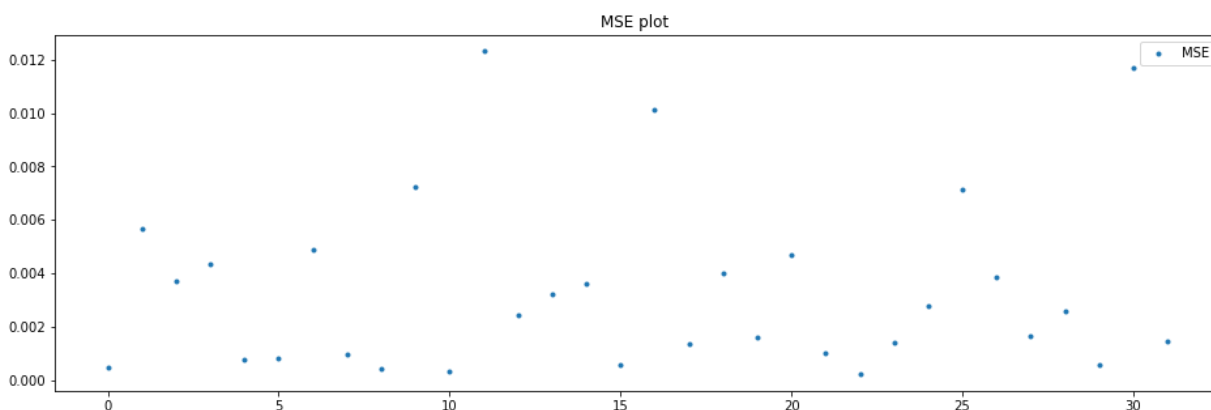
```
Anderson_Darling Test
Statistic: 1.756
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 29
mean=0.0048175,median=0.00322 ,max=0.01527,min=0.00022,variance=1.91866e-05
```
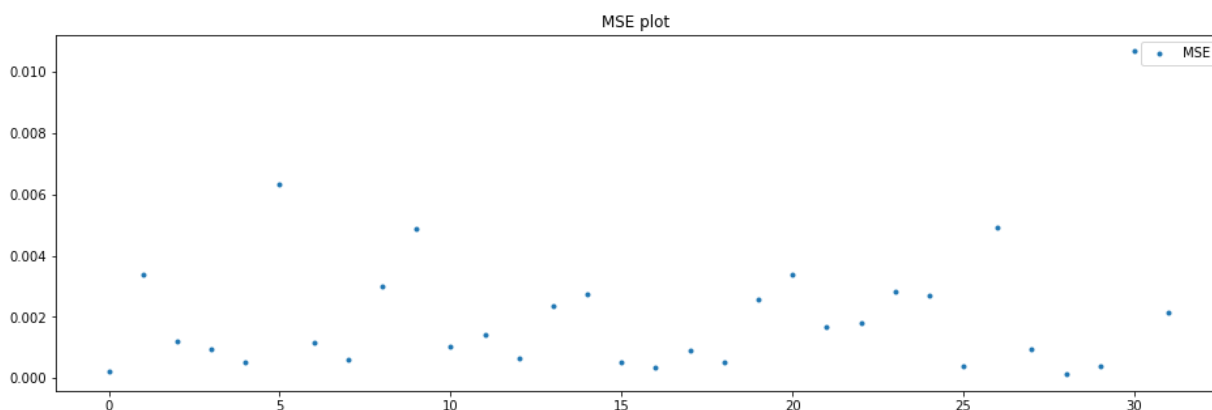

Boxplots and Distribution plot for Reconstruction Error

MSE plot
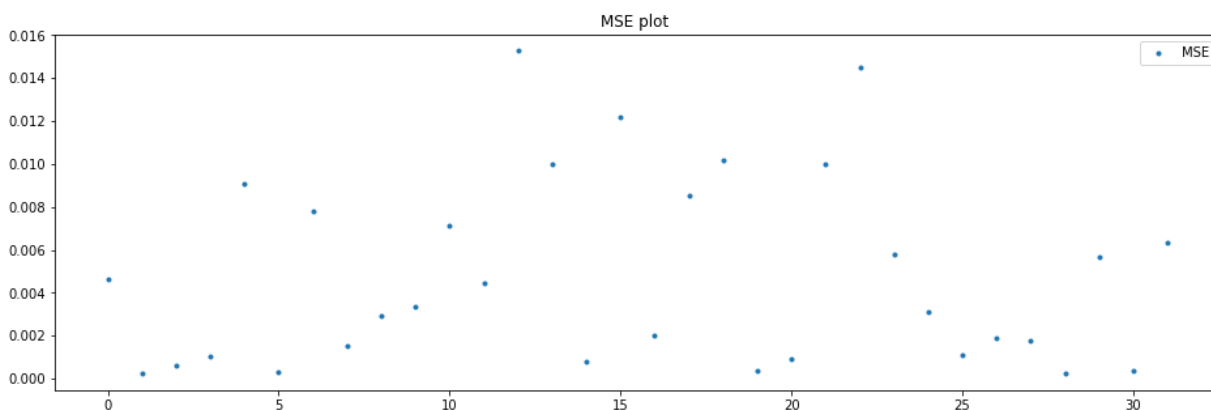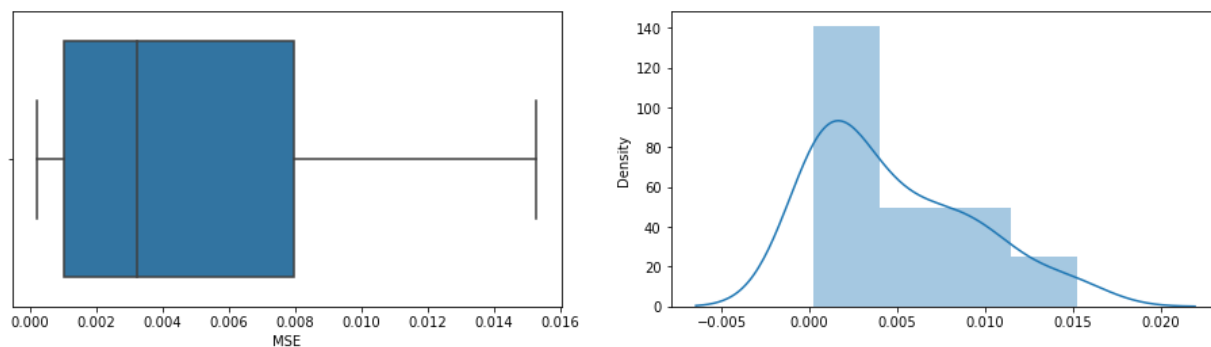
```
Anderson_Darling Test
Statistic: 1.256
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 30
mean=0.003246875,median=0.002975 ,max=0.00959,min=0.00032,variance=4.7661e-06
```
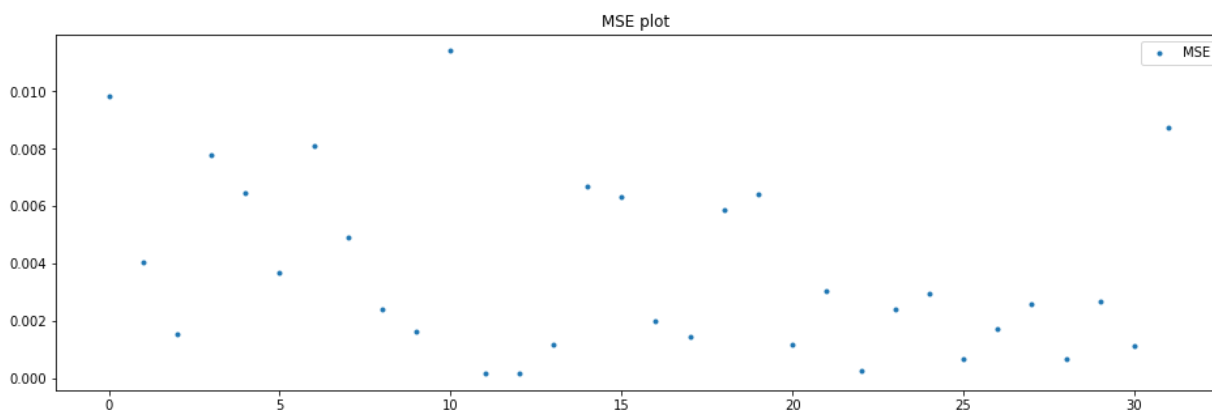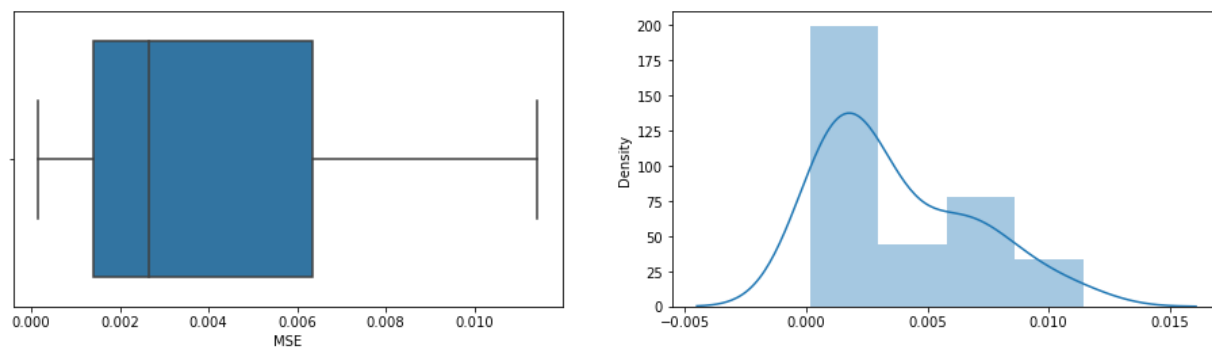
Boxplots and Distribution plot for Reconstruction Error

MSE plot
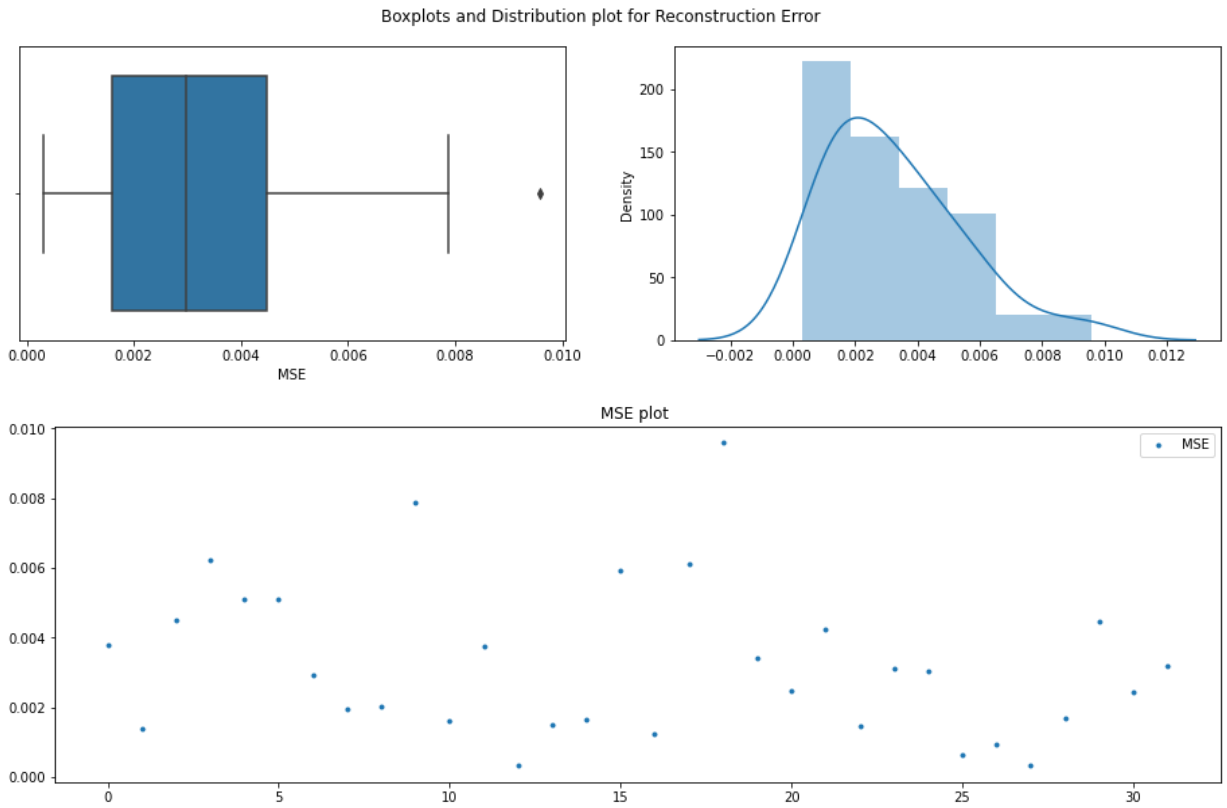

```
Anderson_Darling Test
Statistic: 0.650
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 31
mean=0.0019278125,median=0.00126 ,max=0.00994,min=0.00037,variance=3.4959e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
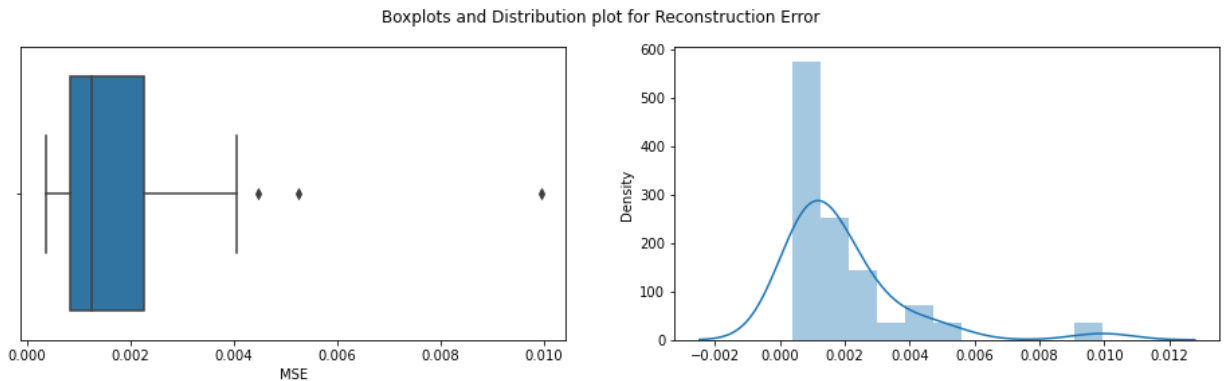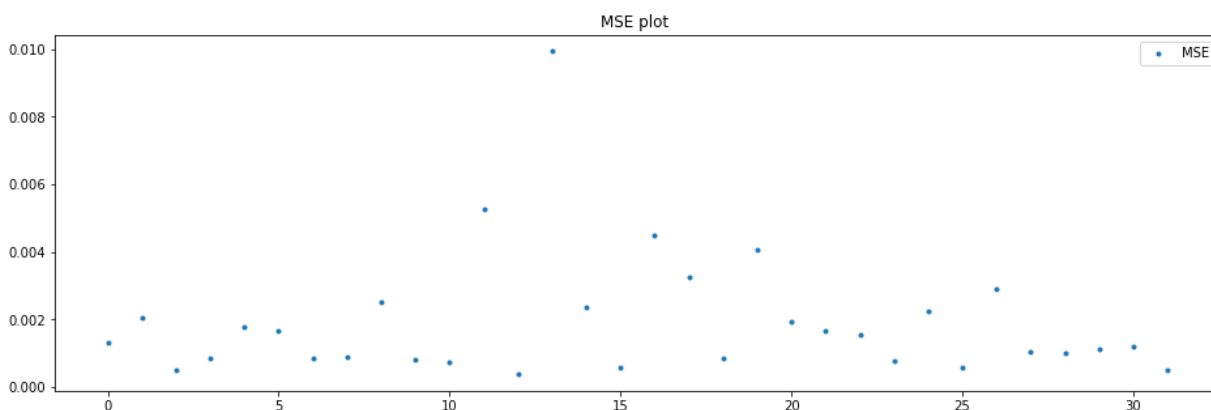
Anderson_Darling Test
Statistic: 2.705
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
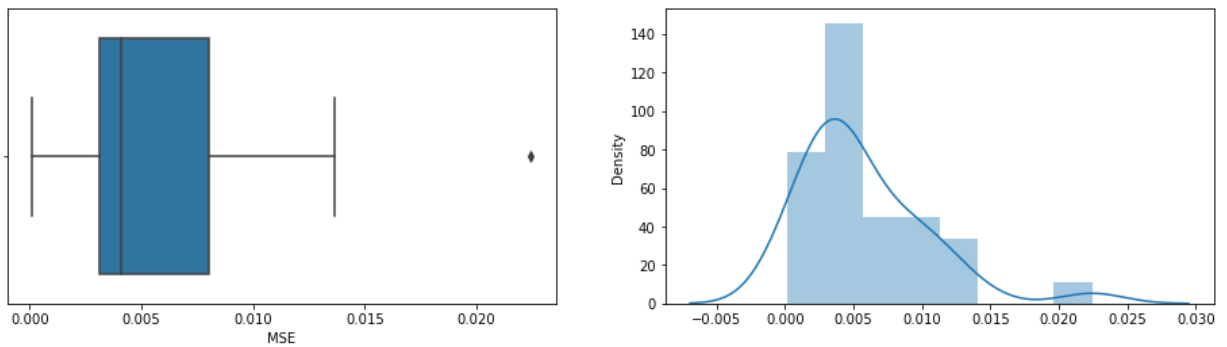5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
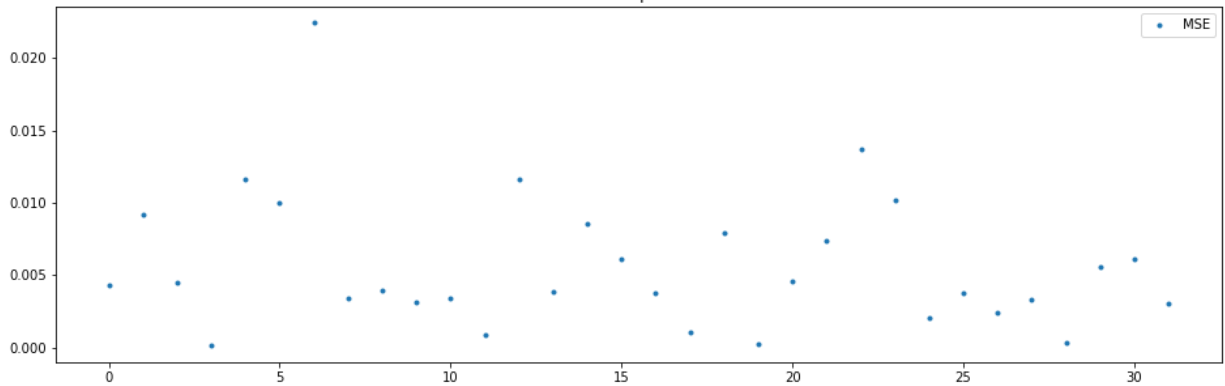1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 32
mean=0.0040971875,median=0.00243 ,max=0.02099,min=0.00013,variance=2.09647e-05

Boxplots and Distribution plot for Reconstruction Error
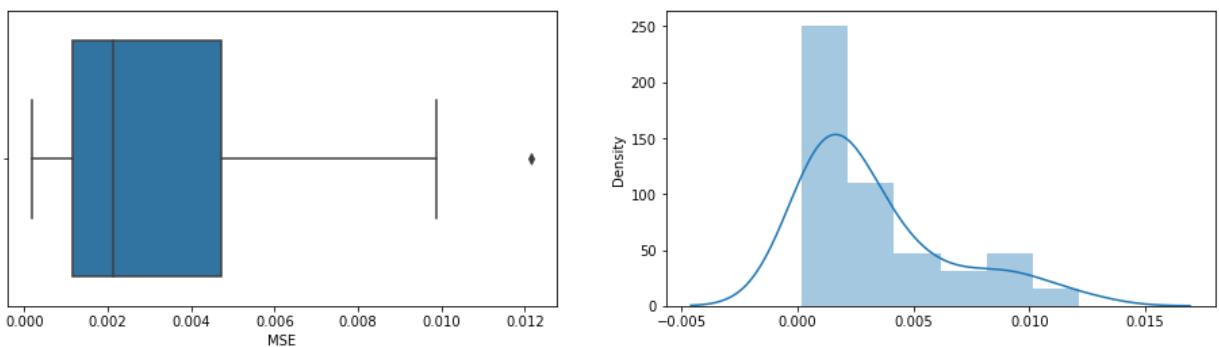

MSE plot
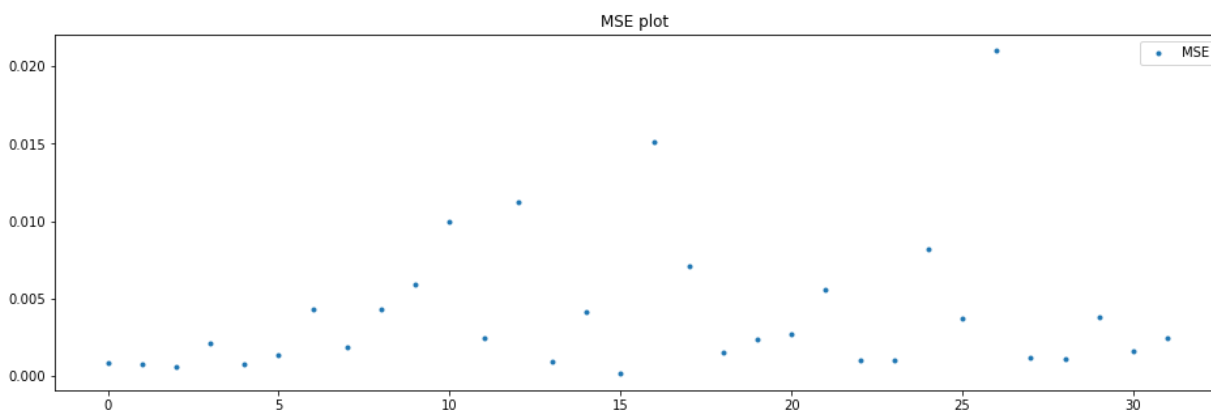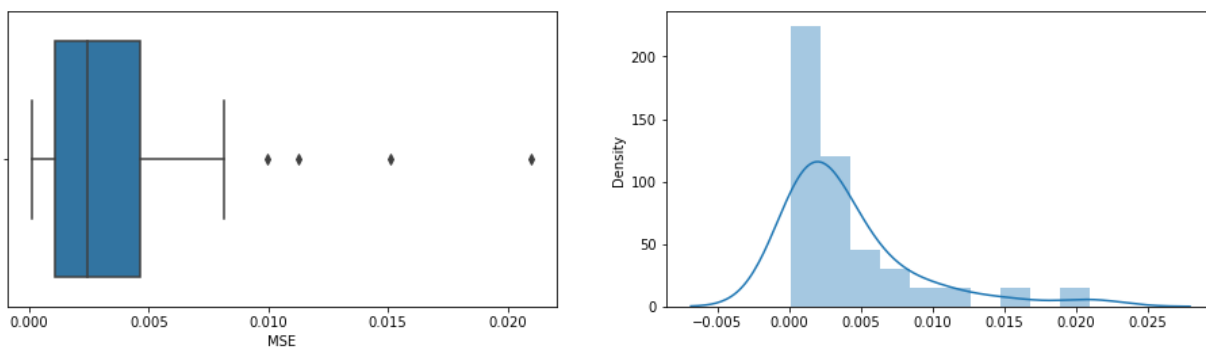
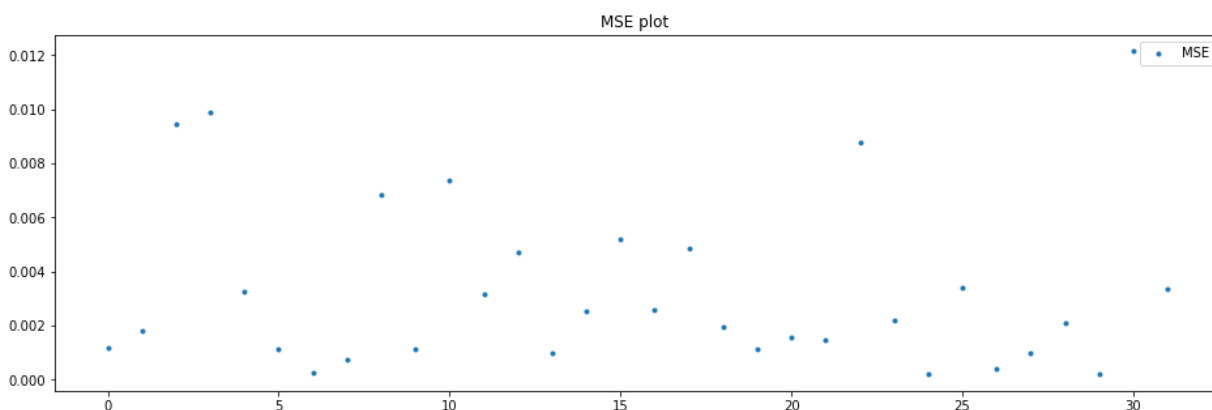Anderson_Darling Test
Statistic: 2.735
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 33
mean=0.0033740625,median=0.002635 ,max=0.01408,min=0.00042,variance=9.489e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
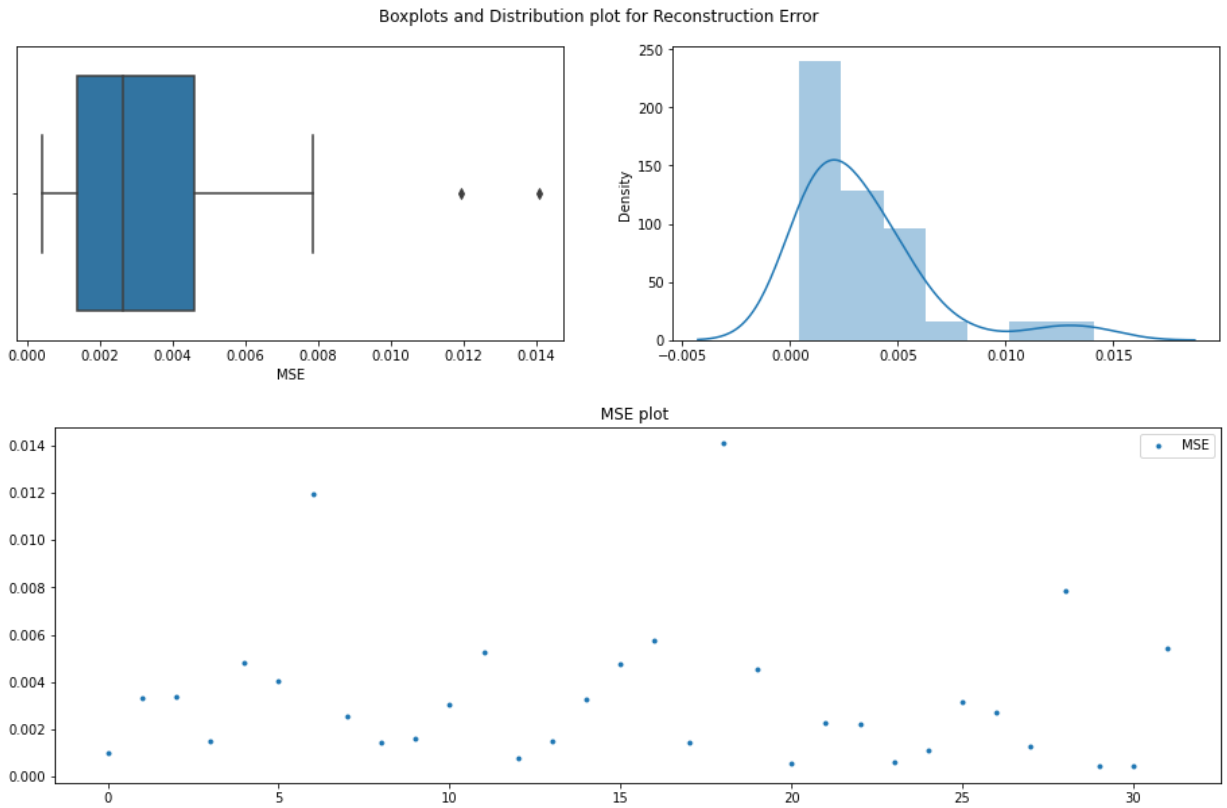

```
Anderson_Darling Test
Statistic: 1.913
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 34
mean=0.0031478125,median=0.0018 ,max=0.00981,min=6e-05,variance=8.3762e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
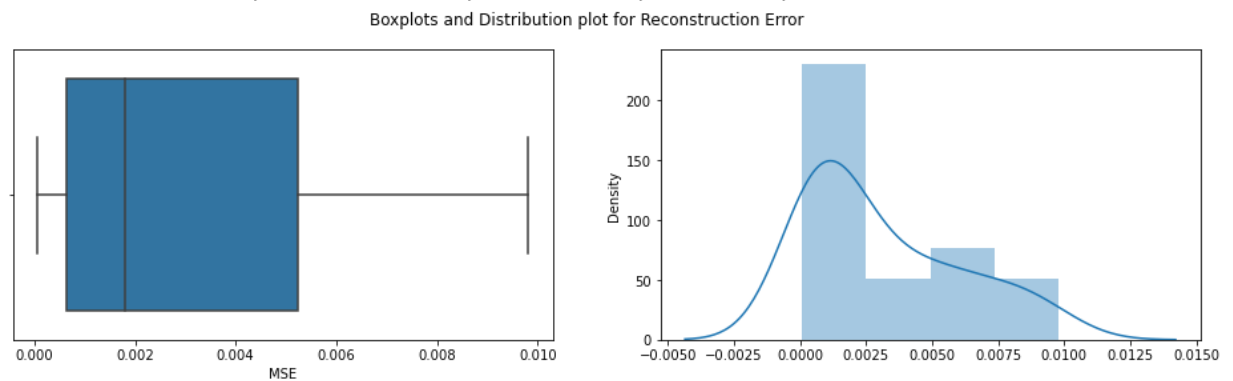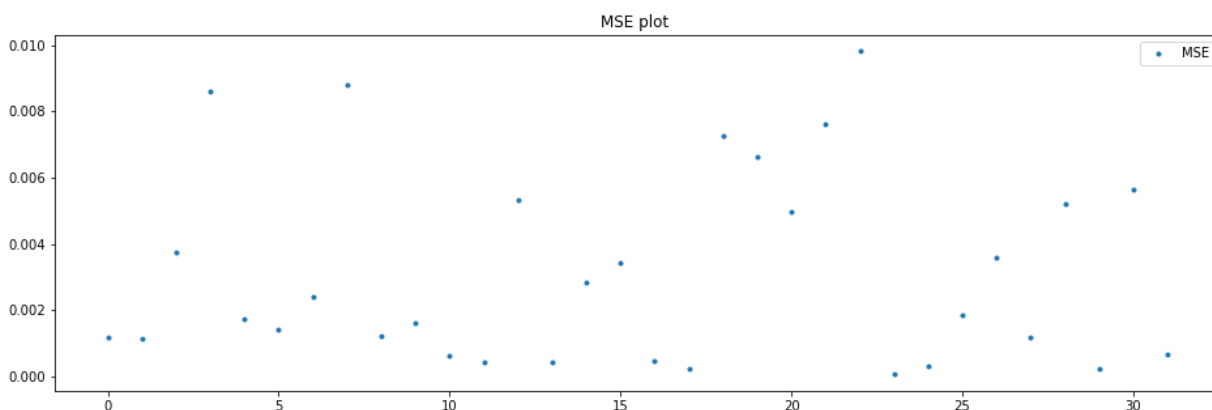
Anderson_Darling Test
Statistic: 1.551
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
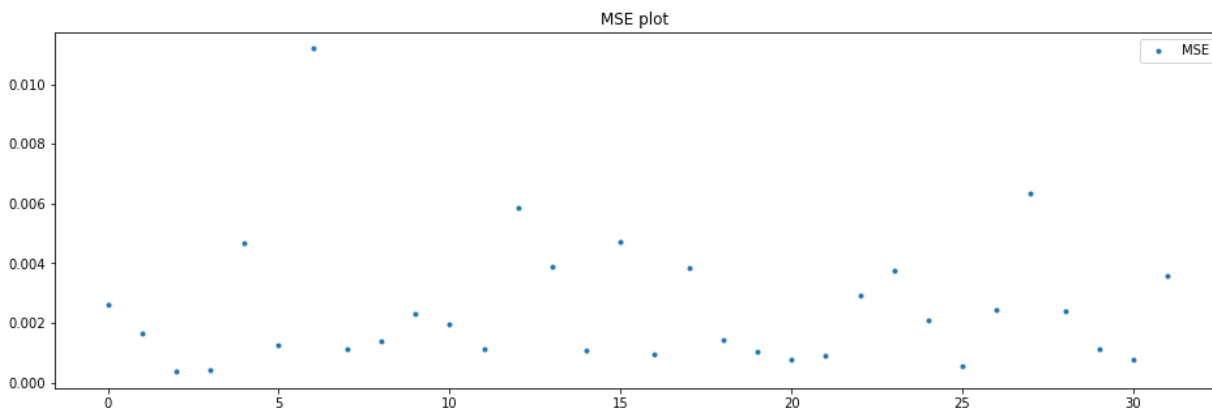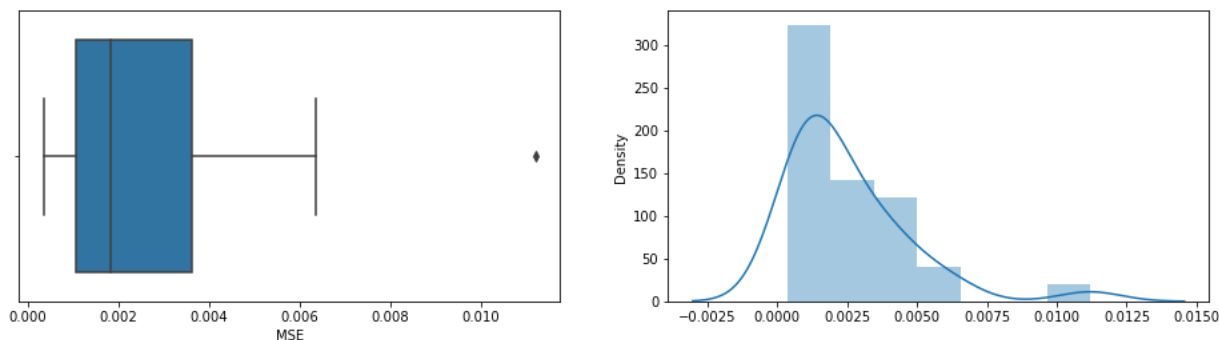5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 35
mean=0.0021978125,median=0.00124 ,max=0.01922,min=0.0004,variance=1.07786e-05

Boxplots and Distribution plot for Reconstruction Error

MSE plot
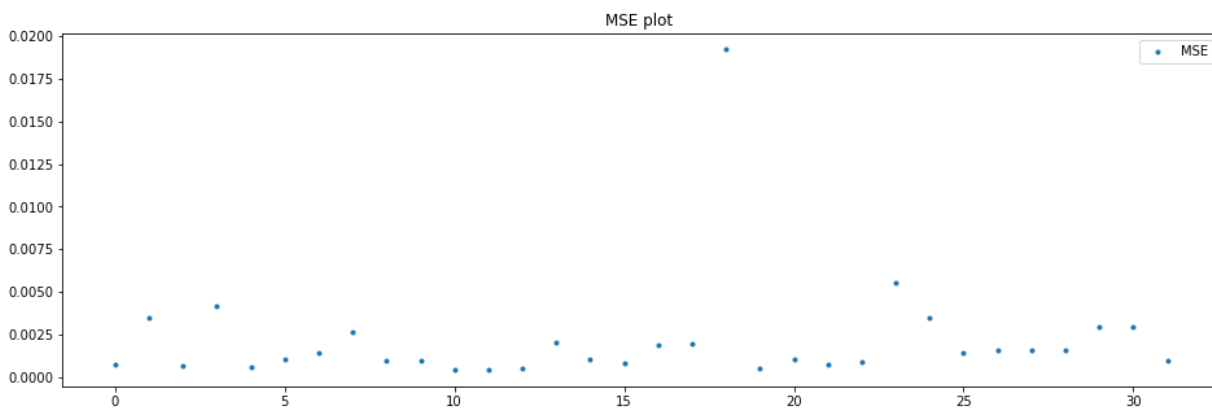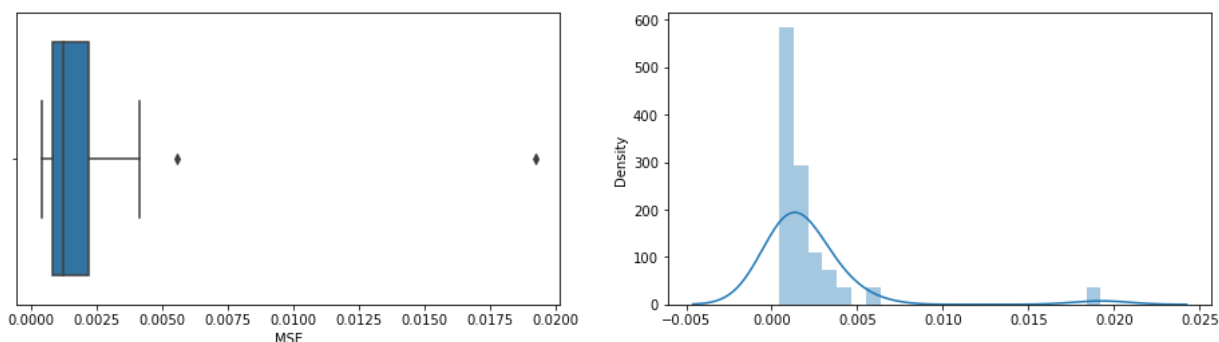
Anderson_Darling Test
Statistic: 5.199
15.000: 0.523, data does not look normal (reject H0)
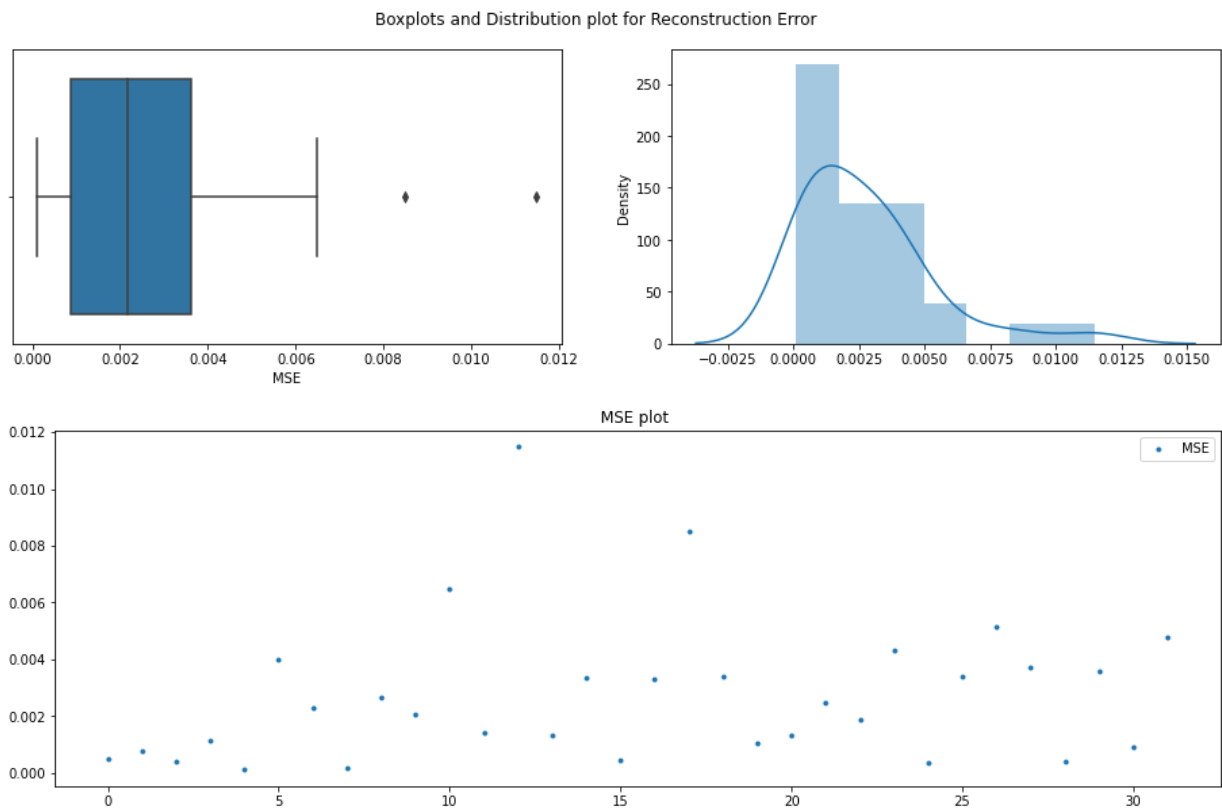10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ****
Batch: 36
mean=0.0029778125,median=0.002025 ,max=0.01125,min=0.00029,variance=7.1206e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
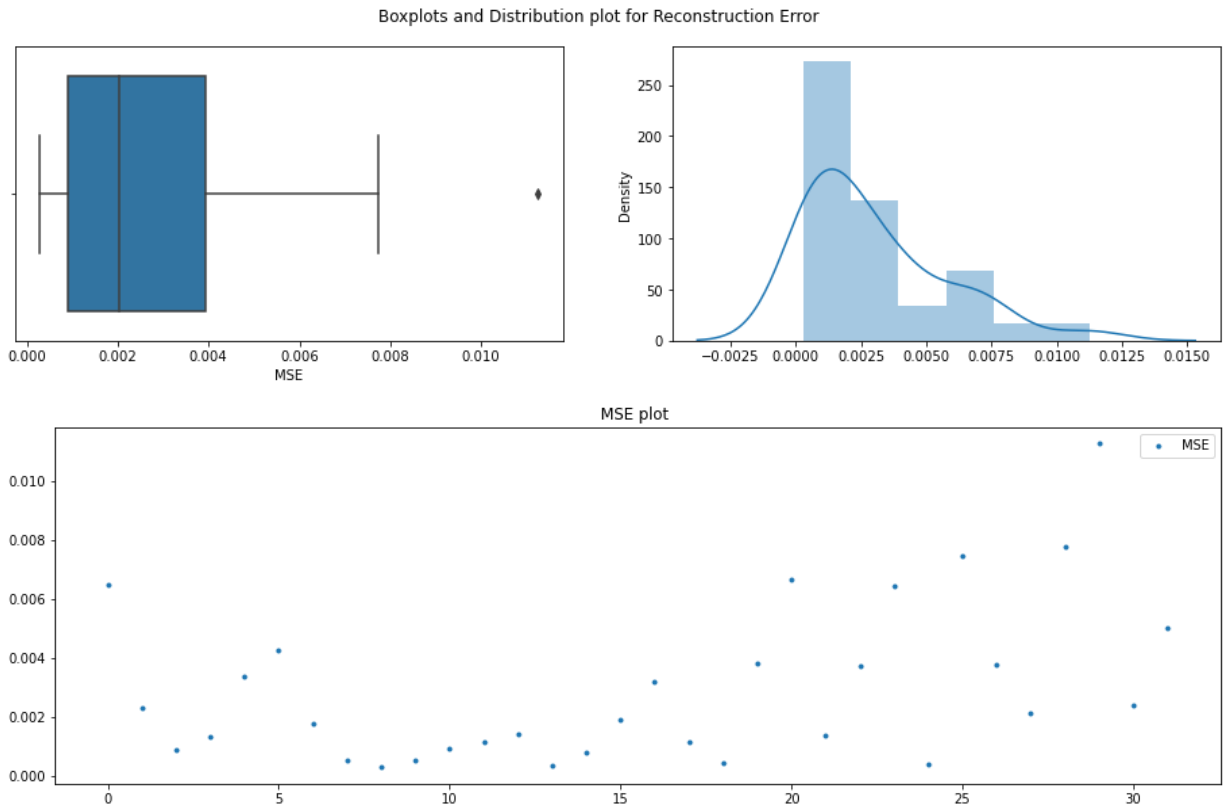

```
Anderson_Darling Test
Statistic: 1.514
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 37
mean=0.0038990625,median=0.003155 ,max=0.01731,min=0.00018,variance=1.48617e-05
```
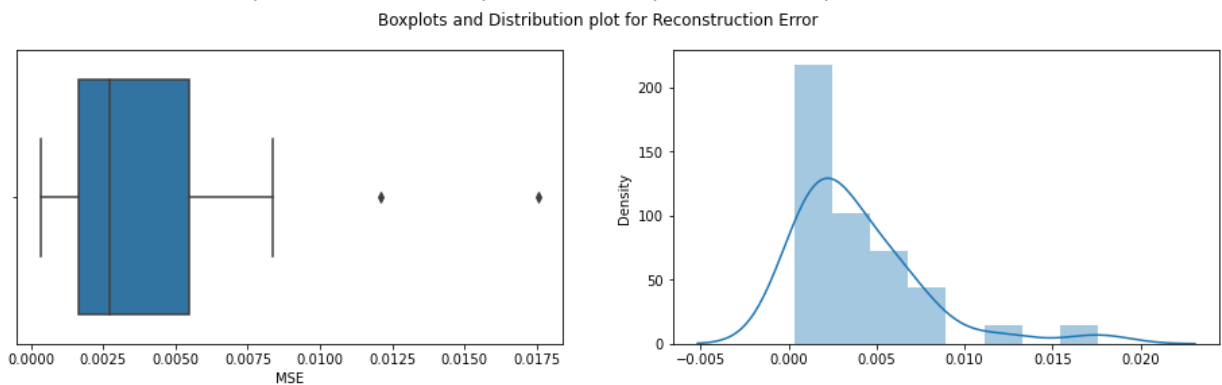
Boxplots and Distribution plot for Reconstruction Error

MSE plot
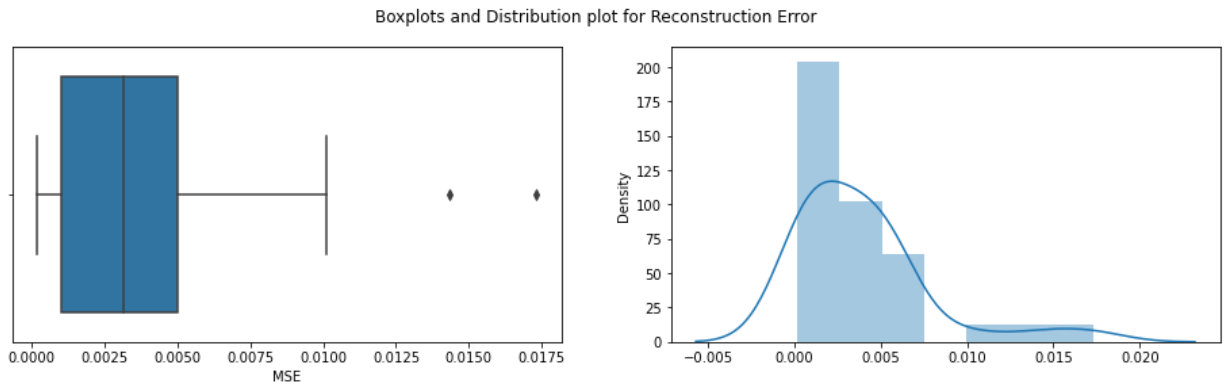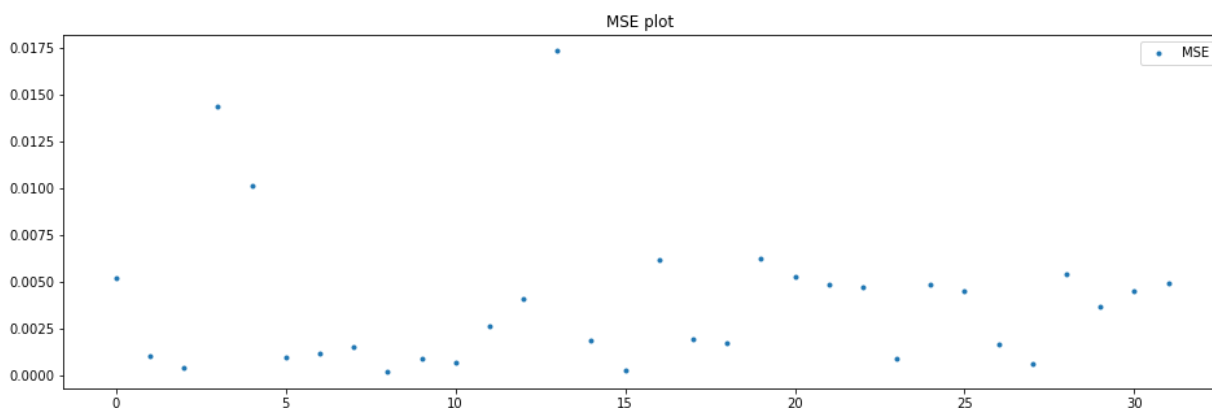
```
Anderson_Darling Test
Statistic: 2.035
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 38
mean=0.00218375,median=0.002015 ,max=0.00813,min=0.00018,variance=3.5487e-06
```
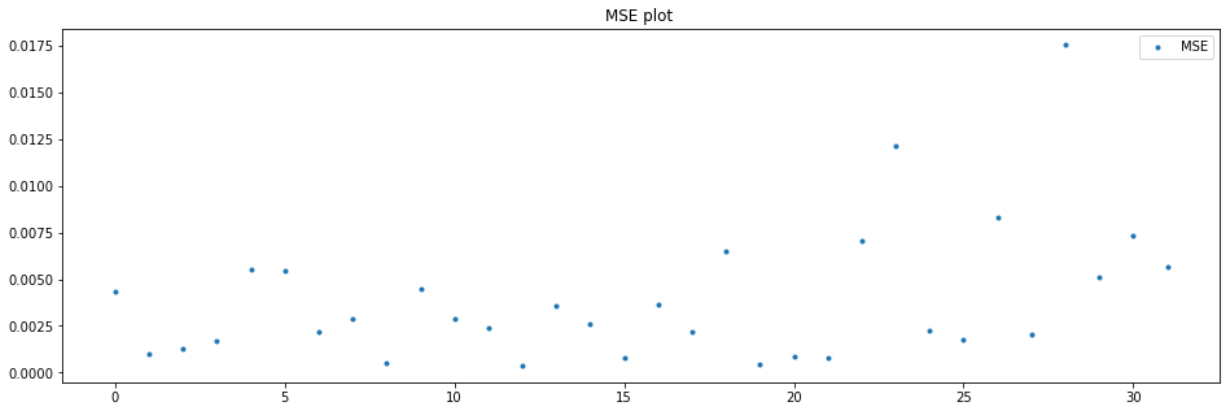

Boxplots and Distribution plot for Reconstruction Error
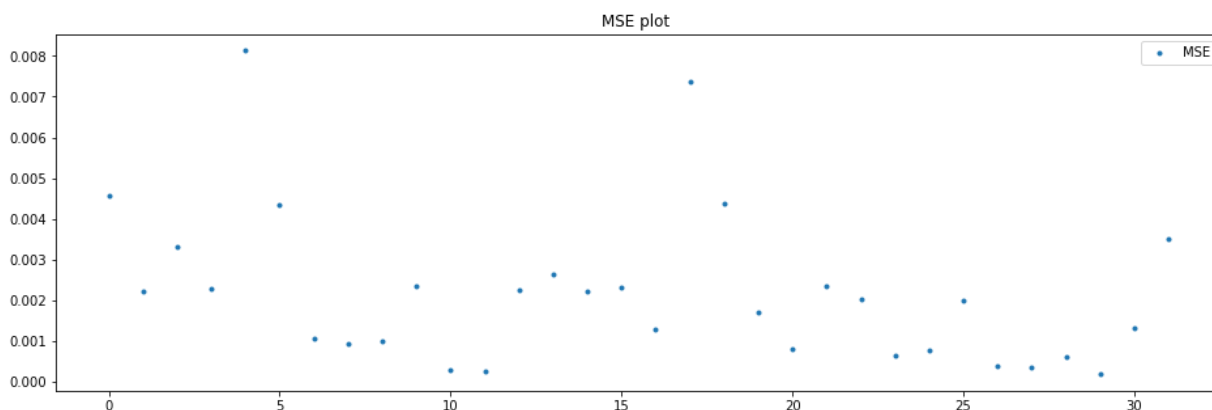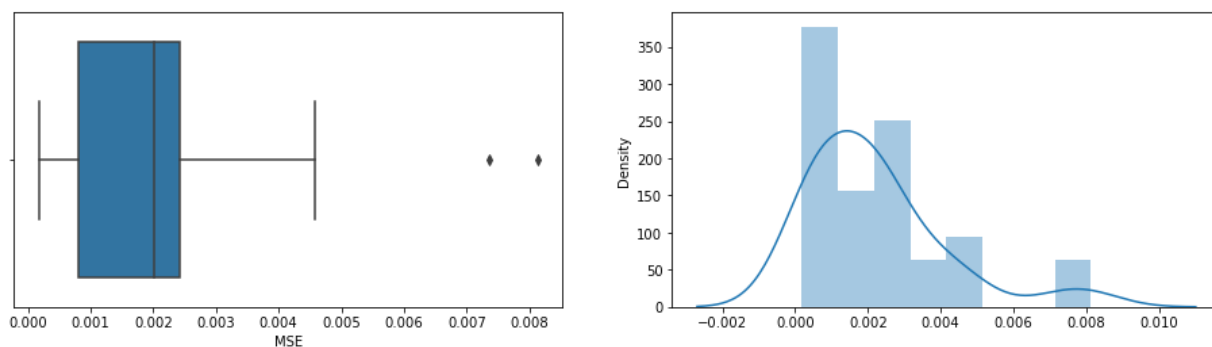
MSE plot

```
Anderson_Darling Test
Statistic: 1.528
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 39
mean=0.0030228125,median=0.002195 ,max=0.00889,min=0.00014,variance=7.1636e-06
```
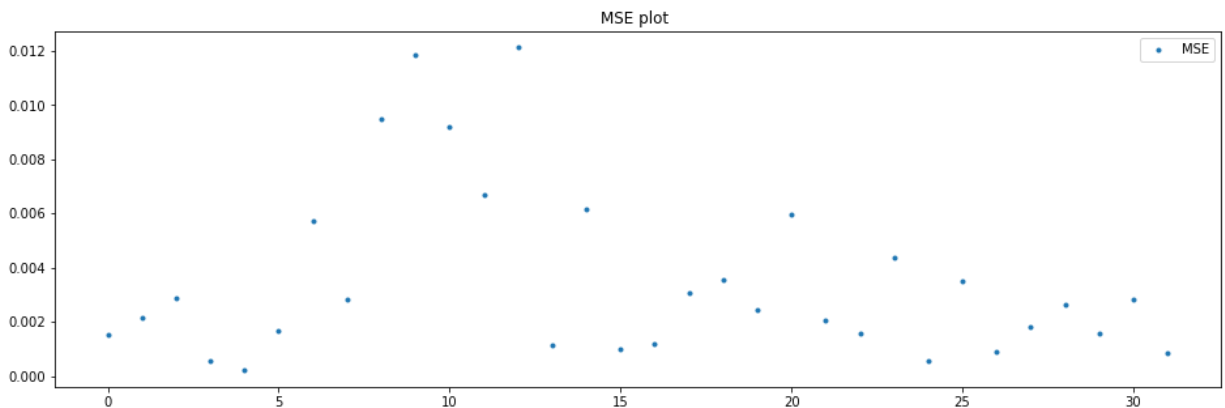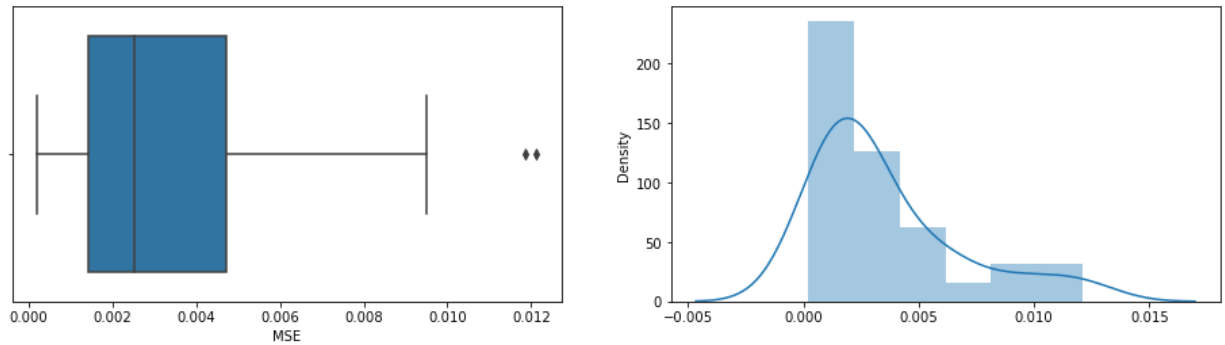
Boxplots and Distribution plot for Reconstruction Error

MSE plot
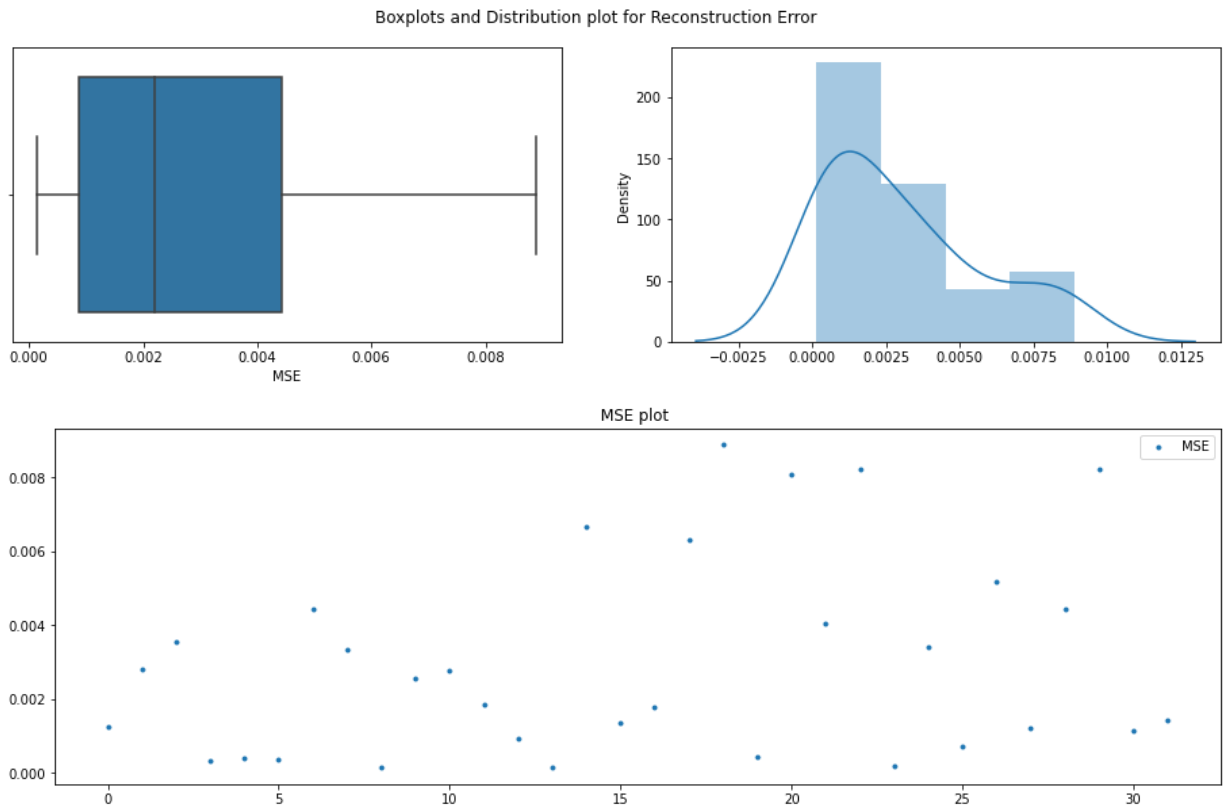

```
Anderson_Darling Test
Statistic: 1.343
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 40
mean=0.0022463636,median=0.00121 ,max=0.00768,min=0.0004,variance=5.1508e-06
```
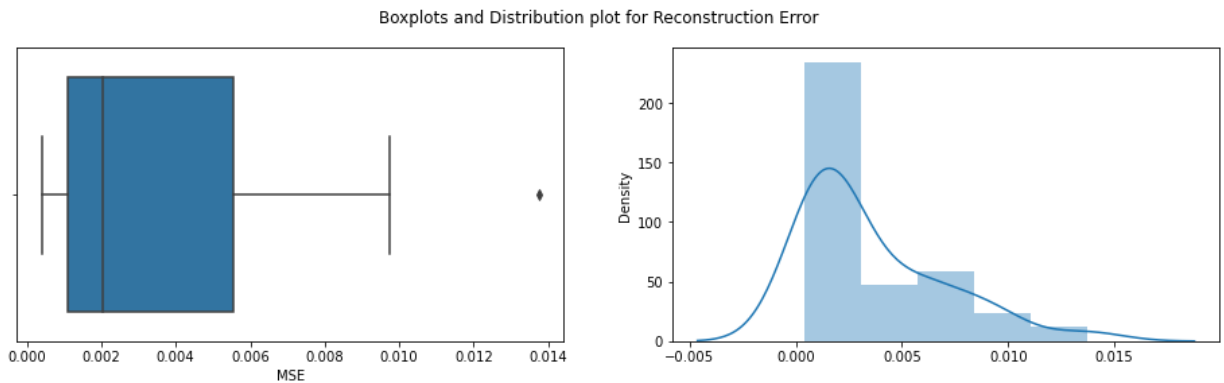
Boxplots and Distribution plot for Reconstruction Error

MSE plot
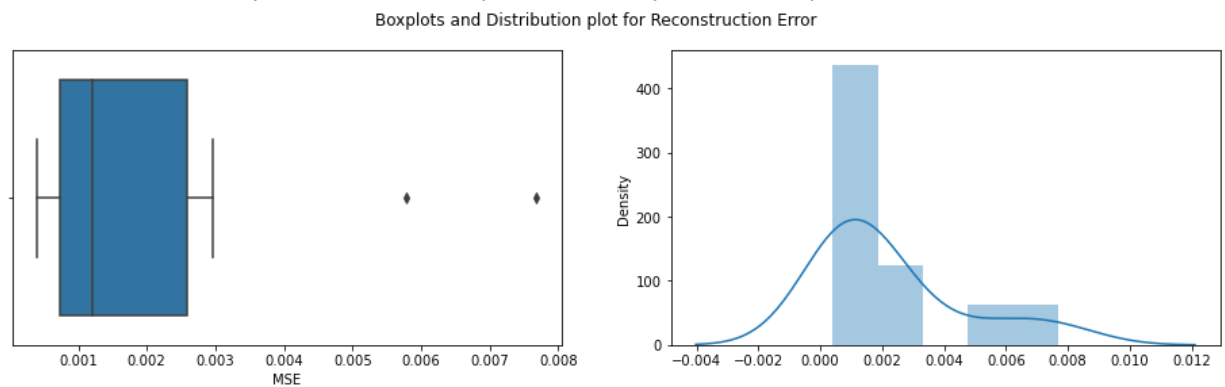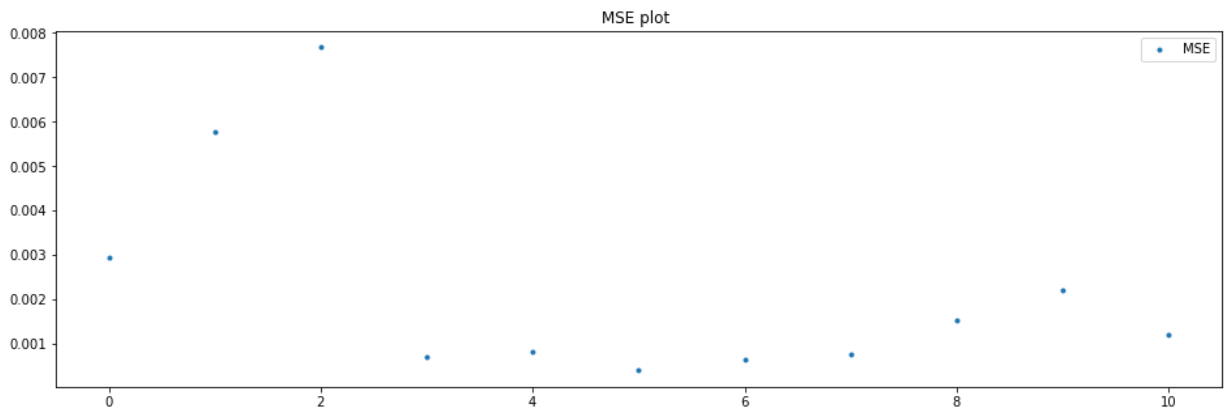
```
Anderson_Darling Test
Statistic: 1.161
15.000: 0.498, data does not look normal (reject H0)
10.000: 0.567, data does not look normal (reject H0)
5.000: 0.680, data does not look normal (reject H0)
2.500: 0.793, data does not look normal (reject H0)
1.000: 0.944, data does not look normal (reject H0)
```

Instance Threshold

In [49]:
```
instance_thresh_pos,zscore_list_pos=compute_instance_threshold_firstN_batches(batch_
```

In [50]:
```
instance_thresh_pos
```

Out[50]: 0.0126

Batch Threshold

In [51]:
```
thres_iqr_batch_pos, thres_zscore_batch_pos=compute_batch_threshold_testdata(batch_a
```

In [52]:
```
thres_zscore_batch_pos
```

Out[52]: 0.0064

Count Threshold

In [53]:
```
# Counts the MSE values exceeding threshold in each batch
exceed_count_pos,total_pos=threshold_exceed_count(batch_mse_values_pos,instance_thres
```

In [54]:
```
exceed_list_pos=[]
for key in exceed_count_pos.keys():
    exceed_list_pos.append(exceed_count_pos[key])
```

In [55]:
```
plot_results(exceed_list_pos)
```

mean=0.512195122,median=0.0 ,max=2,min=0,variance=0.5913146936

Boxplots and Distribution plot for Reconstruction Error
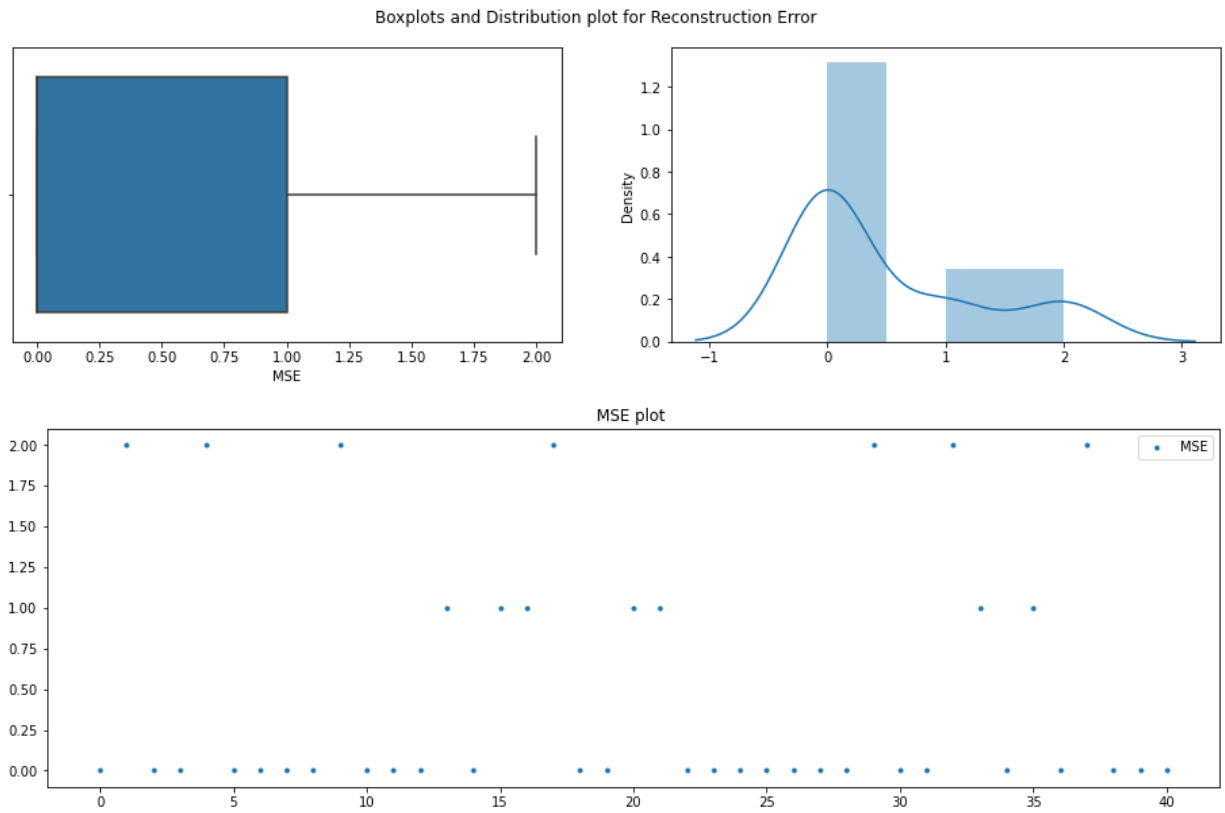

```
In [56]:    exceed_list_pos;
```

```
In [57]:    count_thresh_pos=np.median(exceed_list_pos)
```

```
In [58]:    count_thresh_pos
```

Out[58]:   0.0

6. working on stream data without any drift introduced

```
In [59]:    stream
```

Out[59]:

	attribute1	attribute2	attribute3	attribute4	attribute5	attribute6	attribute7	attribute8	cla
16343	0.352	0.472	0.008	0.137	0.222	0.191	0.338	0.399	
16344	0.444	0.566	0.006	0.012	0.168	0.130	0.397	0.504	
16345	0.466	0.572	0.006	0.137	0.158	0.210	0.448	0.515	
16346	0.462	0.556	0.007	0.226	0.208	0.210	0.440	0.523	
16347	0.376	0.477	0.008	0.210	0.201	0.170	0.347	0.429	
...	...	...	...	...	...	...	...	...	
18154	0.425	0.461	0.009	0.278	0.441	0.512	0.423	0.446	

	attribute1	attribute2	attribute3	attribute4	attribute5	attribute6	attribute7	attribute8	cla
18155	0.465	0.495	0.008	0.278	0.355	0.363	0.561	0.412	
18156	0.514	0.538	0.007	0.278	0.165	0.170	0.606	0.480	
18157	0.519	0.536	0.007	0.278	0.115	0.149	0.515	0.515	
18158	0.464	0.534	0.008	0.270	0.168	0.236	0.530	0.446	

1816 rows × 9 columns

In [60]:
```python
stream2=stream.copy()
del stream2['class']
```

In [61]:
```python
stream2
```

Out[61]:

	attribute1	attribute2	attribute3	attribute4	attribute5	attribute6	attribute7	attribute8
16343	0.352	0.472	0.008	0.137	0.222	0.191	0.338	0.399
16344	0.444	0.566	0.006	0.012	0.168	0.130	0.397	0.504
16345	0.466	0.572	0.006	0.137	0.158	0.210	0.448	0.515
16346	0.462	0.556	0.007	0.226	0.208	0.210	0.440	0.523
16347	0.376	0.477	0.008	0.210	0.201	0.170	0.347	0.429
...	...	...	...	...	...	...	...	...
18154	0.425	0.461	0.009	0.278	0.441	0.512	0.423	0.446
18155	0.465	0.495	0.008	0.278	0.355	0.363	0.561	0.412
18156	0.514	0.538	0.007	0.278	0.165	0.170	0.606	0.480
18157	0.519	0.536	0.007	0.278	0.115	0.149	0.515	0.515
18158	0.464	0.534	0.008	0.270	0.168	0.236	0.530	0.446

1816 rows × 8 columns

In [62]:
```python
batches_n=make_batches(stream2)
```

In [63]:
```python
# This function makes a list of dictionary values
def return_list_of_dict_values(d):
    values_list=[]
    for key in d.keys():
        values_list.append(d[key])
    return values_list
```

7. Drift Detection Framework

In [64]:

```python
def detect_at_batch_level(test_batch,b,batch_thres_pos,batch_thres_neg,count_thresh_p

    # Layer 1 Variables
    mse_list_layer1=[]      # Holds the recon loss values predicted by Layer 1 Autoenc
    exceed_count_layer1=0   # How many instances exceed layer one instance threshold
    mse_sum=0               # sum of recon.error values from layer 1 AE for this batch


    # Layer 2 Variables
    mse_list_layer2=[]      # Holds the recon.error values predicted by Layer 2 Autoe
    exceed_count_layer2=-1  # If a batch is not passed to the layer2 AE , then excee
    mse_sum_layer2=0        # sum of recon.error values from layer 2 AE for this batc


    layer1_excede_list=[] # Holds the batch numbers of bathces exceeding layer1 thres
    #all_excede_list=[]     # Hold the batch number of batches exceeding both Layer-1
    layer_one_instance_exceed_list=[] # Holds the indices of instances exceeding laye
    layer_two_instance_exceed_list=[] # Holds the indices of instances exceeding laye


    # Determine Layer 1 and Layer2 AE and their associated thresholds
    layer_one_batch_thres= batch_thres_pos if batch_thres_pos<batch_thres_neg  else b
    layer_two_batch_thres= batch_thres_pos if batch_thres_pos>batch_thres_neg  else b
    layer_one_encoder= encoder_pos_class if batch_thres_pos<batch_thres_neg else enco
    layer_two_encoder= encoder_pos_class if batch_thres_pos>batch_thres_neg else enco

    layer_one_count_threshold=count_thresh_pos if batch_thres_pos<batch_thres_neg  el
    layer_two_count_threshold=count_thresh_pos if batch_thres_pos>batch_thres_neg  el

    layer1_ins_thresh=instance_thresh_pos if  batch_thres_pos<batch_thres_neg  else i
    layer2_ins_thresh=instance_thresh_pos if  batch_thres_pos>batch_thres_neg  else i

    # Pass each instance of a batch to Layer 1 AE. Compute Batch MSE and Number of In
    avg_mse_layer1=0
    for i in range(0,test_batch.shape[0]):
        ROW = np.array([test_batch[i]])
        pred= layer_one_encoder.predict(ROW)
        mse = np.round(np.mean(np.power(test_batch[i] - pred, 2)),5)
        mse_list_layer1.append(mse)
        if mse>layer1_ins_thresh:
            exceed_count_layer1+=1
            layer_one_instance_exceed_list.append(i)
        mse_sum+=mse
    avg_mse_layer1=(mse_sum)/len(test_batch)
    avg_mse_layer2=0
    # Check if This batch exceeds both Layer 1 batch and count thresholds
    if ((avg_mse_layer1>layer_one_batch_thres) and ( exceed_count_layer1 >layer_one_c
        layer1_excede_list.append(b)# Keep track of batches exceesding layer 1 thresh
        exceed_count_layer2=0
        # Pass each instance of this batch to Layer 2 AE. Compute Batch MSE and Numbe
        for i in range(0,test_batch.shape[0]):
            ROW = np.array([test_batch[i]])
            pred= layer_two_encoder.predict(ROW)
            mse = np.round(np.mean(np.power(test_batch[i] - pred, 2)),5)
            mse_list_layer2.append(mse)
            if mse>layer2_ins_thresh:
                exceed_count_layer2+=1
```

```
                            layer_two_instance_exceed_list.append(i)
                        mse_sum_layer2+=mse
                    avg_mse_layer2=(mse_sum_layer2)/len(test_batch)


                    if  (avg_mse_layer2 > layer_two_batch_thres) and (exceed_count_layer2>layer_t
                        all_excede_list.append(b)# Keep track of batches exceesding layer 2 thres


            return  all_excede_list,mse_list_layer1 , exceed_count_layer1 ,avg_mse_layer2,exc
```

In [65]:
```
def detect_stream_drift(batches,encoder_pos_class,encoder_neg_class,batch_thres_pos,b
    exceed_count_layer2_instance_thresh={} # Holds Number of instances exceeding laye

    mse_dict_L1={}          # Holds batchwise recon.error values from Layer 1 AE
    exceed_count_L1={}      # Batchwise number of Instances exceeding layer 1 count th
    layer_one_instance_exceed_list={} # batch wise list of instances ( indices ) exce
    avg_mse_l1={}

    mse_dict_L2={}          # Holds batchwise recon. error  values from Layer 2 AE
    exceed_count_L2={}      # Batchwise number of Instances exceeding layer 2 count th
    layer_two_instance_exceed_list={} # For each batch maintains the indices where re
    avg_mse_l2={}           #
    all_excede_list=[]
    n=0
    for b in batches:
        print("\n\n")
        print("**************")
        print('\nBatch Number : {}'.format(b))
        all_excede_list,mse_dict_L1[b],exceed_count_L1[b],avg_mse_l2[b],exceed_count_


        print('\nData Points Exceeding Layer 1 Encoder Instance Threshold : {} '.forr
        print('\nData Points Exceeding Layer 2 Encoder Instance Threshold: {}'.format
        print('\nNumber of Data Points Exceeding Layer 2 Encoder Instance thresholds:

    mse_list_layer1=return_list_of_dict_values(avg_mse_l1)
    exceed_count_list_layer1=return_list_of_dict_values(exceed_count_L1)


    ## Detect Drift at Batch Level
    print ("\n Drift Detection at Batch Level\n")
    exceed_list=return_list_of_dict_values(exceed_count_L2)
    mse_list=return_list_of_dict_values(avg_mse_l2)
    detect_drift(mse_list,exceed_list,layer_two_batch_thres,layer_two_count_threshol

    return all_excede_list,exceed_count_layer2_instance_thresh ,exceed_count_L2,avg_r
```

In [66]:

```python
# This function takes two lists of Batch recon.error values  and Exceed Counts along
# If a batch exceeds both thresholds , warning is generated and for 3 consectutive b
def detect_drift(batch_mse,exceed_list, Thresh,count_thresh):
    n=0 # total number of batches where recon error exceeds threshold
    count=0 ## counts the number of consecutive batches exceding threshold
    w_index_list=[] # Contains indices of batches where batch recon. error exceeds th
    drift_batches=[]
    for i in range(0,len(batch_mse)):
        #print (batch_mse)
        if(((((batch_mse[i])>Thresh)) and (exceed_list[i]>count_thresh)):
            print(' Threshold exceeds at batch : {}'.format(i))
            n=n+1

            if(len(w_index_list)==0 or (i-w_index_list[-1]==1)):
                # Check if w_index_list is empty or its last entry is the previous b
                    w_index_list.append(i)# then append this batch to w_index_list
            count+=1

            print(w_index_list)
            if (count>2):# if for more than two consecutive batches  threshold are su
                        # confirm drift
                drift_batch=i-2 # Drift starting point

                print( " Drift Confirmed at Batch No : % d" %drift_batch)
                drift_batches.append(drift_batch)
            if (len(w_index_list)>=1 and len(w_index_list)<=2):
                w_level=i-len(w_index_list)
                print("Warning Level at Batch",i)
                w_count+=1


        else:
            count=0 # reset count
            if len(w_index_list)<=3:
                w_index_list=[]
    #print(" Number of Drifted Batches" + str(len(drift_batches)))
    #print(drift_batches)
    #print(" Number of Warnings: "+ str(n))
```

In [67]:

```python
all_excede_list_n,exceed_count_L2_instThresh_n ,exceed_count_L2_countThresh_n,avg_mse
```

****

Batch Number : 0

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 5, 17, 18]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

```
Batch Number : 1

Data Points Exceeding Layer 1 Encoder Instance Threshold : [16, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 2

Data Points Exceeding Layer 1 Encoder Instance Threshold : [24, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 3

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 18, 19, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 4

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 15, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 5

Data Points Exceeding Layer 1 Encoder Instance Threshold : [12]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 6
```

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 7

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 5, 6, 15]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 8

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 9

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 10

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 17, 18]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 11

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 3, 4, 7, 20, 21]

```
Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 12

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 24]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 13

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 14

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 15

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 4, 9, 11, 21, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 16

Data Points Exceeding Layer 1 Encoder Instance Threshold : [27, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []
```

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 17

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 6, 8, 11, 12, 13, 14, 24, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1

****

Batch Number : 18

Data Points Exceeding Layer 1 Encoder Instance Threshold : [4, 9, 10, 20, 21, 26, 29, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 19

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 20

Data Points Exceeding Layer 1 Encoder Instance Threshold : [25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 21

Data Points Exceeding Layer 1 Encoder Instance Threshold : [11, 29, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 22

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 17, 18, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 23

Data Points Exceeding Layer 1 Encoder Instance Threshold : [23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 24

Data Points Exceeding Layer 1 Encoder Instance Threshold : [30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 25

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 15, 16, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 26

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

```
**************

Batch Number : 27

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 5]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 28

Data Points Exceeding Layer 1 Encoder Instance Threshold : [26, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 29

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 7, 8, 17, 24]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 30

Data Points Exceeding Layer 1 Encoder Instance Threshold : [6, 12, 18, 26, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [6]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1


**************

Batch Number : 31

Data Points Exceeding Layer 1 Encoder Instance Threshold : [26, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0
```

```
**************

Batch Number : 32

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 33

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7, 8, 21, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 34

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 4, 14, 20, 24, 25, 30,
31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 35

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 7, 14, 15]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 36

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0
```

```
**************

Batch Number : 37

Data Points Exceeding Layer 1 Encoder Instance Threshold : [15, 21, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 38

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 10, 13, 14, 16]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [5]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1


**************

Batch Number : 39

Data Points Exceeding Layer 1 Encoder Instance Threshold : [20, 25, 26, 27, 28, 29, 3
0, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [26]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1


**************

Batch Number : 40

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 3, 5, 6, 7, 14, 18,
23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 41

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 4, 6, 7, 8, 9, 1
4, 15, 21, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [2, 7]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 2
```

```
**************

Batch Number : 42

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 10, 14, 17, 18, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 43

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 10, 22, 23, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 44

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 15, 16]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 45

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 46

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 29, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************
```

Batch Number : 47

Data Points Exceeding Layer 1 Encoder Instance Threshold : [28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 48

Data Points Exceeding Layer 1 Encoder Instance Threshold : [18, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 49

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 50

Data Points Exceeding Layer 1 Encoder Instance Threshold : [12, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [23]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1

****

Batch Number : 51

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 10, 16, 17, 18, 20, 21
, 22, 23, 25, 26, 27, 28, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [2]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1

****

```
Batch Number : 52

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 3, 6, 8, 15, 23, 25
, 26, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0



**************

Batch Number : 53

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 7, 16, 20]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0



**************

Batch Number : 54

Data Points Exceeding Layer 1 Encoder Instance Threshold : [4, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0



**************

Batch Number : 55

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 6, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0



**************

Batch Number : 56

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

 Drift Detection at Batch Level

 Threshold exceeds at batch : 41
[41]
Warning Level at Batch 41
```

```
---------------------------------------------------------------------------
UnboundLocalError                         Traceback (most recent call last)
<ipython-input-67-81512fba7f7a> in <module>
----> 1 all_excede_list_n,exceed_count_L2_instThresh_n ,exceed_count_L2_countThresh_
n,avg_mse_l2_list_n,mse_list_layer1_n,exceed_count_list_layer1_n=detect_stream_drift
(batches_n,encoder_pos_class,encoder_neg_class,thres_zscore_batch_pos,thres_zscore_ba
tch_neg, count_thresh_pos,count_thresh_neg)

<ipython-input-65-be235c18cb7b> in detect_stream_drift(batches, encoder_pos_class, en
coder_neg_class, batch_thres_pos, batch_thres_neg, count_thresh_pos, count_thres_neg)
     32        exceed_list=return_list_of_dict_values(exceed_count_L2)
     33        mse_list=return_list_of_dict_values(avg_mse_l2)
---> 34        detect_drift(mse_list,exceed_list,layer_two_batch_thres,layer_two_count_t
hreshold )
     35
     36        return all_excede_list,exceed_count_layer2_instance_thresh ,exceed_count_
L2,avg_mse_l2 ,mse_list_layer1,exceed_count_list_layer1

<ipython-input-66-1b3410a64099> in detect_drift(batch_mse, exceed_list, Thresh, count
_thresh)
     27                 w_level=i-len(w_index_list)
     28                 print("Warning Level at Batch",i)
---> 29                 w_count+=1
     30
     31

UnboundLocalError: local variable 'w_count' referenced before assignment
```

7. Working with Drifted Data

Feature Ranking based on Mutual Information

```python
In [ ]:
def feature_rank(data,label_col):
    from sklearn.model_selection import train_test_split
    from sklearn.feature_selection import mutual_info_classif

    X_train,X_test,y_train,y_test=train_test_split(data.drop(labels=[label_col], axis
    random_state=0)

    mutual_info = mutual_info_classif(X_train, y_train)
    mutual_info = pd.Series(mutual_info)
    mutual_info.index = X_train.columns
    mutual_info.sort_values(ascending=False,inplace=True)

    return mutual_info
```

```python
In [ ]:
rank_list=feature_rank(data,'class')
```

```python
In [ ]:
rank_list
```

In [ ]:
```python
def inject_sudden_drift(stream,rank_list,batch_size,fper):
    # fper is percentage of features
    #labels=pd.DataFrame(stream['class'].reset_index(drop=True))
    # retain class labels for later use
    n=int(fper*len(rank_list))
    # Number of features ( top 25 % or top fper%)
    top25p_features=list(rank_list[0:int(n)].index) # list of top n features
    bottom25p_features=list(rank_list[-int(n):].index) # list of bottom n features
    all_features=list(rank_list.index) # features sorted ( descending order) by mutuc
    unchanged_features_top25=set(all_features)-set(top25p_features)
    unchanged_features_bottom25=set(all_features)-set(bottom25p_features)
    unchanged_data_top25=stream[unchanged_features_top25].reset_index(drop=True)
    unchanged_data_bottom25=stream[unchanged_features_bottom25].reset_index(drop=True
    data_for_drift_top25=stream[top25p_features].reset_index(drop=True)
    data_for_drift_bottom25=stream[bottom25p_features].reset_index(drop=True)


    # Injecting sudden drift starting from batch 20 for top 25% (fper) features

    first_20_batches_top25=data_for_drift_top25[0:(batch_size*20)]
    drifted_top25=data_for_drift_top25[batch_size*20:len(stream)]

    # This code swaps the values of columns so that col(i+1)values assigned to col(i)
    for i in range(0,len(drifted_top25.columns)-1) :
        drifted_top25['temp']=drifted_top25.iloc[:,i+1]
        drifted_top25.iloc[:,i+1]=drifted_top25.iloc[:,i]
        drifted_top25.iloc[:,i]=drifted_top25['temp']
    del drifted_top25['temp']

    stream_top25=pd.concat([first_20_batches_top25,drifted_top25],axis=0)
    stream_top25=pd.concat([stream_top25,unchanged_data_top25],axis=1)
    stream_top25=stream_top25.reindex(columns=sorted(stream_top25.columns))


     # Injecting sudden drift starting from batch 20 for bottom 25% (fper) features

    first_20_batches_bottom25=data_for_drift_bottom25[0:(batch_size*20)]
    drifted_bottom25=data_for_drift_bottom25[batch_size*20:len(stream)]

     # This code swaps the values of columns so that col(i+1)values assigned to col(i
    for i in range(0,len(drifted_bottom25.columns)-1) :
        drifted_bottom25['temp']=drifted_bottom25.iloc[:,i+1]
        drifted_bottom25.iloc[:,i+1]=drifted_bottom25.iloc[:,i]
        drifted_bottom25.iloc[:,i]=drifted_bottom25['temp']
    del drifted_bottom25['temp']

    stream_bottom25=pd.concat([first_20_batches_bottom25,drifted_bottom25],axis=0)
    stream_bottom25=pd.concat([stream_bottom25,unchanged_data_bottom25],axis=1)
    stream_bottom25=stream_bottom25.reindex(columns=sorted(stream_bottom25.columns))


    return stream_top25,stream_bottom25
```

```
In [ ]:  stream_top25,stream_bottom25=inject_sudden_drift(stream,rank_list,batch_size=32,fper
```

```
In [ ]:  stream
```

```
In [ ]:  stream_top25
```

A) Sudden Drift Top 25 or Top x% (Here Top 40%)

```
In [ ]:  batches_d=make_batches(stream_top25)
```

```
In [ ]:  #batches_d=dict(list(batches_d.items())[:30])
```

Drift Detection through AE-DDM

```
In [ ]:  all_excede_list_d,exceed_count_L2_instThresh_d ,exceed_count_L2_countThresh_d,avg_mse
```

Students t Test

```
In [ ]:  # t-Test

         #H0: MSE Means of Normal and Drifted Data are not significantly different
         #H1: MSE Means of Normal and Drifted Data are significantly different

         def two_sample_tTest(sample1, sample2,alpha) :
             t_value,p_value=stats.ttest_ind(sample1,sample2)
             print('Test statistic is %f'%float("{:.6f}".format(t_value)))
             print('p-value for two tailed test is %f'%p_value)
             if p_value<=alpha:
                 print('Conclusion :\n''Since p-value(=%f)'%p_value,'<','alpha(=%.2f)'%alpha,
             else:
                 print( 'Accept H0: There is no drift in the dataset')
```

In [ ]:
```python
def perform_t_test():

    print("Layer 1 Reconstruction Error  Values for Normal and Drifted Data")
    two_sample_tTest(mse_list_layer1_d,mse_list_layer1_n, alpha=0.05)


    print("\nLayer 1 Exceed Count   Values for Normal and Drifted Data")
    two_sample_tTest(exceed_count_list_layer1_n,exceed_count_list_layer1_d, alpha=0.(


    print("\nLayer 2 Reconstruction Error  Values for Normal and Drifted Data")
    avg_mse_l2_list_d2=return_list_of_dict_values(avg_mse_l2_list_d) # Preserve orig
    avg_mse_l2_list_n2=return_list_of_dict_values(avg_mse_l2_list_n)

    two_sample_tTest(avg_mse_l2_list_d2,avg_mse_l2_list_n2, alpha=0.05)

    print("\nLayer 2 Exceed Count   Values for Normal and Drifted Data")
    exceed_count_L2_instThresh_d_values=return_list_of_dict_values(exceed_count_L2_in
    exceed_count_L2_instThresh_n_values=return_list_of_dict_values(exceed_count_L2_in
    two_sample_tTest(exceed_count_L2_instThresh_d_values,exceed_count_L2_instThresh_r
```

In [ ]:
```python
perform_t_test()
```

Drift Analysis Through Plots

In [ ]:

```python
def visual_analysis():
    df_plotting=pd.DataFrame()
    df_plotting['Layer 1: Non-drifted Data']=mse_list_layer1_n
    df_plotting['Layer 1: Drifted Data']=mse_list_layer1_d
    df_plotting['Layer 2: Non-Drifted Data']=list(avg_mse_l2_list_n.values())
    df_plotting['Layer 2: Drifted Data']=list(avg_mse_l2_list_d.values())

    df_plotting_counts=pd.DataFrame()

    df_plotting_counts['Layer 1: Non-drifted Data']=exceed_count_list_layer1_n
    df_plotting_counts['Layer 1: Drifted Data']=exceed_count_list_layer1_d
    df_plotting_counts['Layer 2: Non-Drifted Data']=list(exceed_count_L2_countThresh_
    df_plotting_counts['Layer 2: Drifted Data']=list(exceed_count_L2_countThresh_d.va

    from plotly import express as px

    config = {
  'toImageButtonOptions': {
    'format': 'png', # one of png, svg, jpeg, webp
    'filename': 'custom_image',
    'height': 500,
    'width': 800,
    'scale':9 # Multiply title/legend/axis/canvas sizes by this factor
  }}

    fig = px.scatter(df_plotting, x=df_plotting.index, y=[df_plotting['Layer 1: Non-
    fig.update_layout(showlegend=True,
    legend=dict(
        yanchor='top',
        y=.95,
        xanchor='left',
        x=0.01),xaxis_title="Batch Number ", yaxis_title="Reconstruction Error" , le

    fig.show(config=config)

    fig2 = px.scatter(df_plotting, x=df_plotting.index, y=[df_plotting['Layer 2: Non-
    fig2.update_layout(showlegend=True,
    legend=dict(
        yanchor='top',
        y=.95,
        xanchor='left',
        x=0.01),xaxis_title="Batch Number ", yaxis_title="Reconstruction Error", leg
    fig2.show(config=config)

    fig3 = px.scatter(df_plotting_counts, x=df_plotting_counts.index, y=[df_plotting_
    fig3.update_layout(showlegend=True,
    legend=dict(
        yanchor='top', y=.95,xanchor='left', x=0.01),
                        xaxis_title="Batch Number ", yaxis_title="Exceed Counts", leg
    fig3.show(config=config)

    fig4 = px.scatter(df_plotting_counts, x=df_plotting_counts.index, y=[df_plotting_
    fig4.update_layout(showlegend=True,
    legend=dict(
```

```
                        yanchor='top',
                        y=.95,
                        xanchor='left',
                        x=0.01),xaxis_title="Batch Number ", yaxis_title="Exceed Counts", legend_titl

                fig4.show(config=config)


            return df_plotting , df_plotting_counts
```

In [ ]:
```
df_plotting=visual_analysis()
```

Effect on Classification Perfromance

In [85]:
```python
def train_classifiers(train,test,class_col):

    # Necessary Imports

    from sklearn.naive_bayes import GaussianNB
    from sklearn.linear_model import LogisticRegression
    from sklearn.tree import DecisionTreeClassifier # , plot_tree
    from sklearn.neighbors import KNeighborsClassifier
    from sklearn.svm import SVC
    from sklearn.ensemble import RandomForestClassifier
    from sklearn.ensemble import GradientBoostingClassifier
    from sklearn.neural_network import MLPClassifier
    from sklearn import metrics


    # Classification models : a list of tuples
    models = [
            ('LogReg', LogisticRegression()),
            ('RF', RandomForestClassifier()),
            ('KNN', KNeighborsClassifier()),
            ('SVM', SVC()),
            ('GNB', GaussianNB()),
            ('XGB', GradientBoostingClassifier()),
            ('DT',DecisionTreeClassifier()),
            ('MLP',MLPClassifier())]


      # Creating a DataFrame with columns for accuracy , precision and recall for ea

    # Separating features and class from train and test data

    train_data=train.copy()
    test_data=test.copy()


    y_train=train_data[class_col].values
    del train_data[class_col]
    x_train=train_data.values

    y_test=test_data[class_col].values
    del test_data[class_col]
    x_test=test_data.values


    # Model training on the available labelled data ( 80% of te datasets is used for

    for name,model in models:
        print ("Training " + name+":")
        clf=model.fit(x_train,y_train)
        y_predict_train=clf.predict(x_train)
        accuracy_train = metrics.accuracy_score(y_train,y_predict_train)
        recall_train=metrics.recall_score(y_train,y_predict_train)
        precision_train=metrics.precision_score(y_train,y_predict_train)
        fscore_train=metrics.f1_score(y_train,y_predict_train)

        y_predict_test=clf.predict(x_test)
```

```python
        accuracy_test = metrics.accuracy_score(y_test, y_predict_test)
        recall_test=metrics.recall_score(y_test, y_predict_test)
        precision_test=metrics.precision_score(y_test, y_predict_test)
        fscore_test=metrics.f1_score(y_test, y_predict_test)
        print("Train Accuracy : {} , Test Accuracy :{}".format(accuracy_train,accura
        print("Train Recall Score : {} , Test Recall Score :{}".format(recall_train,
        print("Train Precision Score: {} , Test Precision score: {}".format(precision
        print("Train f1 Score: {} , Test f1 socre score: {}".format(fscore_train,pre


    return models
```

In [86]:
```python
train["class"]=np.where(train["class"] ==2,1,0)
test["class"]=np.where(test["class"] ==2,1,0)
stream["class"]=np.where(stream["class"] ==2,1,0)
```

In [87]:
```python
models=train_classifiers(train,test,'class')
```

```
Training LogReg:
Train Accuracy : 0.7834159389505153 , Test Accuracy :0.7524779735682819
Train Recall Score : 0.49707135250266243 , Test Recall Score :0.43067389620449265
Train Precision Score: 0.6836323690955693 , Test Precision score: 0.5529587270014918
Train f1 Score: 0.5756127639895176 , Test f1 socre score: 0.7722222222222223
Training RF:
Train Accuracy : 1.0 , Test Accuracy :0.7868942731277533
Train Recall Score : 1.0 , Test Recall Score :0.5182029434546863
Train Precision Score: 1.0 , Test Precision score: 0.6335227272727273
Train f1 Score: 1.0 , Test f1 socre score: 0.8148599269183922
Training KNN:
Train Accuracy : 0.8480056643851782 , Test Accuracy :0.7601872246696035
Train Recall Score : 0.672790202342918 , Test Recall Score :0.499612703330751136
Train Precision Score: 0.7823529411764706 , Test Precision score: 0.5969458583988894
Train f1 Score: 0.7234468937875752 , Test f1 socre score: 0.7413793103448276
Training SVM:
Train Accuracy : 0.8126032570214775 , Test Accuracy :0.787169603524229
Train Recall Score : 0.5548455804046858 , Test Recall Score :0.5027110766847405
Train Precision Score: 0.7458840372226199 , Test Precision score: 0.6267503621438918
Train f1 Score: 0.6363358778625953 , Test f1 socre score: 0.8320512820512821
Training GNB:
Train Accuracy : 0.6923137440012588 , Test Accuracy :0.7098017621145375
Train Recall Score : 0.5995740149094781 , Test Recall Score :0.5003872966692486
Train Precision Score: 0.48336552908349434 , Test Precision score: 0.5507246376811595
Train f1 Score: 0.5352346999405823 , Test f1 socre score: 0.6123222748815166
Training XGB:
Train Accuracy : 0.8277869561796869 , Test Accuracy :0.7833149779735683
Train Recall Score : 0.6033013844515442 , Test Recall Score :0.47947327652982186
Train Precision Score: 0.7642495784148398 , Test Precision score: 0.611358024691358
Train f1 Score: 0.67430441898527 , Test f1 socre score: 0.8433242506811989
Training DT:
Train Accuracy : 1.0 , Test Accuracy :0.739262114537445
Train Recall Score : 1.0 , Test Recall Score :0.5290472501936483
Train Precision Score: 1.0 , Test Precision score: 0.5905750108084737
Train f1 Score: 1.0 , Test f1 socre score: 0.6682974559686888
Training MLP:
Train Accuracy : 0.8103217685469278 , Test Accuracy :0.7868942731277533
Train Recall Score : 0.5391373801916933 , Test Recall Score :0.5011618900077459
Train Precision Score: 0.7486136783733827 , Test Precision score: 0.6257253384912959
```

```
Train f1 Score: 0.6268379507816128 , Test f1 socre score: 0.832689832698327
```

In [88]:
```python
def classify_batches(models,drift_stream,stream,class_col,batch_size):


    # Creating a DataFrame with columns for accuracy , precision and recall for eac

    df=pd.DataFrame()
    for name,model in models:
        df[name+"_accuracy"]=[]
        df[name+"_precision"]=[]
        df[name+"_recall"]=[]
        df[name+""]=[]


    batches_data=make_batches(drift_stream)
    labels=stream['class']
    data=np.array(labels)
    #batch_size=32
    batches={}
    count=0
    shift=batch_size
    for index in range(0,data.shape[0],batch_size):
        batches[count]=data[index:shift]
        count+=1
        shift+=batch_size

    for i in range(0,len(batches)):
        for name,model in models:
            clf=model
            x_test=batches_data[i]
            y_test=batches[i]
            print ("Batch " +str(i) +":"+name)
            y_predict=clf.predict(x_test)
            accuracy = metrics.accuracy_score(y_test, y_predict).round(3)
            recall=metrics.recall_score(y_test, y_predict).round(3)
            precision=metrics.precision_score(y_test, y_predict).round(3)
            f1score=metrics.f1_score(y_test, y_predict).round(3)
            df.loc[i,name+"_accuracy"]=accuracy
            df.loc[i,name+"_recall"]=recall
            df.loc[i,name+"_precision"]=precision
            df.loc[i,name+""]=f1score


            print("Accuracy :{}".format(accuracy))
            print("Recall: {}".format(recall))
            print("Precision:{}".format(precision))
            print("F1_Score:{}".format(f1score))


    # df2 contains the average of every 5 batches
    df2=df.groupby(np.arange(len(df))//5).mean()

    return df,df2
```

In [89]:
```python
df,df2=classify_batches(models,stream_top25 ,stream,'class',batch_size=32)
```

```
Batch 0:LogReg
Accuracy :0.938
Recall: 0.714
Precision:1.0
F1_Score:0.833
Batch 0:RF
Accuracy :0.906
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 0:KNN
Accuracy :0.875
Recall: 0.714
Precision:0.714
F1_Score:0.714
Batch 0:SVM
Accuracy :0.938
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 0:GNB
Accuracy :0.781
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 0:XGB
Accuracy :0.906
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 0:DT
Accuracy :0.844
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 0:MLP
Accuracy :0.938
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 1:LogReg
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:RF
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:KNN
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 1:SVM
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:GNB
Accuracy :0.688
```

```
Recall: 0.182
Precision:0.667
F1_Score:0.286
Batch 1:XGB
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 1:DT
Accuracy :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
Batch 1:MLP
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 2:LogReg
Accuracy :0.656
Recall: 0.333
Precision:0.833
F1_Score:0.476
Batch 2:RF
Accuracy :0.844
Recall: 0.8
Precision:0.857
F1_Score:0.828
Batch 2:KNN
Accuracy :0.75
Recall: 0.667
Precision:0.769
F1_Score:0.714
Batch 2:SVM
Accuracy :0.75
Recall: 0.6
Precision:0.818
F1_Score:0.692
Batch 2:GNB
Accuracy :0.625
Recall: 0.467
Precision:0.636
F1_Score:0.538
Batch 2:XGB
Accuracy :0.719
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 2:DT
Accuracy :0.719
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 2:MLP
Accuracy :0.781
Recall: 0.6
Precision:0.9
F1_Score:0.72
Batch 3:LogReg
Accuracy :0.719
Recall: 0.571
Precision:1.0
```

```
F1_Score:0.727
Batch 3:RF
Accuracy :0.938
Recall: 0.952
Precision:0.952
F1_Score:0.952
Batch 3:KNN
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 3:SVM
Accuracy :0.906
Recall: 0.905
Precision:0.95
F1_Score:0.927
Batch 3:GNB
Accuracy :0.688
Recall: 0.667
Precision:0.824
F1_Score:0.737
Batch 3:XGB
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 3:DT
Accuracy :0.812
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 3:MLP
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 4:LogReg
Accuracy :0.719
Recall: 0.65
Precision:0.867
F1_Score:0.743
Batch 4:RF
Accuracy :0.781
Recall: 0.7
Precision:0.933
F1_Score:0.8
Batch 4:KNN
Accuracy :0.75
Recall: 0.65
Precision:0.929
F1_Score:0.765
Batch 4:SVM
Accuracy :0.812
Recall: 0.7
Precision:1.0
F1_Score:0.824
Batch 4:GNB
Accuracy :0.75
Recall: 0.95
Precision:0.731
F1_Score:0.826
Batch 4:XGB
```

```
Accuracy :0.781
Recall: 0.75
Precision:0.882
F1_Score:0.811
Batch 4:DT
Accuracy :0.688
Recall: 0.5
Precision:1.0
F1_Score:0.667
Batch 4:MLP
Accuracy :0.781
Recall: 0.65
Precision:1.0
F1_Score:0.788
Batch 5:LogReg
Accuracy :0.625
Recall: 0.615
Precision:0.533
F1_Score:0.571
Batch 5:RF
Accuracy :0.781
Recall: 0.538
Precision:0.875
F1_Score:0.667
Batch 5:KNN
Accuracy :0.688
Recall: 0.538
Precision:0.636
F1_Score:0.583
Batch 5:SVM
Accuracy :0.719
Recall: 0.462
Precision:0.75
F1_Score:0.571
Batch 5:GNB
Accuracy :0.5
Recall: 1.0
Precision:0.448
F1_Score:0.619
Batch 5:XGB
Accuracy :0.688
Recall: 0.462
Precision:0.667
F1_Score:0.545
Batch 5:DT
Accuracy :0.625
Recall: 0.385
Precision:0.556
F1_Score:0.455
Batch 5:MLP
Accuracy :0.781
Recall: 0.462
Precision:1.0
F1_Score:0.632
Batch 6:LogReg
Accuracy :0.562
Recall: 0.667
Precision:0.353
F1_Score:0.462
Batch 6:RF
Accuracy :0.656
Recall: 0.222
```

```
Precision:0.333
F1_Score:0.267
Batch 6:KNN
Accuracy :0.688
Recall: 0.444
Precision:0.444
F1_Score:0.444
Batch 6:SVM
Accuracy :0.719
Recall: 0.222
Precision:0.5
F1_Score:0.308
Batch 6:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.3
F1_Score:0.462
Batch 6:XGB
Accuracy :0.719
Recall: 0.111
Precision:0.5
F1_Score:0.182
Batch 6:DT
Accuracy :0.688
Recall: 0.333
Precision:0.429
F1_Score:0.375
Batch 6:MLP
Accuracy :0.688
Recall: 0.111
Precision:0.333
F1_Score:0.167
Batch 7:LogReg
Accuracy :0.562
Recall: 0.5
Precision:0.429
F1_Score:0.462
Batch 7:RF
Accuracy :0.812
Recall: 0.583
Precision:0.875
F1_Score:0.7
Batch 7:KNN
Accuracy :0.719
Recall: 0.417
Precision:0.714
F1_Score:0.526
Batch 7:SVM
Accuracy :0.844
Recall: 0.667
Precision:0.889
F1_Score:0.762
Batch 7:GNB
Accuracy :0.406
Recall: 0.833
Precision:0.37
F1_Score:0.513
Batch 7:XGB
Accuracy :0.719
Recall: 0.333
Precision:0.8
F1_Score:0.471
```

```
Batch 7:DT
Accuracy :0.625
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 7:MLP
Accuracy :0.688
Recall: 0.333
Precision:0.667
F1_Score:0.444
Batch 8:LogReg
Accuracy :0.75
Recall: 0.385
Precision:1.0
F1_Score:0.556
Batch 8:RF
Accuracy :0.844
Recall: 0.615
Precision:1.0
F1_Score:0.762
Batch 8:KNN
Accuracy :0.812
Recall: 0.538
Precision:1.0
F1_Score:0.7
Batch 8:SVM
Accuracy :0.781
Recall: 0.462
Precision:1.0
F1_Score:0.632
Batch 8:GNB
Accuracy :0.75
Recall: 0.846
Precision:0.647
F1_Score:0.733
Batch 8:XGB
Accuracy :0.75
Recall: 0.385
Precision:1.0
F1_Score:0.556
Batch 8:DT
Accuracy :0.812
Recall: 0.615
Precision:0.889
F1_Score:0.727
Batch 8:MLP
Accuracy :0.781
Recall: 0.462
Precision:1.0
F1_Score:0.632
Batch 9:LogReg
Accuracy :0.844
Recall: 0.5
Precision:0.8
F1_Score:0.615
Batch 9:RF
Accuracy :0.844
Recall: 0.625
Precision:0.714
F1_Score:0.667
Batch 9:KNN
Accuracy :0.781
```

```
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 9:SVM
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 9:GNB
Accuracy :0.781
Recall: 0.125
Precision:1.0
F1_Score:0.222
Batch 9:XGB
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 9:DT
Accuracy :0.625
Recall: 0.5
Precision:0.333
F1_Score:0.4
Batch 9:MLP
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 10:LogReg
Accuracy :0.688
Recall: 0.125
Precision:0.25
F1_Score:0.167
Batch 10:RF
Accuracy :0.812
Recall: 0.375
Precision:0.75
F1_Score:0.5
Batch 10:KNN
Accuracy :0.688
Recall: 0.25
Precision:0.333
F1_Score:0.286
Batch 10:SVM
Accuracy :0.812
Recall: 0.375
Precision:0.75
F1_Score:0.5
Batch 10:GNB
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 10:XGB
Accuracy :0.812
Recall: 0.25
Precision:1.0
F1_Score:0.4
Batch 10:DT
Accuracy :0.75
Recall: 0.25
Precision:0.5
```

```
F1_Score:0.333
Batch 10:MLP
Accuracy :0.812
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 11:LogReg
Accuracy :0.812
Recall: 0.571
Precision:0.571
F1_Score:0.571
Batch 11:RF
Accuracy :0.844
Recall: 0.571
Precision:0.667
F1_Score:0.615
Batch 11:KNN
Accuracy :0.781
Recall: 0.286
Precision:0.5
F1_Score:0.364
Batch 11:SVM
Accuracy :0.906
Recall: 0.714
Precision:0.833
F1_Score:0.769
Batch 11:GNB
Accuracy :0.781
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 11:XGB
Accuracy :0.875
Recall: 0.857
Precision:0.667
F1_Score:0.75
Batch 11:DT
Accuracy :0.812
Recall: 0.429
Precision:0.6
F1_Score:0.5
Batch 11:MLP
Accuracy :0.875
Recall: 0.714
Precision:0.714
F1_Score:0.714
Batch 12:LogReg
Accuracy :0.812
Recall: 0.286
Precision:0.667
F1_Score:0.4
Batch 12:RF
Accuracy :0.844
Recall: 0.429
Precision:0.75
F1_Score:0.545
Batch 12:KNN
Accuracy :0.875
Recall: 0.429
Precision:1.0
F1_Score:0.6
Batch 12:SVM
```

```
Accuracy :0.844
Recall: 0.286
Precision:1.0
F1_Score:0.444
Batch 12:GNB
Accuracy :0.781
Recall: 0.143
Precision:0.5
F1_Score:0.222
Batch 12:XGB
Accuracy :0.875
Recall: 0.571
Precision:0.8
F1_Score:0.667
Batch 12:DT
Accuracy :0.875
Recall: 0.571
Precision:0.8
F1_Score:0.667
Batch 12:MLP
Accuracy :0.875
Recall: 0.429
Precision:1.0
F1_Score:0.6
Batch 13:LogReg
Accuracy :0.875
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 13:RF
Accuracy :0.906
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 13:KNN
Accuracy :0.844
Recall: 0.2
Precision:0.5
F1_Score:0.286
Batch 13:SVM
Accuracy :0.875
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 13:GNB
Accuracy :0.875
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 13:XGB
Accuracy :0.906
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 13:DT
Accuracy :0.781
Recall: 0.2
Precision:0.25
F1_Score:0.222
Batch 13:MLP
Accuracy :0.906
Recall: 0.4
```

```
Precision:1.0
F1_Score:0.571
Batch 14:LogReg
Accuracy :0.562
Recall: 0.133
Precision:0.667
F1_Score:0.222
Batch 14:RF
Accuracy :0.719
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 14:KNN
Accuracy :0.656
Recall: 0.4
Precision:0.75
F1_Score:0.522
Batch 14:SVM
Accuracy :0.656
Recall: 0.267
Precision:1.0
F1_Score:0.421
Batch 14:GNB
Accuracy :0.719
Recall: 0.667
Precision:0.714
F1_Score:0.69
Batch 14:XGB
Accuracy :0.688
Recall: 0.333
Precision:1.0
F1_Score:0.5
Batch 14:DT
Accuracy :0.594
Recall: 0.4
Precision:0.6
F1_Score:0.48
Batch 14:MLP
Accuracy :0.656
Recall: 0.267
Precision:1.0
F1_Score:0.421
Batch 15:LogReg
Accuracy :0.625
Recall: 0.64
Precision:0.842
F1_Score:0.727
Batch 15:RF
Accuracy :0.875
Recall: 0.92
Precision:0.92
F1_Score:0.92
Batch 15:KNN
Accuracy :0.844
Recall: 0.92
Precision:0.885
F1_Score:0.902
Batch 15:SVM
Accuracy :0.812
Recall: 0.84
Precision:0.913
F1_Score:0.875
```

```
Batch 15:GNB
Accuracy :0.688
Recall: 0.84
Precision:0.778
F1_Score:0.808
Batch 15:XGB
Accuracy :0.812
Recall: 0.8
Precision:0.952
F1_Score:0.87
Batch 15:DT
Accuracy :0.719
Recall: 0.68
Precision:0.944
F1_Score:0.791
Batch 15:MLP
Accuracy :0.781
Recall: 0.8
Precision:0.909
F1_Score:0.851
Batch 16:LogReg
Accuracy :0.625
Recall: 0.692
Precision:0.529
F1_Score:0.6
Batch 16:RF
Accuracy :0.812
Recall: 0.692
Precision:0.818
F1_Score:0.75
Batch 16:KNN
Accuracy :0.719
Recall: 0.615
Precision:0.667
F1_Score:0.64
Batch 16:SVM
Accuracy :0.781
Recall: 0.538
Precision:0.875
F1_Score:0.667
Batch 16:GNB
Accuracy :0.5
Recall: 1.0
Precision:0.448
F1_Score:0.619
Batch 16:XGB
Accuracy :0.75
Recall: 0.538
Precision:0.778
F1_Score:0.636
Batch 16:DT
Accuracy :0.625
Recall: 0.385
Precision:0.556
F1_Score:0.455
Batch 16:MLP
Accuracy :0.781
Recall: 0.538
Precision:0.875
F1_Score:0.667
Batch 17:LogReg
Accuracy :0.562
```

```
Recall: 0.929
Precision:0.5
F1_Score:0.65
Batch 17:RF
Accuracy :0.594
Recall: 0.5
Precision:0.538
F1_Score:0.519
Batch 17:KNN
Accuracy :0.656
Recall: 0.714
Precision:0.588
F1_Score:0.645
Batch 17:SVM
Accuracy :0.719
Recall: 0.643
Precision:0.692
F1_Score:0.667
Batch 17:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 17:XGB
Accuracy :0.656
Recall: 0.714
Precision:0.588
F1_Score:0.645
Batch 17:DT
Accuracy :0.531
Recall: 0.429
Precision:0.462
F1_Score:0.444
Batch 17:MLP
Accuracy :0.719
Recall: 0.5
Precision:0.778
F1_Score:0.609
Batch 18:LogReg
Accuracy :0.469
Recall: 0.909
Precision:0.385
F1_Score:0.541
Batch 18:RF
Accuracy :0.656
Recall: 0.818
Precision:0.5
F1_Score:0.621
Batch 18:KNN
Accuracy :0.5
Recall: 0.545
Precision:0.353
F1_Score:0.429
Batch 18:SVM
Accuracy :0.594
Recall: 0.727
Precision:0.444
F1_Score:0.552
Batch 18:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
```

```
F1_Score:0.512
Batch 18:XGB
Accuracy :0.656
Recall: 0.818
Precision:0.5
F1_Score:0.621
Batch 18:DT
Accuracy :0.656
Recall: 0.636
Precision:0.5
F1_Score:0.56
Batch 18:MLP
Accuracy :0.625
Recall: 0.727
Precision:0.471
F1_Score:0.571
Batch 19:LogReg
Accuracy :0.875
Recall: 0.625
Precision:0.833
F1_Score:0.714
Batch 19:RF
Accuracy :0.719
Recall: 0.625
Precision:0.455
F1_Score:0.526
Batch 19:KNN
Accuracy :0.688
Recall: 0.625
Precision:0.417
F1_Score:0.5
Batch 19:SVM
Accuracy :0.844
Recall: 0.875
Precision:0.636
F1_Score:0.737
Batch 19:GNB
Accuracy :0.531
Recall: 1.0
Precision:0.348
F1_Score:0.516
Batch 19:XGB
Accuracy :0.781
Recall: 0.75
Precision:0.545
F1_Score:0.632
Batch 19:DT
Accuracy :0.719
Recall: 0.625
Precision:0.455
F1_Score:0.526
Batch 19:MLP
Accuracy :0.812
Recall: 0.625
Precision:0.625
F1_Score:0.625
Batch 20:LogReg
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 20:RF
```

```
Accuracy :0.75
Recall: 0.125
Precision:0.5
F1_Score:0.2
Batch 20:KNN
Accuracy :0.719
Recall: 0.375
Precision:0.429
F1_Score:0.4
Batch 20:SVM
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 20:GNB
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 20:XGB
Accuracy :0.781
Recall: 0.125
Precision:1.0
F1_Score:0.222
Batch 20:DT
Accuracy :0.656
Recall: 0.375
Precision:0.333
F1_Score:0.353
Batch 20:MLP
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 21:LogReg
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 21:RF
Accuracy :0.719
Recall: 0.333
Precision:0.8
F1_Score:0.471
Batch 21:KNN
Accuracy :0.688
Recall: 0.25
Precision:0.75
F1_Score:0.375
Batch 21:SVM
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 21:GNB
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 21:XGB
Accuracy :0.625
Recall: 0.0
```

```
Precision:0.0
F1_Score:0.0
Batch 21:DT
Accuracy :0.625
Recall: 0.417
Precision:0.5
F1_Score:0.455
Batch 21:MLP
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 22:LogReg
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 22:RF
Accuracy :0.875
Recall: 0.333
Precision:1.0
F1_Score:0.5
Batch 22:KNN
Accuracy :0.812
Recall: 0.167
Precision:0.5
F1_Score:0.25
Batch 22:SVM
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 22:GNB
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 22:XGB
Accuracy :0.844
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 22:DT
Accuracy :0.781
Recall: 0.333
Precision:0.4
F1_Score:0.364
Batch 22:MLP
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 23:LogReg
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 23:RF
Accuracy :0.906
Recall: 0.25
Precision:1.0
F1_Score:0.4
```

```
Batch 23:KNN
Accuracy :0.906
Recall: 0.25
Precision:1.0
F1_Score:0.4
Batch 23:SVM
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 23:GNB
Accuracy :0.125
Recall: 1.0
Precision:0.125
F1_Score:0.222
Batch 23:XGB
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 23:DT
Accuracy :0.906
Recall: 0.75
Precision:0.6
F1_Score:0.667
Batch 23:MLP
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 24:LogReg
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 24:RF
Accuracy :0.812
Recall: 0.375
Precision:0.75
F1_Score:0.5
Batch 24:KNN
Accuracy :0.812
Recall: 0.25
Precision:1.0
F1_Score:0.4
Batch 24:SVM
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 24:GNB
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 24:XGB
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 24:DT
Accuracy :0.781
```

```
Recall: 0.625
Precision:0.556
F1_Score:0.588
Batch 24:MLP
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 25:LogReg
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 25:RF
Accuracy :0.656
Recall: 0.1
Precision:0.333
F1_Score:0.154
Batch 25:KNN
Accuracy :0.656
Recall: 0.1
Precision:0.333
F1_Score:0.154
Batch 25:SVM
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 25:GNB
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 25:XGB
Accuracy :0.719
Recall: 0.1
Precision:1.0
F1_Score:0.182
Batch 25:DT
Accuracy :0.594
Recall: 0.5
Precision:0.385
F1_Score:0.435
Batch 25:MLP
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 26:LogReg
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 26:RF
Accuracy :0.625
Recall: 0.143
Precision:1.0
F1_Score:0.25
Batch 26:KNN
Accuracy :0.469
Recall: 0.286
Precision:0.364
```

```
F1_Score:0.32
Batch 26:SVM
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 26:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 26:XGB
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 26:DT
Accuracy :0.531
Recall: 0.286
Precision:0.444
F1_Score:0.348
Batch 26:MLP
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 27:LogReg
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 27:RF
Accuracy :0.594
Recall: 0.071
Precision:1.0
F1_Score:0.133
Batch 27:KNN
Accuracy :0.719
Recall: 0.643
Precision:0.692
F1_Score:0.667
Batch 27:SVM
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 27:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 27:XGB
Accuracy :0.594
Recall: 0.071
Precision:1.0
F1_Score:0.133
Batch 27:DT
Accuracy :0.438
Recall: 0.143
Precision:0.25
F1_Score:0.182
Batch 27:MLP
```

```
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 28:LogReg
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 28:RF
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 28:KNN
Accuracy :0.688
Recall: 0.583
Precision:0.583
F1_Score:0.583
Batch 28:SVM
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 28:GNB
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 28:XGB
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 28:DT
Accuracy :0.594
Recall: 0.25
Precision:0.429
F1_Score:0.316
Batch 28:MLP
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 29:LogReg
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 29:RF
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 29:KNN
Accuracy :0.594
Recall: 0.364
Precision:0.4
F1_Score:0.381
Batch 29:SVM
Accuracy :0.656
Recall: 0.0
```

```
Precision:0.0
F1_Score:0.0
Batch 29:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 29:XGB
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 29:DT
Accuracy :0.594
Recall: 0.273
Precision:0.375
F1_Score:0.316
Batch 29:MLP
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 30:LogReg
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 30:RF
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 30:KNN
Accuracy :0.531
Recall: 0.273
Precision:0.3
F1_Score:0.286
Batch 30:SVM
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 30:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 30:XGB
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 30:DT
Accuracy :0.625
Recall: 0.182
Precision:0.4
F1_Score:0.25
Batch 30:MLP
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
```

```
Batch 31:LogReg
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 31:RF
Accuracy :0.75
Recall: 0.417
Precision:0.833
F1_Score:0.556
Batch 31:KNN
Accuracy :0.625
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 31:SVM
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 31:GNB
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 31:XGB
Accuracy :0.688
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 31:DT
Accuracy :0.75
Recall: 0.5
Precision:0.75
F1_Score:0.6
Batch 31:MLP
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 32:LogReg
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 32:RF
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 32:KNN
Accuracy :0.812
Recall: 0.455
Precision:1.0
F1_Score:0.625
Batch 32:SVM
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 32:GNB
Accuracy :0.344
```

```
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 32:XGB
Accuracy :0.719
Recall: 0.182
Precision:1.0
F1_Score:0.308
Batch 32:DT
Accuracy :0.625
Recall: 0.636
Precision:0.467
F1_Score:0.538
Batch 32:MLP
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 33:LogReg
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 33:RF
Accuracy :0.812
Recall: 0.167
Precision:0.5
F1_Score:0.25
Batch 33:KNN
Accuracy :0.75
Recall: 0.167
Precision:0.25
F1_Score:0.2
Batch 33:SVM
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 33:GNB
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 33:XGB
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 33:DT
Accuracy :0.656
Recall: 0.833
Precision:0.333
F1_Score:0.476
Batch 33:MLP
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 34:LogReg
Accuracy :0.688
Recall: 0.0
Precision:0.0
```

```
F1_Score:0.0
Batch 34:RF
Accuracy :0.719
Recall: 0.1
Precision:1.0
F1_Score:0.182
Batch 34:KNN
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 34:SVM
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 34:GNB
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 34:XGB
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 34:DT
Accuracy :0.719
Recall: 0.6
Precision:0.545
F1_Score:0.571
Batch 34:MLP
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 35:LogReg
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 35:RF
Accuracy :0.75
Recall: 0.5
Precision:0.625
F1_Score:0.556
Batch 35:KNN
Accuracy :0.719
Recall: 0.3
Precision:0.6
F1_Score:0.4
Batch 35:SVM
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 35:GNB
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 35:XGB
```

```
                    Accuracy :0.75
                    Recall: 0.2
                    Precision:1.0
                    F1_Score:0.333
                    Batch 35:DT
                    Accuracy :0.719
                    Recall: 0.7
                    Precision:0.538
                    F1_Score:0.609
                    Batch 35:MLP
                    Accuracy :0.688
                    Recall: 0.0
                    Precision:0.0
                    F1_Score:0.0
                    Batch 36:LogReg
                    Accuracy :0.531
                    Recall: 0.0
                    Precision:0.0
                    F1_Score:0.0
                    Batch 36:RF
                    Accuracy :0.688
                    Recall: 0.4
                    Precision:0.857
                    F1_Score:0.545
                    Batch 36:KNN
                    Accuracy :0.625
                    Recall: 0.4
                    Precision:0.667
                    F1_Score:0.5
                    Batch 36:SVM
                    Accuracy :0.5
                    Recall: 0.0
                    Precision:0.0
                    F1_Score:0.0
                    Batch 36:GNB
                    Accuracy :0.469
                    Recall: 1.0
                    Precision:0.469
                    F1_Score:0.638
                    Batch 36:XGB
                    Accuracy :0.562
                    Recall: 0.133
                    Precision:0.667
                    F1_Score:0.222
                    Batch 36:DT
                    Accuracy :0.719
                    Recall: 0.6
                    Precision:0.75
                    F1_Score:0.667
                    Batch 36:MLP
                    Accuracy :0.531
                    Recall: 0.0
                    Precision:0.0
                    F1_Score:0.0
                    Batch 37:LogReg
                    Accuracy :0.375
                    Recall: 0.0
                    Precision:0.0
                    F1_Score:0.0
                    Batch 37:RF
                    Accuracy :0.625
                    Recall: 0.45
```

```
Precision:0.9
F1_Score:0.6
Batch 37:KNN
Accuracy :0.562
Recall: 0.5
Precision:0.714
F1_Score:0.588
Batch 37:SVM
Accuracy :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 37:GNB
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 37:XGB
Accuracy :0.438
Recall: 0.1
Precision:1.0
F1_Score:0.182
Batch 37:DT
Accuracy :0.406
Recall: 0.2
Precision:0.571
F1_Score:0.296
Batch 37:MLP
Accuracy :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 38:LogReg
Accuracy :0.281
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 38:RF
Accuracy :0.344
Recall: 0.087
Precision:1.0
F1_Score:0.16
Batch 38:KNN
Accuracy :0.625
Recall: 0.739
Precision:0.739
F1_Score:0.739
Batch 38:SVM
Accuracy :0.281
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 38:GNB
Accuracy :0.719
Recall: 1.0
Precision:0.719
F1_Score:0.836
Batch 38:XGB
Accuracy :0.281
Recall: 0.0
Precision:0.0
F1_Score:0.0
```

```
Batch 38:DT
Accuracy :0.375
Recall: 0.13
Precision:1.0
F1_Score:0.231
Batch 38:MLP
Accuracy :0.281
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 39:LogReg
Accuracy :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 39:RF
Accuracy :0.438
Recall: 0.1
Precision:1.0
F1_Score:0.182
Batch 39:KNN
Accuracy :0.688
Recall: 0.7
Precision:0.778
F1_Score:0.737
Batch 39:SVM
Accuracy :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 39:GNB
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 39:XGB
Accuracy :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 39:DT
Accuracy :0.375
Recall: 0.05
Precision:0.5
F1_Score:0.091
Batch 39:MLP
Accuracy :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 40:LogReg
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 40:RF
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 40:KNN
Accuracy :0.812
```

```
Recall: 0.571
Precision:1.0
F1_Score:0.727
Batch 40:SVM
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 40:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:XGB
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 40:DT
Accuracy :0.625
Recall: 0.143
Precision:1.0
F1_Score:0.25
Batch 40:MLP
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 41:LogReg
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 41:RF
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 41:KNN
Accuracy :0.688
Recall: 0.625
Precision:0.417
F1_Score:0.5
Batch 41:SVM
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 41:GNB
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 41:XGB
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 41:DT
Accuracy :0.688
Recall: 0.0
Precision:0.0
```

```
F1_Score:0.0
Batch 41:MLP
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 42:LogReg
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 42:RF
Accuracy :0.656
Recall: 0.214
Precision:1.0
F1_Score:0.353
Batch 42:KNN
Accuracy :0.719
Recall: 0.786
Precision:0.647
F1_Score:0.71
Batch 42:SVM
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 42:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 42:XGB
Accuracy :0.625
Recall: 0.143
Precision:1.0
F1_Score:0.25
Batch 42:DT
Accuracy :0.531
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 42:MLP
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 43:LogReg
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 43:RF
Accuracy :0.719
Recall: 0.357
Precision:1.0
F1_Score:0.526
Batch 43:KNN
Accuracy :0.75
Recall: 0.5
Precision:0.875
F1_Score:0.636
Batch 43:SVM
```

```
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 43:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 43:XGB
Accuracy :0.719
Recall: 0.357
Precision:1.0
F1_Score:0.526
Batch 43:DT
Accuracy :0.594
Recall: 0.357
Precision:0.556
F1_Score:0.435
Batch 43:MLP
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 44:LogReg
Accuracy :0.906
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 44:RF
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 44:KNN
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 44:SVM
Accuracy :0.906
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 44:GNB
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 44:XGB
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 44:DT
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 44:MLP
Accuracy :0.906
Recall: 0.0
```

```
Precision:0.0
F1_Score:0.0
Batch 45:LogReg
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 45:RF
Accuracy :0.906
Recall: 0.25
Precision:1.0
F1_Score:0.4
Batch 45:KNN
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 45:SVM
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 45:GNB
Accuracy :0.125
Recall: 1.0
Precision:0.125
F1_Score:0.222
Batch 45:XGB
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 45:DT
Accuracy :0.781
Recall: 0.75
Precision:0.333
F1_Score:0.462
Batch 45:MLP
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 46:LogReg
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 46:RF
Accuracy :0.688
Recall: 0.273
Precision:0.6
F1_Score:0.375
Batch 46:KNN
Accuracy :0.719
Recall: 0.364
Precision:0.667
F1_Score:0.471
Batch 46:SVM
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
```

```
Batch 46:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 46:XGB
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 46:DT
Accuracy :0.594
Recall: 0.636
Precision:0.438
F1_Score:0.519
Batch 46:MLP
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 47:LogReg
Accuracy :0.844
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 47:RF
Accuracy :0.719
Recall: 0.2
Precision:0.167
F1_Score:0.182
Batch 47:KNN
Accuracy :0.844
Recall: 0.4
Precision:0.5
F1_Score:0.444
Batch 47:SVM
Accuracy :0.844
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 47:GNB
Accuracy :0.156
Recall: 1.0
Precision:0.156
F1_Score:0.27
Batch 47:XGB
Accuracy :0.844
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 47:DT
Accuracy :0.656
Recall: 0.8
Precision:0.286
F1_Score:0.421
Batch 47:MLP
Accuracy :0.844
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 48:LogReg
Accuracy :0.406
```

```
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 48:RF
Accuracy :0.75
Recall: 0.789
Precision:0.789
F1_Score:0.789
Batch 48:KNN
Accuracy :0.719
Recall: 0.737
Precision:0.778
F1_Score:0.757
Batch 48:SVM
Accuracy :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 48:GNB
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 48:XGB
Accuracy :0.594
Recall: 0.368
Precision:0.875
F1_Score:0.519
Batch 48:DT
Accuracy :0.406
Recall: 0.053
Precision:0.5
F1_Score:0.095
Batch 48:MLP
Accuracy :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 49:LogReg
Accuracy :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 49:RF
Accuracy :0.625
Recall: 0.368
Precision:1.0
F1_Score:0.538
Batch 49:KNN
Accuracy :0.812
Recall: 0.947
Precision:0.783
F1_Score:0.857
Batch 49:SVM
Accuracy :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 49:GNB
Accuracy :0.594
Recall: 1.0
Precision:0.594
```

```
F1_Score:0.745
Batch 49:XGB
Accuracy :0.469
Recall: 0.105
Precision:1.0
F1_Score:0.19
Batch 49:DT
Accuracy :0.312
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 49:MLP
Accuracy :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 50:LogReg
Accuracy :0.469
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 50:RF
Accuracy :0.438
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 50:KNN
Accuracy :0.531
Recall: 0.765
Precision:0.542
F1_Score:0.634
Batch 50:SVM
Accuracy :0.469
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 50:GNB
Accuracy :0.531
Recall: 1.0
Precision:0.531
F1_Score:0.694
Batch 50:XGB
Accuracy :0.469
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 50:DT
Accuracy :0.469
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 50:MLP
Accuracy :0.469
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 51:LogReg
Accuracy :0.594
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 51:RF
```

```
Accuracy :0.594
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 51:KNN
Accuracy :0.5
Recall: 0.538
Precision:0.412
F1_Score:0.467
Batch 51:SVM
Accuracy :0.594
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 51:GNB
Accuracy :0.406
Recall: 1.0
Precision:0.406
F1_Score:0.578
Batch 51:XGB
Accuracy :0.594
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 51:DT
Accuracy :0.594
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 51:MLP
Accuracy :0.594
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 52:LogReg
Accuracy :0.719
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 52:RF
Accuracy :0.719
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 52:KNN
Accuracy :0.656
Recall: 0.778
Precision:0.438
F1_Score:0.56
Batch 52:SVM
Accuracy :0.719
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 52:GNB
Accuracy :0.281
Recall: 1.0
Precision:0.281
F1_Score:0.439
Batch 52:XGB
Accuracy :0.719
Recall: 0.0
```

```
Precision:0.0
F1_Score:0.0
Batch 52:DT
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 52:MLP
Accuracy :0.719
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 53:LogReg
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 53:RF
Accuracy :0.688
Recall: 0.091
Precision:1.0
F1_Score:0.167
Batch 53:KNN
Accuracy :0.656
Recall: 0.636
Precision:0.5
F1_Score:0.56
Batch 53:SVM
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 53:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 53:XGB
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 53:DT
Accuracy :0.594
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 53:MLP
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 54:LogReg
Accuracy :0.906
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 54:RF
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
```

```
Batch 54:KNN
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 54:SVM
Accuracy :0.906
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 54:GNB
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 54:XGB
Accuracy :0.906
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 54:DT
Accuracy :0.781
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 54:MLP
Accuracy :0.906
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 55:LogReg
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 55:RF
Accuracy :0.875
Recall: 0.5
Precision:0.75
F1_Score:0.6
Batch 55:KNN
Accuracy :0.812
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 55:SVM
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 55:GNB
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 55:XGB
Accuracy :0.906
Recall: 0.5
Precision:1.0
F1_Score:0.667
Batch 55:DT
Accuracy :0.781
```

```
Recall: 0.167
Precision:0.333
F1_Score:0.222
Batch 55:MLP
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 56:LogReg
Accuracy :0.917
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 56:RF
Accuracy :0.792
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 56:KNN
Accuracy :0.917
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 56:SVM
Accuracy :0.917
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 56:GNB
Accuracy :0.083
Recall: 1.0
Precision:0.083
F1_Score:0.154
Batch 56:XGB
Accuracy :0.917
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 56:DT
Accuracy :0.583
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 56:MLP
Accuracy :0.917
Recall: 0.0
Precision:0.0
F1_Score:0.0
```

In [90]: `df2`

Out[90]:

	LogReg_accuracy	LogReg_precision	LogReg_recall	LogReg	RF_accuracy	RF_precision	RF_recall
0	0.7502	0.8900	0.5082	0.6358	0.8376	0.8484	0.7164
1	0.6686	0.6230	0.5334	0.5332	0.7874	0.7594	0.5166
2	0.7498	0.6310	0.2630	0.3386	0.8250	0.8334	0.4350
3	0.6312	0.6178	0.7590	0.6464	0.7312	0.6462	0.7110

	LogReg_accuracy	LogReg_precision	LogReg_recall	LogReg	RF_accuracy	RF_precision	RF_recall
4	0.7624	0.0000	0.0000	0.0000	0.8124	0.8100	0.2832
5	0.6186	0.0000	0.0000	0.0000	0.6312	0.4666	0.0628
6	0.6874	0.0000	0.0000	0.0000	0.7374	0.6266	0.2096
7	0.4500	0.0000	0.0000	0.0000	0.5690	0.8764	0.3074
8	0.6684	0.0000	0.0000	0.0000	0.6998	0.4000	0.1142
9	0.6374	0.0000	0.0000	0.0000	0.7376	0.7112	0.3760
10	0.6688	0.0000	0.0000	0.0000	0.6378	0.2000	0.0182
11	0.8645	0.0000	0.0000	0.0000	0.8335	0.3750	0.2500

12 rows × 32 columns

Perfromance Analysis using Graphs

In [91]:

```python
## df : accuracy , recall and precision measures for all 8 classifiers for each batch
## df2 : accuracy , recall and precision measures for all 8 classifiers averaged over
def plt_classification_results(df,df2):
    from plotly import express as px
    #fig = px.line(df, x=df.index, y=[df['LogReg_accuracy'],df['RF_accuracy'],df['KNN
    #fig.show()
    #fig2 = px.line(df2, x=df2.index, y=[df2['LogReg_accuracy'],df2['RF_accuracy'],df
    #fig2.show()

    #fig3 = px.line(df, x=df.index, y=[df['LogReg_recall'],df['RF_recall'],df['KNN_re
    # fig3.show()
    #fig4 = px.line(df2, x=df2.index,y=[df2['LogReg_recall'],df2['RF_recall'],df2['KNN

    # fig4.update_layout(showlegend=True,
    #xaxis_title="Batch Stream ", yaxis_title="Recall", legend_title="Legend")


    config = {
'toImageButtonOptions': {
    'format': 'png', # one of png, svg, jpeg, webp
    'filename': 'custom_image',
    'height': 500,
    'width': 800,
    'scale':9 # Multiply title/legend/axis/canvas sizes by this factor
}}


    fig5 = px.line(df2, x=df2.index,y=[df2['LogReg'],df2['RF'],df2['KNN'],df2['SVM']

    fig5.update_layout(showlegend=True,
    xaxis_title="Batch Stream ", yaxis_title="F1 Score", legend_title="Legend")


    fig5.show(config=config)

   # fig6 = px.line(df, x=df.index,y=[df['LogReg_f1score'],df['RF_f1score'],df['KNN_f

    #fig6.show()
```

In [92]:

```python
plt_classification_results(df,df2)
```

B. Bottom 25 Sudden Drift

In [93]:
```python
stream_top25,stream_bottom25=inject_sudden_drift(stream,rank_list,batch_size=32,fper
```

In [94]:
```python
batches_d=make_batches(stream_bottom25)
```

In [95]:
```python
all_excede_list_d,exceed_count_L2_instThresh_d ,exceed_count_L2_countThresh_d,avg_mse
```

****

Batch Number : 0

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 5, 17, 18]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 1

Data Points Exceeding Layer 1 Encoder Instance Threshold : [16, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 2

```
Data Points Exceeding Layer 1 Encoder Instance Threshold : [24, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 3

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 18, 19, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 4

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 15, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 5

Data Points Exceeding Layer 1 Encoder Instance Threshold : [12]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 6

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 7

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 5, 6, 7, 15]
```

```
Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 8

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 9

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 10

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 17, 18]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 11

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 3, 4, 7, 20, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 12

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 13, 24]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []
```

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 13

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 14

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 15

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 4, 9, 11, 21, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 16

Data Points Exceeding Layer 1 Encoder Instance Threshold : [27, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 17

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 6, 8, 11, 12, 13, 14, 19, 24, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 18

Data Points Exceeding Layer 1 Encoder Instance Threshold : [4, 9, 10, 20, 21, 26, 29, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 19

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 20

Data Points Exceeding Layer 1 Encoder Instance Threshold : [25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 21

Data Points Exceeding Layer 1 Encoder Instance Threshold : [11, 29, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 22

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 17, 18, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

```
**************

Batch Number : 23

Data Points Exceeding Layer 1 Encoder Instance Threshold : [23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 24

Data Points Exceeding Layer 1 Encoder Instance Threshold : [30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 25

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 15, 16, 21, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 26

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 27

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 5]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0
```

```
**************

Batch Number : 28

Data Points Exceeding Layer 1 Encoder Instance Threshold : [26, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 29

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 7, 8, 17, 24]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 30

Data Points Exceeding Layer 1 Encoder Instance Threshold : [6, 12, 18, 26, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [6]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1


**************

Batch Number : 31

Data Points Exceeding Layer 1 Encoder Instance Threshold : [26, 27, 28, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 32

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************
```

Batch Number : 33

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7, 8, 21, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 34

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 4, 14, 20, 24, 25, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 35

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 7, 14, 15]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 36

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 10]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 37

Data Points Exceeding Layer 1 Encoder Instance Threshold : [15, 21, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 38

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 5, 9, 13, 14, 16]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 39

Data Points Exceeding Layer 1 Encoder Instance Threshold : [5, 20, 25, 27, 28, 29, 30
, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 40

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 3, 5, 6, 7, 14, 15,
18, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 41

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 4, 6, 7, 8, 9, 1
4, 15, 21, 22, 23, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [7]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1

****

Batch Number : 42

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 3, 9, 10, 14, 17, 1
8, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

```
Batch Number : 43

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 10, 16, 22, 23, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [24]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1


**************

Batch Number : 44

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 15, 16]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 45

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 46

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 29, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 47

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 6, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 48
```

Data Points Exceeding Layer 1 Encoder Instance Threshold : [18, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 49

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 50

Data Points Exceeding Layer 1 Encoder Instance Threshold : [12, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 51

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 6, 10, 16, 17, 18, 20,
21, 22, 23, 24, 25, 26, 27, 28, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 52

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 3, 6, 8, 12, 15, 18
, 23, 25, 26, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 53

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 7, 13, 16, 20]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 54

Data Points Exceeding Layer 1 Encoder Instance Threshold : [4, 15, 26, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 55

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 6, 7, 27, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 56

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

 Drift Detection at Batch Level

In [333...
```
perform_t_test()
```

```
Layer 1 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 0.084036
p-value for two tailed test is 0.933178
Accept H0: There is no drift in the dataset

Layer 1 Exceed Count   Values for Normal and Drifted Data
Test statistic is 0.077813
p-value for two tailed test is 0.938116
Accept H0: There is no drift in the dataset

Layer 2 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 0.209181
p-value for two tailed test is 0.834687
```

```
        Accept H0: There is no drift in the dataset

        Layer 2 Exceed Count   Values for Normal and Drifted Data
        Test statistic is -0.195047
        p-value for two tailed test is 0.845709
        Accept H0: There is no drift in the dataset
```

In [334…

```python
df_plotting=visual_analysis()
```

In [335…

```python
df,df2=classify_batches(models,stream_bottom25 ,stream,'class',batch_size=32)
```

```
Batch 0:LogReg
Accuracy :0.938
Recall: 0.714
Precision:1.0
F1_Score:0.833
Batch 0:RF
Accuracy :0.875
Recall: 0.857
Precision:0.667
F1_Score:0.75
Batch 0:KNN
Accuracy :0.875
Recall: 0.714
Precision:0.714
F1_Score:0.714
Batch 0:SVM
Accuracy :0.938
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 0:GNB
Accuracy :0.781
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 0:XGB
Accuracy :0.906
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 0:DT
Accuracy :0.812
Recall: 0.714
Precision:0.556
F1_Score:0.625
```

```
Batch 0:MLP
Accuracy :0.906
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 1:LogReg
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:RF
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 1:KNN
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 1:SVM
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:GNB
Accuracy :0.688
Recall: 0.182
Precision:0.667
F1_Score:0.286
Batch 1:XGB
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 1:DT
Accuracy :0.75
Recall: 0.545
Precision:0.667
F1_Score:0.6
Batch 1:MLP
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 2:LogReg
Accuracy :0.656
Recall: 0.333
Precision:0.833
F1_Score:0.476
Batch 2:RF
Accuracy :0.844
Recall: 0.733
Precision:0.917
F1_Score:0.815
Batch 2:KNN
Accuracy :0.75
Recall: 0.667
Precision:0.769
F1_Score:0.714
Batch 2:SVM
Accuracy :0.75
```

```
Recall: 0.6
Precision:0.818
F1_Score:0.692
Batch 2:GNB
Accuracy :0.625
Recall: 0.467
Precision:0.636
F1_Score:0.538
Batch 2:XGB
Accuracy :0.719
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 2:DT
Accuracy :0.688
Recall: 0.533
Precision:0.727
F1_Score:0.615
Batch 2:MLP
Accuracy :0.719
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 3:LogReg
Accuracy :0.719
Recall: 0.571
Precision:1.0
F1_Score:0.727
Batch 3:RF
Accuracy :0.969
Recall: 0.952
Precision:1.0
F1_Score:0.976
Batch 3:KNN
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 3:SVM
Accuracy :0.906
Recall: 0.905
Precision:0.95
F1_Score:0.927
Batch 3:GNB
Accuracy :0.688
Recall: 0.667
Precision:0.824
F1_Score:0.737
Batch 3:XGB
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 3:DT
Accuracy :0.812
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 3:MLP
Accuracy :0.906
Recall: 0.857
Precision:1.0
```

```
F1_Score:0.923
Batch 4:LogReg
Accuracy :0.719
Recall: 0.65
Precision:0.867
F1_Score:0.743
Batch 4:RF
Accuracy :0.812
Recall: 0.7
Precision:1.0
F1_Score:0.824
Batch 4:KNN
Accuracy :0.75
Recall: 0.65
Precision:0.929
F1_Score:0.765
Batch 4:SVM
Accuracy :0.812
Recall: 0.7
Precision:1.0
F1_Score:0.824
Batch 4:GNB
Accuracy :0.75
Recall: 0.95
Precision:0.731
F1_Score:0.826
Batch 4:XGB
Accuracy :0.781
Recall: 0.75
Precision:0.882
F1_Score:0.811
Batch 4:DT
Accuracy :0.719
Recall: 0.55
Precision:1.0
F1_Score:0.71
Batch 4:MLP
Accuracy :0.781
Recall: 0.65
Precision:1.0
F1_Score:0.788
Batch 5:LogReg
Accuracy :0.625
Recall: 0.615
Precision:0.533
F1_Score:0.571
Batch 5:RF
Accuracy :0.75
Recall: 0.462
Precision:0.857
F1_Score:0.6
Batch 5:KNN
Accuracy :0.688
Recall: 0.538
Precision:0.636
F1_Score:0.583
Batch 5:SVM
Accuracy :0.719
Recall: 0.462
Precision:0.75
F1_Score:0.571
Batch 5:GNB
```

```
Accuracy :0.5
Recall: 1.0
Precision:0.448
F1_Score:0.619
Batch 5:XGB
Accuracy :0.688
Recall: 0.462
Precision:0.667
F1_Score:0.545
Batch 5:DT
Accuracy :0.531
Recall: 0.308
Precision:0.4
F1_Score:0.348
Batch 5:MLP
Accuracy :0.781
Recall: 0.538
Precision:0.875
F1_Score:0.667
Batch 6:LogReg
Accuracy :0.562
Recall: 0.667
Precision:0.353
F1_Score:0.462
Batch 6:RF
Accuracy :0.688
Recall: 0.333
Precision:0.429
F1_Score:0.375
Batch 6:KNN
Accuracy :0.688
Recall: 0.444
Precision:0.444
F1_Score:0.444
Batch 6:SVM
Accuracy :0.719
Recall: 0.222
Precision:0.5
F1_Score:0.308
Batch 6:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.3
F1_Score:0.462
Batch 6:XGB
Accuracy :0.719
Recall: 0.111
Precision:0.5
F1_Score:0.182
Batch 6:DT
Accuracy :0.719
Recall: 0.333
Precision:0.5
F1_Score:0.4
Batch 6:MLP
Accuracy :0.75
Recall: 0.333
Precision:0.6
F1_Score:0.429
Batch 7:LogReg
Accuracy :0.562
Recall: 0.5
```

```
Precision:0.429
F1_Score:0.462
Batch 7:RF
Accuracy :0.781
Recall: 0.583
Precision:0.778
F1_Score:0.667
Batch 7:KNN
Accuracy :0.719
Recall: 0.417
Precision:0.714
F1_Score:0.526
Batch 7:SVM
Accuracy :0.844
Recall: 0.667
Precision:0.889
F1_Score:0.762
Batch 7:GNB
Accuracy :0.406
Recall: 0.833
Precision:0.37
F1_Score:0.513
Batch 7:XGB
Accuracy :0.719
Recall: 0.333
Precision:0.8
F1_Score:0.471
Batch 7:DT
Accuracy :0.531
Recall: 0.333
Precision:0.364
F1_Score:0.348
Batch 7:MLP
Accuracy :0.75
Recall: 0.5
Precision:0.75
F1_Score:0.6
Batch 8:LogReg
Accuracy :0.75
Recall: 0.385
Precision:1.0
F1_Score:0.556
Batch 8:RF
Accuracy :0.812
Recall: 0.538
Precision:1.0
F1_Score:0.7
Batch 8:KNN
Accuracy :0.812
Recall: 0.538
Precision:1.0
F1_Score:0.7
Batch 8:SVM
Accuracy :0.781
Recall: 0.462
Precision:1.0
F1_Score:0.632
Batch 8:GNB
Accuracy :0.75
Recall: 0.846
Precision:0.647
F1_Score:0.733
```

```
Batch 8:XGB
Accuracy :0.75
Recall: 0.385
Precision:1.0
F1_Score:0.556
Batch 8:DT
Accuracy :0.812
Recall: 0.615
Precision:0.889
F1_Score:0.727
Batch 8:MLP
Accuracy :0.812
Recall: 0.538
Precision:1.0
F1_Score:0.7
Batch 9:LogReg
Accuracy :0.844
Recall: 0.5
Precision:0.8
F1_Score:0.615
Batch 9:RF
Accuracy :0.812
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 9:KNN
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 9:SVM
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 9:GNB
Accuracy :0.781
Recall: 0.125
Precision:1.0
F1_Score:0.222
Batch 9:XGB
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 9:DT
Accuracy :0.656
Recall: 0.5
Precision:0.364
F1_Score:0.421
Batch 9:MLP
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 10:LogReg
Accuracy :0.688
Recall: 0.125
Precision:0.25
F1_Score:0.167
Batch 10:RF
Accuracy :0.812
```

```
Recall: 0.375
Precision:0.75
F1_Score:0.5
Batch 10:KNN
Accuracy :0.688
Recall: 0.25
Precision:0.333
F1_Score:0.286
Batch 10:SVM
Accuracy :0.812
Recall: 0.375
Precision:0.75
F1_Score:0.5
Batch 10:GNB
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 10:XGB
Accuracy :0.812
Recall: 0.25
Precision:1.0
F1_Score:0.4
Batch 10:DT
Accuracy :0.781
Recall: 0.375
Precision:0.6
F1_Score:0.462
Batch 10:MLP
Accuracy :0.844
Recall: 0.5
Precision:0.8
F1_Score:0.615
Batch 11:LogReg
Accuracy :0.812
Recall: 0.571
Precision:0.571
F1_Score:0.571
Batch 11:RF
Accuracy :0.812
Recall: 0.571
Precision:0.571
F1_Score:0.571
Batch 11:KNN
Accuracy :0.781
Recall: 0.286
Precision:0.5
F1_Score:0.364
Batch 11:SVM
Accuracy :0.906
Recall: 0.714
Precision:0.833
F1_Score:0.769
Batch 11:GNB
Accuracy :0.781
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 11:XGB
Accuracy :0.875
Recall: 0.857
Precision:0.667
```

```
F1_Score:0.75
Batch 11:DT
Accuracy :0.719
Recall: 0.429
Precision:0.375
F1_Score:0.4
Batch 11:MLP
Accuracy :0.844
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 12:LogReg
Accuracy :0.812
Recall: 0.286
Precision:0.667
F1_Score:0.4
Batch 12:RF
Accuracy :0.844
Recall: 0.429
Precision:0.75
F1_Score:0.545
Batch 12:KNN
Accuracy :0.875
Recall: 0.429
Precision:1.0
F1_Score:0.6
Batch 12:SVM
Accuracy :0.844
Recall: 0.286
Precision:1.0
F1_Score:0.444
Batch 12:GNB
Accuracy :0.781
Recall: 0.143
Precision:0.5
F1_Score:0.222
Batch 12:XGB
Accuracy :0.875
Recall: 0.571
Precision:0.8
F1_Score:0.667
Batch 12:DT
Accuracy :0.875
Recall: 0.571
Precision:0.8
F1_Score:0.667
Batch 12:MLP
Accuracy :0.844
Recall: 0.429
Precision:0.75
F1_Score:0.545
Batch 13:LogReg
Accuracy :0.875
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 13:RF
Accuracy :0.906
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 13:KNN
```

```
Accuracy :0.844
Recall: 0.2
Precision:0.5
F1_Score:0.286
Batch 13:SVM
Accuracy :0.875
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 13:GNB
Accuracy :0.875
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 13:XGB
Accuracy :0.906
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 13:DT
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 13:MLP
Accuracy :0.906
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 14:LogReg
Accuracy :0.562
Recall: 0.133
Precision:0.667
F1_Score:0.222
Batch 14:RF
Accuracy :0.75
Recall: 0.467
Precision:1.0
F1_Score:0.636
Batch 14:KNN
Accuracy :0.656
Recall: 0.4
Precision:0.75
F1_Score:0.522
Batch 14:SVM
Accuracy :0.656
Recall: 0.267
Precision:1.0
F1_Score:0.421
Batch 14:GNB
Accuracy :0.719
Recall: 0.667
Precision:0.714
F1_Score:0.69
Batch 14:XGB
Accuracy :0.688
Recall: 0.333
Precision:1.0
F1_Score:0.5
Batch 14:DT
Accuracy :0.562
Recall: 0.4
```

```
Precision:0.545
F1_Score:0.462
Batch 14:MLP
Accuracy :0.656
Recall: 0.267
Precision:1.0
F1_Score:0.421
Batch 15:LogReg
Accuracy :0.625
Recall: 0.64
Precision:0.842
F1_Score:0.727
Batch 15:RF
Accuracy :0.844
Recall: 0.92
Precision:0.885
F1_Score:0.902
Batch 15:KNN
Accuracy :0.844
Recall: 0.92
Precision:0.885
F1_Score:0.902
Batch 15:SVM
Accuracy :0.812
Recall: 0.84
Precision:0.913
F1_Score:0.875
Batch 15:GNB
Accuracy :0.688
Recall: 0.84
Precision:0.778
F1_Score:0.808
Batch 15:XGB
Accuracy :0.812
Recall: 0.8
Precision:0.952
F1_Score:0.87
Batch 15:DT
Accuracy :0.781
Recall: 0.76
Precision:0.95
F1_Score:0.844
Batch 15:MLP
Accuracy :0.781
Recall: 0.8
Precision:0.909
F1_Score:0.851
Batch 16:LogReg
Accuracy :0.625
Recall: 0.692
Precision:0.529
F1_Score:0.6
Batch 16:RF
Accuracy :0.75
Recall: 0.615
Precision:0.727
F1_Score:0.667
Batch 16:KNN
Accuracy :0.719
Recall: 0.615
Precision:0.667
F1_Score:0.64
```

```
Batch 16:SVM
Accuracy :0.781
Recall: 0.538
Precision:0.875
F1_Score:0.667
Batch 16:GNB
Accuracy :0.5
Recall: 1.0
Precision:0.448
F1_Score:0.619
Batch 16:XGB
Accuracy :0.75
Recall: 0.538
Precision:0.778
F1_Score:0.636
Batch 16:DT
Accuracy :0.688
Recall: 0.462
Precision:0.667
F1_Score:0.545
Batch 16:MLP
Accuracy :0.75
Recall: 0.615
Precision:0.727
F1_Score:0.667
Batch 17:LogReg
Accuracy :0.562
Recall: 0.929
Precision:0.5
F1_Score:0.65
Batch 17:RF
Accuracy :0.75
Recall: 0.643
Precision:0.75
F1_Score:0.692
Batch 17:KNN
Accuracy :0.656
Recall: 0.714
Precision:0.588
F1_Score:0.645
Batch 17:SVM
Accuracy :0.719
Recall: 0.643
Precision:0.692
F1_Score:0.667
Batch 17:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 17:XGB
Accuracy :0.656
Recall: 0.714
Precision:0.588
F1_Score:0.645
Batch 17:DT
Accuracy :0.469
Recall: 0.357
Precision:0.385
F1_Score:0.37
Batch 17:MLP
Accuracy :0.688
```

```
Recall: 0.643
Precision:0.643
F1_Score:0.643
Batch 18:LogReg
Accuracy :0.469
Recall: 0.909
Precision:0.385
F1_Score:0.541
Batch 18:RF
Accuracy :0.625
Recall: 0.727
Precision:0.471
F1_Score:0.571
Batch 18:KNN
Accuracy :0.5
Recall: 0.545
Precision:0.353
F1_Score:0.429
Batch 18:SVM
Accuracy :0.594
Recall: 0.727
Precision:0.444
F1_Score:0.552
Batch 18:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 18:XGB
Accuracy :0.656
Recall: 0.818
Precision:0.5
F1_Score:0.621
Batch 18:DT
Accuracy :0.594
Recall: 0.545
Precision:0.429
F1_Score:0.48
Batch 18:MLP
Accuracy :0.625
Recall: 0.818
Precision:0.474
F1_Score:0.6
Batch 19:LogReg
Accuracy :0.875
Recall: 0.625
Precision:0.833
F1_Score:0.714
Batch 19:RF
Accuracy :0.688
Recall: 0.5
Precision:0.4
F1_Score:0.444
Batch 19:KNN
Accuracy :0.688
Recall: 0.625
Precision:0.417
F1_Score:0.5
Batch 19:SVM
Accuracy :0.844
Recall: 0.875
Precision:0.636
```

```
F1_Score:0.737
Batch 19:GNB
Accuracy :0.531
Recall: 1.0
Precision:0.348
F1_Score:0.516
Batch 19:XGB
Accuracy :0.781
Recall: 0.75
Precision:0.545
F1_Score:0.632
Batch 19:DT
Accuracy :0.719
Recall: 0.625
Precision:0.455
F1_Score:0.526
Batch 19:MLP
Accuracy :0.844
Recall: 0.875
Precision:0.636
F1_Score:0.737
Batch 20:LogReg
Accuracy :0.844
Recall: 0.625
Precision:0.714
F1_Score:0.667
Batch 20:RF
Accuracy :0.938
Recall: 1.0
Precision:0.8
F1_Score:0.889
Batch 20:KNN
Accuracy :0.906
Recall: 0.875
Precision:0.778
F1_Score:0.824
Batch 20:SVM
Accuracy :0.875
Recall: 0.875
Precision:0.7
F1_Score:0.778
Batch 20:GNB
Accuracy :0.656
Recall: 0.75
Precision:0.4
F1_Score:0.522
Batch 20:XGB
Accuracy :0.906
Recall: 0.875
Precision:0.778
F1_Score:0.824
Batch 20:DT
Accuracy :0.812
Recall: 0.75
Precision:0.6
F1_Score:0.667
Batch 20:MLP
Accuracy :0.906
Recall: 0.875
Precision:0.778
F1_Score:0.824
Batch 21:LogReg
```

```
Accuracy :0.812
Recall: 0.667
Precision:0.8
F1_Score:0.727
Batch 21:RF
Accuracy :0.781
Recall: 0.667
Precision:0.727
F1_Score:0.696
Batch 21:KNN
Accuracy :0.781
Recall: 0.667
Precision:0.727
F1_Score:0.696
Batch 21:SVM
Accuracy :0.812
Recall: 0.667
Precision:0.8
F1_Score:0.727
Batch 21:GNB
Accuracy :0.688
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 21:XGB
Accuracy :0.719
Recall: 0.583
Precision:0.636
F1_Score:0.609
Batch 21:DT
Accuracy :0.625
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 21:MLP
Accuracy :0.781
Recall: 0.667
Precision:0.727
F1_Score:0.696
Batch 22:LogReg
Accuracy :0.781
Recall: 0.5
Precision:0.429
F1_Score:0.462
Batch 22:RF
Accuracy :0.906
Recall: 0.5
Precision:1.0
F1_Score:0.667
Batch 22:KNN
Accuracy :0.875
Recall: 0.333
Precision:1.0
F1_Score:0.5
Batch 22:SVM
Accuracy :0.906
Recall: 0.5
Precision:1.0
F1_Score:0.667
Batch 22:GNB
Accuracy :0.844
Recall: 0.167
```

```
Precision:1.0
F1_Score:0.286
Batch 22:XGB
Accuracy :0.938
Recall: 0.667
Precision:1.0
F1_Score:0.8
Batch 22:DT
Accuracy :0.875
Recall: 0.667
Precision:0.667
F1_Score:0.667
Batch 22:MLP
Accuracy :0.906
Recall: 0.667
Precision:0.8
F1_Score:0.727
Batch 23:LogReg
Accuracy :0.844
Recall: 0.5
Precision:0.4
F1_Score:0.444
Batch 23:RF
Accuracy :0.969
Recall: 0.75
Precision:1.0
F1_Score:0.857
Batch 23:KNN
Accuracy :0.906
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 23:SVM
Accuracy :0.938
Recall: 0.5
Precision:1.0
F1_Score:0.667
Batch 23:GNB
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 23:XGB
Accuracy :0.969
Recall: 0.75
Precision:1.0
F1_Score:0.857
Batch 23:DT
Accuracy :0.844
Recall: 0.75
Precision:0.429
F1_Score:0.545
Batch 23:MLP
Accuracy :0.938
Recall: 0.5
Precision:1.0
F1_Score:0.667
Batch 24:LogReg
Accuracy :0.781
Recall: 0.375
Precision:0.6
F1_Score:0.462
```

```
Batch 24:RF
Accuracy :0.906
Recall: 0.75
Precision:0.857
F1_Score:0.8
Batch 24:KNN
Accuracy :0.875
Recall: 0.75
Precision:0.75
F1_Score:0.75
Batch 24:SVM
Accuracy :0.875
Recall: 0.625
Precision:0.833
F1_Score:0.714
Batch 24:GNB
Accuracy :0.812
Recall: 0.25
Precision:1.0
F1_Score:0.4
Batch 24:XGB
Accuracy :0.844
Recall: 0.75
Precision:0.667
F1_Score:0.706
Batch 24:DT
Accuracy :0.812
Recall: 0.75
Precision:0.6
F1_Score:0.667
Batch 24:MLP
Accuracy :0.875
Recall: 0.625
Precision:0.833
F1_Score:0.714
Batch 25:LogReg
Accuracy :0.75
Recall: 0.5
Precision:0.625
F1_Score:0.556
Batch 25:RF
Accuracy :0.719
Recall: 0.6
Precision:0.545
F1_Score:0.571
Batch 25:KNN
Accuracy :0.688
Recall: 0.6
Precision:0.5
F1_Score:0.545
Batch 25:SVM
Accuracy :0.781
Recall: 0.6
Precision:0.667
F1_Score:0.632
Batch 25:GNB
Accuracy :0.719
Recall: 0.5
Precision:0.556
F1_Score:0.526
Batch 25:XGB
Accuracy :0.812
```

```
Recall: 0.7
Precision:0.7
F1_Score:0.7
Batch 25:DT
Accuracy :0.719
Recall: 0.6
Precision:0.545
F1_Score:0.571
Batch 25:MLP
Accuracy :0.812
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 26:LogReg
Accuracy :0.688
Recall: 0.286
Precision:1.0
F1_Score:0.444
Batch 26:RF
Accuracy :0.688
Recall: 0.429
Precision:0.75
F1_Score:0.545
Batch 26:KNN
Accuracy :0.781
Recall: 0.643
Precision:0.818
F1_Score:0.72
Batch 26:SVM
Accuracy :0.719
Recall: 0.429
Precision:0.857
F1_Score:0.571
Batch 26:GNB
Accuracy :0.625
Recall: 0.786
Precision:0.55
F1_Score:0.647
Batch 26:XGB
Accuracy :0.719
Recall: 0.5
Precision:0.778
F1_Score:0.609
Batch 26:DT
Accuracy :0.688
Recall: 0.643
Precision:0.643
F1_Score:0.643
Batch 26:MLP
Accuracy :0.719
Recall: 0.429
Precision:0.857
F1_Score:0.571
Batch 27:LogReg
Accuracy :0.812
Recall: 0.714
Precision:0.833
F1_Score:0.769
Batch 27:RF
Accuracy :0.75
Recall: 0.571
Precision:0.8
```

```
F1_Score:0.667
Batch 27:KNN
Accuracy :0.875
Recall: 0.786
Precision:0.917
F1_Score:0.846
Batch 27:SVM
Accuracy :0.75
Recall: 0.5
Precision:0.875
F1_Score:0.636
Batch 27:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 27:XGB
Accuracy :0.719
Recall: 0.643
Precision:0.692
F1_Score:0.667
Batch 27:DT
Accuracy :0.625
Recall: 0.357
Precision:0.625
F1_Score:0.455
Batch 27:MLP
Accuracy :0.75
Recall: 0.5
Precision:0.875
F1_Score:0.636
Batch 28:LogReg
Accuracy :0.594
Recall: 0.833
Precision:0.476
F1_Score:0.606
Batch 28:RF
Accuracy :0.656
Recall: 0.25
Precision:0.6
F1_Score:0.353
Batch 28:KNN
Accuracy :0.656
Recall: 0.417
Precision:0.556
F1_Score:0.476
Batch 28:SVM
Accuracy :0.688
Recall: 0.333
Precision:0.667
F1_Score:0.444
Batch 28:GNB
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 28:XGB
Accuracy :0.688
Recall: 0.25
Precision:0.75
F1_Score:0.375
Batch 28:DT
```

```
Accuracy :0.625
Recall: 0.25
Precision:0.5
F1_Score:0.333
Batch 28:MLP
Accuracy :0.656
Recall: 0.417
Precision:0.556
F1_Score:0.476
Batch 29:LogReg
Accuracy :0.531
Recall: 0.727
Precision:0.4
F1_Score:0.516
Batch 29:RF
Accuracy :0.75
Recall: 0.636
Precision:0.636
F1_Score:0.636
Batch 29:KNN
Accuracy :0.625
Recall: 0.636
Precision:0.467
F1_Score:0.538
Batch 29:SVM
Accuracy :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
Batch 29:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 29:XGB
Accuracy :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
Batch 29:DT
Accuracy :0.688
Recall: 0.727
Precision:0.533
F1_Score:0.615
Batch 29:MLP
Accuracy :0.719
Recall: 0.727
Precision:0.571
F1_Score:0.64
Batch 30:LogReg
Accuracy :0.562
Recall: 0.818
Precision:0.429
F1_Score:0.562
Batch 30:RF
Accuracy :0.688
Recall: 0.545
Precision:0.545
F1_Score:0.545
Batch 30:KNN
Accuracy :0.625
Recall: 0.545
```

```
Precision:0.462
F1_Score:0.5
Batch 30:SVM
Accuracy :0.594
Recall: 0.636
Precision:0.438
F1_Score:0.519
Batch 30:GNB
Accuracy :0.312
Recall: 0.909
Precision:0.323
F1_Score:0.476
Batch 30:XGB
Accuracy :0.5
Recall: 0.364
Precision:0.308
F1_Score:0.333
Batch 30:DT
Accuracy :0.469
Recall: 0.364
Precision:0.286
F1_Score:0.32
Batch 30:MLP
Accuracy :0.594
Recall: 0.727
Precision:0.444
F1_Score:0.552
Batch 31:LogReg
Accuracy :0.719
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 31:RF
Accuracy :0.719
Recall: 0.583
Precision:0.636
F1_Score:0.609
Batch 31:KNN
Accuracy :0.656
Recall: 0.667
Precision:0.533
F1_Score:0.593
Batch 31:SVM
Accuracy :0.75
Recall: 0.583
Precision:0.7
F1_Score:0.636
Batch 31:GNB
Accuracy :0.531
Recall: 0.667
Precision:0.421
F1_Score:0.516
Batch 31:XGB
Accuracy :0.719
Recall: 0.583
Precision:0.636
F1_Score:0.609
Batch 31:DT
Accuracy :0.594
Recall: 0.583
Precision:0.467
F1_Score:0.519
```

```
Batch 31:MLP
Accuracy :0.75
Recall: 0.583
Precision:0.7
F1_Score:0.636
Batch 32:LogReg
Accuracy :0.719
Recall: 0.727
Precision:0.571
F1_Score:0.64
Batch 32:RF
Accuracy :0.75
Recall: 0.818
Precision:0.6
F1_Score:0.692
Batch 32:KNN
Accuracy :0.688
Recall: 0.636
Precision:0.538
F1_Score:0.583
Batch 32:SVM
Accuracy :0.719
Recall: 0.818
Precision:0.562
F1_Score:0.667
Batch 32:GNB
Accuracy :0.688
Recall: 0.182
Precision:0.667
F1_Score:0.286
Batch 32:XGB
Accuracy :0.688
Recall: 0.818
Precision:0.529
F1_Score:0.643
Batch 32:DT
Accuracy :0.688
Recall: 0.727
Precision:0.533
F1_Score:0.615
Batch 32:MLP
Accuracy :0.719
Recall: 0.818
Precision:0.562
F1_Score:0.667
Batch 33:LogReg
Accuracy :0.656
Recall: 0.833
Precision:0.333
F1_Score:0.476
Batch 33:RF
Accuracy :0.75
Recall: 0.667
Precision:0.4
F1_Score:0.5
Batch 33:KNN
Accuracy :0.719
Recall: 0.333
Precision:0.286
F1_Score:0.308
Batch 33:SVM
Accuracy :0.75
```

```
Recall: 0.667
Precision:0.4
F1_Score:0.5
Batch 33:GNB
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 33:XGB
Accuracy :0.812
Recall: 0.667
Precision:0.5
F1_Score:0.571
Batch 33:DT
Accuracy :0.688
Recall: 0.667
Precision:0.333
F1_Score:0.444
Batch 33:MLP
Accuracy :0.719
Recall: 0.833
Precision:0.385
F1_Score:0.526
Batch 34:LogReg
Accuracy :0.688
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 34:RF
Accuracy :0.656
Recall: 0.4
Precision:0.444
F1_Score:0.421
Batch 34:KNN
Accuracy :0.719
Recall: 0.5
Precision:0.556
F1_Score:0.526
Batch 34:SVM
Accuracy :0.719
Recall: 0.3
Precision:0.6
F1_Score:0.4
Batch 34:GNB
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 34:XGB
Accuracy :0.656
Recall: 0.4
Precision:0.444
F1_Score:0.421
Batch 34:DT
Accuracy :0.625
Recall: 0.5
Precision:0.417
F1_Score:0.455
Batch 34:MLP
Accuracy :0.656
Recall: 0.3
Precision:0.429
```

```
F1_Score:0.353
Batch 35:LogReg
Accuracy :0.75
Recall: 0.8
Precision:0.571
F1_Score:0.667
Batch 35:RF
Accuracy :0.844
Recall: 1.0
Precision:0.667
F1_Score:0.8
Batch 35:KNN
Accuracy :0.781
Recall: 0.9
Precision:0.6
F1_Score:0.72
Batch 35:SVM
Accuracy :0.844
Recall: 0.9
Precision:0.692
F1_Score:0.783
Batch 35:GNB
Accuracy :0.719
Recall: 0.1
Precision:1.0
F1_Score:0.182
Batch 35:XGB
Accuracy :0.781
Recall: 1.0
Precision:0.588
F1_Score:0.741
Batch 35:DT
Accuracy :0.75
Recall: 0.8
Precision:0.571
F1_Score:0.667
Batch 35:MLP
Accuracy :0.844
Recall: 0.9
Precision:0.692
F1_Score:0.783
Batch 36:LogReg
Accuracy :0.719
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 36:RF
Accuracy :0.781
Recall: 0.867
Precision:0.722
F1_Score:0.788
Batch 36:KNN
Accuracy :0.781
Recall: 0.867
Precision:0.722
F1_Score:0.788
Batch 36:SVM
Accuracy :0.844
Recall: 0.933
Precision:0.778
F1_Score:0.848
Batch 36:GNB
```

```
Accuracy :0.656
Recall: 0.467
Precision:0.7
F1_Score:0.56
Batch 36:XGB
Accuracy :0.781
Recall: 0.867
Precision:0.722
F1_Score:0.788
Batch 36:DT
Accuracy :0.688
Recall: 0.733
Precision:0.647
F1_Score:0.688
Batch 36:MLP
Accuracy :0.844
Recall: 0.933
Precision:0.778
F1_Score:0.848
Batch 37:LogReg
Accuracy :0.625
Recall: 0.5
Precision:0.833
F1_Score:0.625
Batch 37:RF
Accuracy :0.781
Recall: 0.9
Precision:0.783
F1_Score:0.837
Batch 37:KNN
Accuracy :0.719
Recall: 0.75
Precision:0.789
F1_Score:0.769
Batch 37:SVM
Accuracy :0.75
Recall: 0.7
Precision:0.875
F1_Score:0.778
Batch 37:GNB
Accuracy :0.781
Recall: 1.0
Precision:0.741
F1_Score:0.851
Batch 37:XGB
Accuracy :0.812
Recall: 0.9
Precision:0.818
F1_Score:0.857
Batch 37:DT
Accuracy :0.719
Recall: 0.75
Precision:0.789
F1_Score:0.769
Batch 37:MLP
Accuracy :0.688
Recall: 0.6
Precision:0.857
F1_Score:0.706
Batch 38:LogReg
Accuracy :0.594
Recall: 0.696
```

```
Precision:0.727
F1_Score:0.711
Batch 38:RF
Accuracy :0.719
Recall: 0.696
Precision:0.889
F1_Score:0.78
Batch 38:KNN
Accuracy :0.562
Recall: 0.565
Precision:0.765
F1_Score:0.65
Batch 38:SVM
Accuracy :0.625
Recall: 0.565
Precision:0.867
F1_Score:0.684
Batch 38:GNB
Accuracy :0.719
Recall: 1.0
Precision:0.719
F1_Score:0.836
Batch 38:XGB
Accuracy :0.625
Recall: 0.696
Precision:0.762
F1_Score:0.727
Batch 38:DT
Accuracy :0.75
Recall: 0.739
Precision:0.895
F1_Score:0.81
Batch 38:MLP
Accuracy :0.594
Recall: 0.565
Precision:0.812
F1_Score:0.667
Batch 39:LogReg
Accuracy :0.781
Recall: 0.95
Precision:0.76
F1_Score:0.844
Batch 39:RF
Accuracy :0.562
Recall: 0.4
Precision:0.8
F1_Score:0.533
Batch 39:KNN
Accuracy :0.625
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 39:SVM
Accuracy :0.656
Recall: 0.5
Precision:0.909
F1_Score:0.645
Batch 39:GNB
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
```

```
Batch 39:XGB
Accuracy :0.625
Recall: 0.55
Precision:0.786
F1_Score:0.647
Batch 39:DT
Accuracy :0.406
Recall: 0.3
Precision:0.545
F1_Score:0.387
Batch 39:MLP
Accuracy :0.688
Recall: 0.7
Precision:0.778
F1_Score:0.737
Batch 40:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:RF
Accuracy :0.812
Recall: 0.571
Precision:1.0
F1_Score:0.727
Batch 40:KNN
Accuracy :0.75
Recall: 0.786
Precision:0.688
F1_Score:0.733
Batch 40:SVM
Accuracy :0.75
Recall: 0.714
Precision:0.714
F1_Score:0.714
Batch 40:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:XGB
Accuracy :0.812
Recall: 0.714
Precision:0.833
F1_Score:0.769
Batch 40:DT
Accuracy :0.719
Recall: 0.5
Precision:0.778
F1_Score:0.609
Batch 40:MLP
Accuracy :0.75
Recall: 0.786
Precision:0.688
F1_Score:0.733
Batch 41:LogReg
Accuracy :0.531
Recall: 1.0
Precision:0.348
F1_Score:0.516
Batch 41:RF
Accuracy :0.812
```

```
Recall: 0.375
Precision:0.75
F1_Score:0.5
Batch 41:KNN
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 41:SVM
Accuracy :0.844
Recall: 0.625
Precision:0.714
F1_Score:0.667
Batch 41:GNB
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 41:XGB
Accuracy :0.906
Recall: 0.75
Precision:0.857
F1_Score:0.8
Batch 41:DT
Accuracy :0.719
Recall: 0.625
Precision:0.455
F1_Score:0.526
Batch 41:MLP
Accuracy :0.875
Recall: 0.75
Precision:0.75
F1_Score:0.75
Batch 42:LogReg
Accuracy :0.781
Recall: 0.786
Precision:0.733
F1_Score:0.759
Batch 42:RF
Accuracy :0.656
Recall: 0.571
Precision:0.615
F1_Score:0.593
Batch 42:KNN
Accuracy :0.719
Recall: 0.714
Precision:0.667
F1_Score:0.69
Batch 42:SVM
Accuracy :0.625
Recall: 0.643
Precision:0.562
F1_Score:0.6
Batch 42:GNB
Accuracy :0.562
Recall: 1.0
Precision:0.5
F1_Score:0.667
Batch 42:XGB
Accuracy :0.688
Recall: 0.786
Precision:0.611
```

```
F1_Score:0.688
Batch 42:DT
Accuracy :0.594
Recall: 0.571
Precision:0.533
F1_Score:0.552
Batch 42:MLP
Accuracy :0.688
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 43:LogReg
Accuracy :0.812
Recall: 0.786
Precision:0.786
F1_Score:0.786
Batch 43:RF
Accuracy :0.594
Recall: 0.857
Precision:0.522
F1_Score:0.649
Batch 43:KNN
Accuracy :0.656
Recall: 0.857
Precision:0.571
F1_Score:0.686
Batch 43:SVM
Accuracy :0.625
Recall: 0.857
Precision:0.545
F1_Score:0.667
Batch 43:GNB
Accuracy :0.75
Recall: 0.643
Precision:0.75
F1_Score:0.692
Batch 43:XGB
Accuracy :0.625
Recall: 0.857
Precision:0.545
F1_Score:0.667
Batch 43:DT
Accuracy :0.531
Recall: 0.714
Precision:0.476
F1_Score:0.571
Batch 43:MLP
Accuracy :0.656
Recall: 0.857
Precision:0.571
F1_Score:0.686
Batch 44:LogReg
Accuracy :0.719
Recall: 0.333
Precision:0.125
F1_Score:0.182
Batch 44:RF
Accuracy :0.625
Recall: 1.0
Precision:0.2
F1_Score:0.333
Batch 44:KNN
```

```
Accuracy :0.531
Recall: 1.0
Precision:0.167
F1_Score:0.286
Batch 44:SVM
Accuracy :0.688
Recall: 1.0
Precision:0.231
F1_Score:0.375
Batch 44:GNB
Accuracy :0.75
Recall: 1.0
Precision:0.273
F1_Score:0.429
Batch 44:XGB
Accuracy :0.656
Recall: 1.0
Precision:0.214
F1_Score:0.353
Batch 44:DT
Accuracy :0.562
Recall: 1.0
Precision:0.176
F1_Score:0.3
Batch 44:MLP
Accuracy :0.688
Recall: 1.0
Precision:0.231
F1_Score:0.375
Batch 45:LogReg
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 45:RF
Accuracy :0.906
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 45:KNN
Accuracy :0.875
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 45:SVM
Accuracy :0.906
Recall: 0.25
Precision:1.0
F1_Score:0.4
Batch 45:GNB
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 45:XGB
Accuracy :0.875
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 45:DT
Accuracy :0.656
Recall: 0.75
```

```
Precision:0.231
F1_Score:0.353
Batch 45:MLP
Accuracy :0.875
Recall: 0.25
Precision:0.5
F1_Score:0.333
Batch 46:LogReg
Accuracy :0.719
Recall: 0.545
Precision:0.6
F1_Score:0.571
Batch 46:RF
Accuracy :0.781
Recall: 0.909
Precision:0.625
F1_Score:0.741
Batch 46:KNN
Accuracy :0.719
Recall: 0.818
Precision:0.562
F1_Score:0.667
Batch 46:SVM
Accuracy :0.812
Recall: 0.727
Precision:0.727
F1_Score:0.727
Batch 46:GNB
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 46:XGB
Accuracy :0.812
Recall: 0.909
Precision:0.667
F1_Score:0.769
Batch 46:DT
Accuracy :0.594
Recall: 0.818
Precision:0.45
F1_Score:0.581
Batch 46:MLP
Accuracy :0.812
Recall: 0.727
Precision:0.727
F1_Score:0.727
Batch 47:LogReg
Accuracy :0.812
Recall: 0.4
Precision:0.4
F1_Score:0.4
Batch 47:RF
Accuracy :0.781
Recall: 0.8
Precision:0.4
F1_Score:0.533
Batch 47:KNN
Accuracy :0.844
Recall: 0.8
Precision:0.5
F1_Score:0.615
```

```
Batch 47:SVM
Accuracy :0.844
Recall: 0.6
Precision:0.5
F1_Score:0.545
Batch 47:GNB
Accuracy :0.844
Recall: 0.2
Precision:0.5
F1_Score:0.286
Batch 47:XGB
Accuracy :0.812
Recall: 0.8
Precision:0.444
F1_Score:0.571
Batch 47:DT
Accuracy :0.531
Recall: 0.8
Precision:0.222
F1_Score:0.348
Batch 47:MLP
Accuracy :0.875
Recall: 0.6
Precision:0.6
F1_Score:0.6
Batch 48:LogReg
Accuracy :0.688
Recall: 0.684
Precision:0.765
F1_Score:0.722
Batch 48:RF
Accuracy :0.781
Recall: 1.0
Precision:0.731
F1_Score:0.844
Batch 48:KNN
Accuracy :0.719
Recall: 0.842
Precision:0.727
F1_Score:0.78
Batch 48:SVM
Accuracy :0.75
Recall: 0.842
Precision:0.762
F1_Score:0.8
Batch 48:GNB
Accuracy :0.719
Recall: 0.947
Precision:0.692
F1_Score:0.8
Batch 48:XGB
Accuracy :0.75
Recall: 1.0
Precision:0.704
F1_Score:0.826
Batch 48:DT
Accuracy :0.656
Recall: 0.842
Precision:0.667
F1_Score:0.744
Batch 48:MLP
Accuracy :0.719
```

```
Recall: 0.789
Precision:0.75
F1_Score:0.769
Batch 49:LogReg
Accuracy :0.875
Recall: 0.842
Precision:0.941
F1_Score:0.889
Batch 49:RF
Accuracy :0.875
Recall: 0.947
Precision:0.857
F1_Score:0.9
Batch 49:KNN
Accuracy :0.781
Recall: 0.737
Precision:0.875
F1_Score:0.8
Batch 49:SVM
Accuracy :0.875
Recall: 0.947
Precision:0.857
F1_Score:0.9
Batch 49:GNB
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 49:XGB
Accuracy :0.812
Recall: 0.947
Precision:0.783
F1_Score:0.857
Batch 49:DT
Accuracy :0.719
Recall: 0.737
Precision:0.778
F1_Score:0.757
Batch 49:MLP
Accuracy :0.875
Recall: 0.947
Precision:0.857
F1_Score:0.9
Batch 50:LogReg
Accuracy :0.656
Recall: 0.941
Precision:0.615
F1_Score:0.744
Batch 50:RF
Accuracy :0.656
Recall: 0.765
Precision:0.65
F1_Score:0.703
Batch 50:KNN
Accuracy :0.688
Recall: 0.824
Precision:0.667
F1_Score:0.737
Batch 50:SVM
Accuracy :0.719
Recall: 0.882
Precision:0.682
```

```
F1_Score:0.769
Batch 50:GNB
Accuracy :0.531
Recall: 1.0
Precision:0.531
F1_Score:0.694
Batch 50:XGB
Accuracy :0.594
Recall: 0.882
Precision:0.577
F1_Score:0.698
Batch 50:DT
Accuracy :0.594
Recall: 0.706
Precision:0.6
F1_Score:0.649
Batch 50:MLP
Accuracy :0.719
Recall: 0.882
Precision:0.682
F1_Score:0.769
Batch 51:LogReg
Accuracy :0.5
Recall: 1.0
Precision:0.448
F1_Score:0.619
Batch 51:RF
Accuracy :0.594
Recall: 0.077
Precision:0.5
F1_Score:0.133
Batch 51:KNN
Accuracy :0.625
Recall: 0.231
Precision:0.6
F1_Score:0.333
Batch 51:SVM
Accuracy :0.594
Recall: 0.231
Precision:0.5
F1_Score:0.316
Batch 51:GNB
Accuracy :0.406
Recall: 1.0
Precision:0.406
F1_Score:0.578
Batch 51:XGB
Accuracy :0.656
Recall: 0.231
Precision:0.75
F1_Score:0.353
Batch 51:DT
Accuracy :0.656
Recall: 0.308
Precision:0.667
F1_Score:0.421
Batch 51:MLP
Accuracy :0.594
Recall: 0.385
Precision:0.5
F1_Score:0.435
Batch 52:LogReg
```

```
Accuracy :0.344
Recall: 1.0
Precision:0.3
F1_Score:0.462
Batch 52:RF
Accuracy :0.5
Recall: 0.333
Precision:0.231
F1_Score:0.273
Batch 52:KNN
Accuracy :0.594
Recall: 0.556
Precision:0.357
F1_Score:0.435
Batch 52:SVM
Accuracy :0.625
Recall: 0.444
Precision:0.364
F1_Score:0.4
Batch 52:GNB
Accuracy :0.281
Recall: 1.0
Precision:0.281
F1_Score:0.439
Batch 52:XGB
Accuracy :0.625
Recall: 0.556
Precision:0.385
F1_Score:0.455
Batch 52:DT
Accuracy :0.625
Recall: 0.444
Precision:0.364
F1_Score:0.4
Batch 52:MLP
Accuracy :0.594
Recall: 0.556
Precision:0.357
F1_Score:0.435
Batch 53:LogReg
Accuracy :0.812
Recall: 0.545
Precision:0.857
F1_Score:0.667
Batch 53:RF
Accuracy :0.875
Recall: 0.818
Precision:0.818
F1_Score:0.818
Batch 53:KNN
Accuracy :0.781
Recall: 0.818
Precision:0.643
F1_Score:0.72
Batch 53:SVM
Accuracy :0.938
Recall: 0.818
Precision:1.0
F1_Score:0.9
Batch 53:GNB
Accuracy :0.438
Recall: 0.909
```

```
Precision:0.37
F1_Score:0.526
Batch 53:XGB
Accuracy :0.812
Recall: 0.909
Precision:0.667
F1_Score:0.769
Batch 53:DT
Accuracy :0.688
Recall: 0.909
Precision:0.526
F1_Score:0.667
Batch 53:MLP
Accuracy :0.938
Recall: 0.818
Precision:1.0
F1_Score:0.9
Batch 54:LogReg
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 54:RF
Accuracy :0.531
Recall: 0.333
Precision:0.071
F1_Score:0.118
Batch 54:KNN
Accuracy :0.75
Recall: 0.667
Precision:0.222
F1_Score:0.333
Batch 54:SVM
Accuracy :0.844
Recall: 0.333
Precision:0.25
F1_Score:0.286
Batch 54:GNB
Accuracy :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 54:XGB
Accuracy :0.625
Recall: 0.333
Precision:0.091
F1_Score:0.143
Batch 54:DT
Accuracy :0.375
Recall: 0.333
Precision:0.053
F1_Score:0.091
Batch 54:MLP
Accuracy :0.844
Recall: 0.333
Precision:0.25
F1_Score:0.286
Batch 55:LogReg
Accuracy :0.844
Recall: 0.5
Precision:0.6
F1_Score:0.545
```

```
Batch 55:RF
Accuracy :0.719
Recall: 1.0
Precision:0.4
F1_Score:0.571
Batch 55:KNN
Accuracy :0.75
Recall: 1.0
Precision:0.429
F1_Score:0.6
Batch 55:SVM
Accuracy :0.906
Recall: 1.0
Precision:0.667
F1_Score:0.8
Batch 55:GNB
Accuracy :0.75
Recall: 0.5
Precision:0.375
F1_Score:0.429
Batch 55:XGB
Accuracy :0.781
Recall: 1.0
Precision:0.462
F1_Score:0.632
Batch 55:DT
Accuracy :0.594
Recall: 1.0
Precision:0.316
F1_Score:0.48
Batch 55:MLP
Accuracy :0.906
Recall: 1.0
Precision:0.667
F1_Score:0.8
Batch 56:LogReg
Accuracy :0.917
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 56:RF
Accuracy :0.833
Recall: 0.5
Precision:0.25
F1_Score:0.333
Batch 56:KNN
Accuracy :0.917
Recall: 1.0
Precision:0.5
F1_Score:0.667
Batch 56:SVM
Accuracy :0.917
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 56:GNB
Accuracy :0.917
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 56:XGB
Accuracy :0.833
```

```
Recall: 0.5
Precision:0.25
F1_Score:0.333
Batch 56:DT
Accuracy :0.583
Recall: 0.5
Precision:0.1
F1_Score:0.167
Batch 56:MLP
Accuracy :0.917
Recall: 0.5
Precision:0.5
F1_Score:0.5
```

In [336...

```python
plt_classification_results(df,df2)
```

C Gradual Drift Top25

In [96]:

```python
shift=int(0.1*len(stream)/32)*32
shift/32
```

Out[96]: 5.0

```python
In [97]:  def inject_gradual_drift(stream,rank_list,batch_size=32):
              #labels=pd.DataFrame(stream['class'].reset_index(drop=True)) # retain class label
              n=int(0.25*len(rank_list)) # Number of features ( top 25 %)
              top25p_features=list(rank_list[0:int(n)].index) # list of top n features
              bottom25p_features=list(rank_list[-int(n):].index) # list of bottom n features
              all_features=list(rank_list.index) # features sorted ( descending order) by mutu
              unchanged_features_top25=set(all_features)-set(top25p_features)
              unchanged_features_bottom25=set(all_features)-set(bottom25p_features)
              unchanged_data_top25=stream[unchanged_features_top25].reset_index(drop=True)
              unchanged_data_bottom25=stream[unchanged_features_bottom25].reset_index(drop=Tru
              data_for_drift_top25=stream[top25p_features].reset_index(drop=True)
              data_for_drift_bottom25=stream[bottom25p_features].reset_index(drop=True)
              # Finding 10 split points after every 10% of instances in the stream . Based on
              # find exact number of batches to be included in each split.

              start=0
              shift=int(0.1*len(stream)/batch_size)*batch_size # start and end define each chu
              end=shift

              df=data_for_drift_top25.copy()# Create a temprary dataframe


              for pas in range (1,11):
                  if pas==1:
                      df1=df[start:end]
                      #df1=df1.where(df1<=1,1)
                      start+=shift
                      end+=shift
                  if pas==2:
                      df2=df[start:end] +df[start:end]*0.1
                      df2=df2.where(df2<=1,1)
                      start=end
                      end+=shift
                  if pas==3:
                      df3=df[start:end] +df[start:end]*0.2
                      df3=df3.where(df3<=1,1)
                      start=end
                      end+=shift
                  if pas==4:
                      df4=df[start:end] +df[start:end]*0.3
                      df4=df4.where(df4<=1,1)
                      start=end
                      end+=shift
                  if pas==5:
                      df5=df[start:end] +df[start:end]*0.4
                      df5=df5.where(df5<=1,1)
                      start=end
                      end+=shift
                  if pas==6:
                      df6=df[start:end] +df[start:end]*0.5
                      df6=df6.where(df6<=1,1)
                      start=end
                      end+=shift
                  if pas==7:
                      df7=df[start:end] +df[start:end]*0.6
                      df7=df7.where(df7<=1,1)
                      start=end
                      end+=shift
```

```python
        if pas==8:
            df8=df[start:end] +df[start:end]*0.7
            df8=df8.where(df8<=1,1)
            start=end
            end+=shift
        if pas==9:
            df9=df[start:end] +df[start:end]*0.8
            df9=df9.where(df9<=1,1)
            start=end
            end+=shift
        if pas==10:
            df10=df[start:end] +df[start:end]*0.9
            df10=df10.where(df10<=1,1)
            start=end
            end+=shift
df11=df[start:len(df)] + df[start:len(df)]*1.0
df11=df11.where(df11<=1,1)
df_drifted_top25=pd.concat([df1,df2,df3,df4,df5,df6,df7,df8,df9,df10,df11],axis=0
df_drifted_top25_all=pd.concat([df_drifted_top25,unchanged_data_top25],axis=1)
df_drifted_top25_all=df_drifted_top25_all.reindex(columns=sorted(df_drifted_top25

# Drift Stream based on bottom 25 percent

start=0
shift=int(0.1*len(stream)/batch_size)*batch_size # start and end define each chu
end=shift

df=data_for_drift_bottom25.copy()# Create a temprary dataframe


for pas in range (1,11):
    if pas==1:
        df1=df[start:end]
        df1=df1.where(df1<=1,1)
        start+=shift
        end+=shift
    if pas==2:
        df2=df[start:end] +df[start:end]*0.1
        df2=df2.where(df2<=1,1)
        start=end
        end+=shift
    if pas==3:
        df3=df[start:end] +df[start:end]*0.2
        df3=df3.where(df3<=1,1)
        start=end
        end+=shift
    if pas==4:
        df4=df[start:end] +df[start:end]*0.3
        df4=df4.where(df4<=1,1)
        start=end
        end+=shift
    if pas==5:
        df5=df[start:end] +df[start:end]*0.4
        df5=df5.where(df5<=1,1)
        start=end
        end+=shift
    if pas==6:
        df6=df[start:end] +df[start:end]*0.5
        df6=df6.where(df6<=1,1)
```

```
                    start=end
                    end+=shift
            if pas==7:
                    df7=df[start:end] +df[start:end]*0.6
                    df7=df7.where(df7<=1,1)
                    start=end
                    end+=shift
            if pas==8:
                    df8=df[start:end] +df[start:end]*0.7
                    df8=df8.where(df8<=1,1)
                    start=end
                    end+=shift
            if pas==9:
                    df9=df[start:end] +df[start:end]*0.8
                    df9=df9.where(df9<=1,1)
                    start=end
                    end+=shift
            if pas==10:
                    df10=df[start:end] +df[start:end]*0.9
                    df10=df10.where(df10<=1,1)
                    start=end
                    end+=shift
        df11=df[start:len(df)] + df[start:len(df)]*1.0
        df11=df11.where(df11<=1,1)
        df_drifted_bottom25=pd.concat([df1,df2,df3,df4,df5,df6,df7,df8,df9,df10,df11],ax:
        df_drifted_bottom25_all=pd.concat([df_drifted_bottom25,unchanged_data_bottom25],a
        df_drifted_bottom25_all=df_drifted_bottom25_all.reindex(columns=sorted(df_drifted


        return df_drifted_top25_all,df_drifted_bottom25_all
```

In [98]:
```
df_drifted_top25_all,df_drifted_bottom25_all=inject_gradual_drift(stream,rank_list,ba
```

In [99]:
```
batches_d=make_batches(df_drifted_top25_all)
```

In [100…
```
all_excede_list_d,exceed_count_L2_instThresh_d ,exceed_count_L2_countThresh_d,avg_mse
```

```
**************

Batch Number : 0

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 5, 17, 18]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 1
```

```
Data Points Exceeding Layer 1 Encoder Instance Threshold : [16, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


*************

Batch Number : 2

Data Points Exceeding Layer 1 Encoder Instance Threshold : [24, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


*************

Batch Number : 3

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 18, 19, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


*************

Batch Number : 4

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 15, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


*************

Batch Number : 5

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7, 12]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


*************

Batch Number : 6

Data Points Exceeding Layer 1 Encoder Instance Threshold : [26]
```

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 7

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 5, 6, 7, 15]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 8

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 9

Data Points Exceeding Layer 1 Encoder Instance Threshold : [6, 7, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 10

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 11, 17, 18, 25, 26]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 11

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 3, 4, 7, 13, 20, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 12

Data Points Exceeding Layer 1 Encoder Instance Threshold : [13, 24]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 13

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 14

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 15

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 3, 4, 5, 6, 8, 9, 1
0, 11, 12, 20, 21, 22, 23, 24, 25, 27, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [11, 21, 22]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3

****

Batch Number : 16

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 8, 13, 26, 27, 28,
29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 17

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1

****

Batch Number : 18

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 4, 5, 6, 8, 9, 10, 11,
12, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [30]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1

****

Batch Number : 19

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 4, 6, 7, 9, 10, 14, 16
, 17, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 20

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 5, 14, 18, 24, 25, 26,
31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [6, 12, 15, 19, 25, 26]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 6

****

Batch Number : 21

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 3, 4, 6, 7, 8, 9, 1
0, 11, 17, 18, 20, 22, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [3, 4]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 2

****

Batch Number : 22

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 13, 17, 18, 19, 20, 21, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [21, 22, 27]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3

****

Batch Number : 23

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 6, 19, 20, 22, 23, 24, 25, 26, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1

****

Batch Number : 24

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 4, 10, 12, 13, 25, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [5, 21, 26]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3

****

Batch Number : 25

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 4, 8, 13, 14, 15, 16, 17, 21, 22, 23, 26, 27, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 8, 14, 15, 16, 17, 21, 22]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 8

****

```
Batch Number : 26

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 4, 5, 6, 7, 8, 9
, 11, 12, 17, 21, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 9, 11, 23]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 5



**************

Batch Number : 27

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 3, 4, 5, 6, 7, 8, 9
, 11, 12, 13, 17, 18, 19, 21, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [2, 3, 4, 5]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 4



**************

Batch Number : 28

Data Points Exceeding Layer 1 Encoder Instance Threshold : [6, 10, 11, 16, 25, 26, 27
, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0



**************

Batch Number : 29

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 3, 4, 7, 8, 15, 16, 17
, 18, 23, 24, 26, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [17]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 1



**************

Batch Number : 30

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 4, 5, 6, 7, 8, 10,
11, 12, 14, 15, 17, 18, 19, 21, 24, 25, 26, 27, 28, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [6, 18, 26, 27]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 4
```

```
**************

Batch Number : 31

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 11, 12, 15, 16, 17, 18
, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [10, 14, 15, 26, 27, 28, 3
1]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 7



**************

Batch Number : 32

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30,
31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 2, 3, 4, 6, 7, 8, 9, 10
, 14, 22, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 13



**************

Batch Number : 33

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29,
30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 2, 3, 7, 8, 9, 13, 1
7, 21, 22, 23, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 13



**************

Batch Number : 34

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 1
0, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [3, 4, 24, 25, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 6



**************

Batch Number : 35
```

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29,
30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [2, 4, 6, 7, 8, 11, 12, 13,
14, 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 28, 30]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 21

****

Batch Number : 36

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 6, 8, 9, 10, 11, 12
, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 2, 9, 10, 11, 12, 15
, 18, 23, 24, 25, 27, 29, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 15

****

Batch Number : 37

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 5, 6, 7, 8, 9
, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 2, 4, 7, 8, 12, 17,
18, 19, 20, 21, 22, 23]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 14

****

Batch Number : 38

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 4, 5, 6, 7, 8, 9
, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 5, 13, 14, 24, 25]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 6

****

Batch Number : 39

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 17, 18,
20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [3, 26]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 2

****

Batch Number : 40

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [23, 25, 29, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 4

****

Batch Number : 41

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 7]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 2

****

Batch Number : 42

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [17, 18, 19, 27, 28, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 6

****

Batch Number : 43

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [3, 4, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 21

****

Batch Number : 44

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29,
30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 2, 3, 5, 8, 9, 10, 14,
15, 16, 17, 18, 21, 22, 24, 25, 26, 27, 28, 30]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 20

****

Batch Number : 45

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 3, 4, 5, 6, 7, 8, 9
, 10, 11, 12, 13, 14, 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [7, 8, 9, 13, 14, 17, 22, 2
4, 25, 26, 27, 28, 29, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 15

****

Batch Number : 46

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29,
30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 2, 4, 5, 6, 7, 8, 9,
10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 24, 25, 26, 27, 28, 29, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 29

****

Batch Number : 47

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29,
30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 2, 3, 4, 5, 6, 7, 9,
10, 11, 13, 14, 15, 16, 17, 18, 22, 23, 24, 26, 27, 28, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 24

****

Batch Number : 48

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29,

30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 3, 4, 6, 7, 8, 9, 10, 13, 14, 15, 18, 19, 20, 21, 22, 26, 27, 28, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 22

****

Batch Number : 49

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 5, 6, 7, 8, 9]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 6

****

Batch Number : 50

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 51

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 6, 8, 9, 10, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 52

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 53

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [18, 29, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 4

****

Batch Number : 54

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8 , 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [11, 12, 13, 14, 15, 18, 19 , 26, 27, 28, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 11

****

Batch Number : 55

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8 , 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 5, 6, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 26

****

Batch Number : 56

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8 , 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 15, 16, 17, 18, 19, 21, 22, 23]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 19

 Drift Detection at Batch Level

 Threshold exceeds at batch : 15
[15]
Warning Level at Batch 15
 Threshold exceeds at batch : 17

```
[17]
Warning Level at Batch 17
 Threshold exceeds at batch : 18
[17, 18]
Warning Level at Batch 18
 Threshold exceeds at batch : 20
[20]
Warning Level at Batch 20
 Threshold exceeds at batch : 22
[22]
Warning Level at Batch 22
 Threshold exceeds at batch : 25
[25]
Warning Level at Batch 25
 Threshold exceeds at batch : 26
[25, 26]
Warning Level at Batch 26
 Threshold exceeds at batch : 27
[25, 26, 27]
 Drift Confirmed at Batch No :  25
 Threshold exceeds at batch : 30
[30]
Warning Level at Batch 30
 Threshold exceeds at batch : 31
[30, 31]
Warning Level at Batch 31
 Threshold exceeds at batch : 32
[30, 31, 32]
 Drift Confirmed at Batch No :  30
 Threshold exceeds at batch : 33
[30, 31, 32, 33]
 Drift Confirmed at Batch No :  31
 Threshold exceeds at batch : 34
[30, 31, 32, 33, 34]
 Drift Confirmed at Batch No :  32
 Threshold exceeds at batch : 35
[30, 31, 32, 33, 34, 35]
 Drift Confirmed at Batch No :  33
 Threshold exceeds at batch : 36
[30, 31, 32, 33, 34, 35, 36]
 Drift Confirmed at Batch No :  34
 Threshold exceeds at batch : 37
[30, 31, 32, 33, 34, 35, 36, 37]
 Drift Confirmed at Batch No :  35
 Threshold exceeds at batch : 38
[30, 31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :  36
 Threshold exceeds at batch : 39
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39]
 Drift Confirmed at Batch No :  37
 Threshold exceeds at batch : 40
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40]
 Drift Confirmed at Batch No :  38
 Threshold exceeds at batch : 41
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41]
 Drift Confirmed at Batch No :  39
 Threshold exceeds at batch : 42
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42]
 Drift Confirmed at Batch No :  40
 Threshold exceeds at batch : 43
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43]
 Drift Confirmed at Batch No :  41
```

```
 Threshold exceeds at batch : 44
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44]
 Drift Confirmed at Batch No :  42
 Threshold exceeds at batch : 45
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45]
 Drift Confirmed at Batch No :  43
 Threshold exceeds at batch : 46
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46]
 Drift Confirmed at Batch No :  44
 Threshold exceeds at batch : 47
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47]
 Drift Confirmed at Batch No :  45
 Threshold exceeds at batch : 48
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48]
 Drift Confirmed at Batch No :  46
 Threshold exceeds at batch : 49
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49]
 Drift Confirmed at Batch No :  47
 Threshold exceeds at batch : 53
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49]
 Drift Confirmed at Batch No :  51
 Threshold exceeds at batch : 54
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49]
 Drift Confirmed at Batch No :  52
 Threshold exceeds at batch : 55
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49]
 Drift Confirmed at Batch No :  53
 Threshold exceeds at batch : 56
[30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49]
 Drift Confirmed at Batch No :  54
```

In [101…

```
perform_t_test()
```

```
Layer 1 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 7.443743
p-value for two tailed test is 0.000000
Conclusion :
Since p-value(=0.000000) < alpha(=0.05) We reject the null hypothesis H0 and Accept H
1 . So we conclude that
There is a drift in the dataset at 0.05 level of significance.

Layer 1 Exceed Count   Values for Normal and Drifted Data
Test statistic is -8.442056
p-value for two tailed test is 0.000000
Conclusion :
Since p-value(=0.000000) < alpha(=0.05) We reject the null hypothesis H0 and Accept H
1 . So we conclude that
There is a drift in the dataset at 0.05 level of significance.

Layer 2 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 7.863491
p-value for two tailed test is 0.000000
Conclusion :
Since p-value(=0.000000) < alpha(=0.05) We reject the null hypothesis H0 and Accept H
1 . So we conclude that
There is a drift in the dataset at 0.05 level of significance.

Layer 2 Exceed Count   Values for Normal and Drifted Data
Test statistic is 5.677138
p-value for two tailed test is 0.000000
Conclusion :
```

Since p-value(=0.000000) < alpha(=0.05) We reject the null hypothesis H0 and Accept H
1 . So we conclude that
There is a drift in the dataset at 0.05 level of significance.

In [102…

```python
df_plotting=visual_analysis()
```

In [103...

```python
df,df2=classify_batches(models,df_drifted_top25_all ,stream,'class',batch_size=32)
```

```
Batch 0:LogReg
Accuracy :0.938
Recall: 0.714
Precision:1.0
F1_Score:0.833
Batch 0:RF
Accuracy :0.906
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 0:KNN
Accuracy :0.875
Recall: 0.714
Precision:0.714
F1_Score:0.714
Batch 0:SVM
Accuracy :0.938
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 0:GNB
Accuracy :0.781
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 0:XGB
Accuracy :0.906
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 0:DT
Accuracy :0.844
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 0:MLP
Accuracy :0.938
Recall: 0.857
```

```
Precision:0.857
F1_Score:0.857
Batch 1:LogReg
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:RF
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:KNN
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 1:SVM
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:GNB
Accuracy :0.688
Recall: 0.182
Precision:0.667
F1_Score:0.286
Batch 1:XGB
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 1:DT
Accuracy :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
Batch 1:MLP
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 2:LogReg
Accuracy :0.656
Recall: 0.333
Precision:0.833
F1_Score:0.476
Batch 2:RF
Accuracy :0.844
Recall: 0.8
Precision:0.857
F1_Score:0.828
Batch 2:KNN
Accuracy :0.75
Recall: 0.667
Precision:0.769
F1_Score:0.714
Batch 2:SVM
Accuracy :0.75
Recall: 0.6
Precision:0.818
F1_Score:0.692
```

```
Batch 2:GNB
Accuracy :0.625
Recall: 0.467
Precision:0.636
F1_Score:0.538
Batch 2:XGB
Accuracy :0.719
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 2:DT
Accuracy :0.719
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 2:MLP
Accuracy :0.781
Recall: 0.6
Precision:0.9
F1_Score:0.72
Batch 3:LogReg
Accuracy :0.719
Recall: 0.571
Precision:1.0
F1_Score:0.727
Batch 3:RF
Accuracy :0.938
Recall: 0.952
Precision:0.952
F1_Score:0.952
Batch 3:KNN
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 3:SVM
Accuracy :0.906
Recall: 0.905
Precision:0.95
F1_Score:0.927
Batch 3:GNB
Accuracy :0.688
Recall: 0.667
Precision:0.824
F1_Score:0.737
Batch 3:XGB
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 3:DT
Accuracy :0.812
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 3:MLP
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 4:LogReg
Accuracy :0.719
```

```
Recall: 0.65
Precision:0.867
F1_Score:0.743
Batch 4:RF
Accuracy :0.781
Recall: 0.7
Precision:0.933
F1_Score:0.8
Batch 4:KNN
Accuracy :0.75
Recall: 0.65
Precision:0.929
F1_Score:0.765
Batch 4:SVM
Accuracy :0.812
Recall: 0.7
Precision:1.0
F1_Score:0.824
Batch 4:GNB
Accuracy :0.75
Recall: 0.95
Precision:0.731
F1_Score:0.826
Batch 4:XGB
Accuracy :0.781
Recall: 0.75
Precision:0.882
F1_Score:0.811
Batch 4:DT
Accuracy :0.688
Recall: 0.5
Precision:1.0
F1_Score:0.667
Batch 4:MLP
Accuracy :0.781
Recall: 0.65
Precision:1.0
F1_Score:0.788
Batch 5:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.419
F1_Score:0.591
Batch 5:RF
Accuracy :0.594
Recall: 0.615
Precision:0.5
F1_Score:0.552
Batch 5:KNN
Accuracy :0.562
Recall: 0.846
Precision:0.478
F1_Score:0.611
Batch 5:SVM
Accuracy :0.5
Recall: 0.846
Precision:0.44
F1_Score:0.579
Batch 5:GNB
Accuracy :0.531
Recall: 0.923
Precision:0.462
```

```
F1_Score:0.615
Batch 5:XGB
Accuracy :0.5
Recall: 0.846
Precision:0.44
F1_Score:0.579
Batch 5:DT
Accuracy :0.562
Recall: 0.538
Precision:0.467
F1_Score:0.5
Batch 5:MLP
Accuracy :0.562
Recall: 0.846
Precision:0.478
F1_Score:0.611
Batch 6:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.3
F1_Score:0.462
Batch 6:RF
Accuracy :0.688
Recall: 0.556
Precision:0.455
F1_Score:0.5
Batch 6:KNN
Accuracy :0.656
Recall: 0.556
Precision:0.417
F1_Score:0.476
Batch 6:SVM
Accuracy :0.625
Recall: 1.0
Precision:0.429
F1_Score:0.6
Batch 6:GNB
Accuracy :0.688
Recall: 0.889
Precision:0.471
F1_Score:0.615
Batch 6:XGB
Accuracy :0.594
Recall: 0.889
Precision:0.4
F1_Score:0.552
Batch 6:DT
Accuracy :0.562
Recall: 0.667
Precision:0.353
F1_Score:0.462
Batch 6:MLP
Accuracy :0.531
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 7:LogReg
Accuracy :0.594
Recall: 1.0
Precision:0.48
F1_Score:0.649
Batch 7:RF
```

```
Accuracy :0.812
Recall: 0.833
Precision:0.714
F1_Score:0.769
Batch 7:KNN
Accuracy :0.781
Recall: 0.833
Precision:0.667
F1_Score:0.741
Batch 7:SVM
Accuracy :0.594
Recall: 1.0
Precision:0.48
F1_Score:0.649
Batch 7:GNB
Accuracy :0.406
Recall: 0.833
Precision:0.37
F1_Score:0.513
Batch 7:XGB
Accuracy :0.781
Recall: 0.917
Precision:0.647
F1_Score:0.759
Batch 7:DT
Accuracy :0.562
Recall: 0.667
Precision:0.444
F1_Score:0.533
Batch 7:MLP
Accuracy :0.688
Recall: 1.0
Precision:0.545
F1_Score:0.706
Batch 8:LogReg
Accuracy :0.844
Recall: 0.846
Precision:0.786
F1_Score:0.815
Batch 8:RF
Accuracy :0.719
Recall: 0.923
Precision:0.6
F1_Score:0.727
Batch 8:KNN
Accuracy :0.688
Recall: 0.923
Precision:0.571
F1_Score:0.706
Batch 8:SVM
Accuracy :0.688
Recall: 1.0
Precision:0.565
F1_Score:0.722
Batch 8:GNB
Accuracy :0.625
Recall: 0.923
Precision:0.522
F1_Score:0.667
Batch 8:XGB
Accuracy :0.75
Recall: 0.846
```

```
Precision:0.647
F1_Score:0.733
Batch 8:DT
Accuracy :0.562
Recall: 0.846
Precision:0.478
F1_Score:0.611
Batch 8:MLP
Accuracy :0.75
Recall: 1.0
Precision:0.619
F1_Score:0.765
Batch 9:LogReg
Accuracy :0.781
Recall: 0.625
Precision:0.556
F1_Score:0.588
Batch 9:RF
Accuracy :0.688
Recall: 0.625
Precision:0.417
F1_Score:0.5
Batch 9:KNN
Accuracy :0.625
Recall: 0.625
Precision:0.357
F1_Score:0.455
Batch 9:SVM
Accuracy :0.625
Recall: 0.625
Precision:0.357
F1_Score:0.455
Batch 9:GNB
Accuracy :0.75
Recall: 0.125
Precision:0.5
F1_Score:0.2
Batch 9:XGB
Accuracy :0.688
Recall: 0.625
Precision:0.417
F1_Score:0.5
Batch 9:DT
Accuracy :0.656
Recall: 0.625
Precision:0.385
F1_Score:0.476
Batch 9:MLP
Accuracy :0.656
Recall: 0.625
Precision:0.385
F1_Score:0.476
Batch 10:LogReg
Accuracy :0.531
Recall: 0.875
Precision:0.333
F1_Score:0.483
Batch 10:RF
Accuracy :0.688
Recall: 0.75
Precision:0.429
F1_Score:0.545
```

```
Batch 10:KNN
Accuracy :0.562
Recall: 0.625
Precision:0.312
F1_Score:0.417
Batch 10:SVM
Accuracy :0.531
Recall: 0.875
Precision:0.333
F1_Score:0.483
Batch 10:GNB
Accuracy :0.781
Recall: 0.125
Precision:1.0
F1_Score:0.222
Batch 10:XGB
Accuracy :0.688
Recall: 0.875
Precision:0.438
F1_Score:0.583
Batch 10:DT
Accuracy :0.656
Recall: 0.75
Precision:0.4
F1_Score:0.522
Batch 10:MLP
Accuracy :0.531
Recall: 0.875
Precision:0.333
F1_Score:0.483
Batch 11:LogReg
Accuracy :0.656
Recall: 0.857
Precision:0.375
F1_Score:0.522
Batch 11:RF
Accuracy :0.75
Recall: 0.714
Precision:0.455
F1_Score:0.556
Batch 11:KNN
Accuracy :0.781
Recall: 0.714
Precision:0.5
F1_Score:0.588
Batch 11:SVM
Accuracy :0.688
Recall: 0.714
Precision:0.385
F1_Score:0.5
Batch 11:GNB
Accuracy :0.812
Recall: 0.143
Precision:1.0
F1_Score:0.25
Batch 11:XGB
Accuracy :0.781
Recall: 0.857
Precision:0.5
F1_Score:0.632
Batch 11:DT
Accuracy :0.625
```

```
Recall: 0.714
Precision:0.333
F1_Score:0.455
Batch 11:MLP
Accuracy :0.656
Recall: 0.714
Precision:0.357
F1_Score:0.476
Batch 12:LogReg
Accuracy :0.812
Recall: 1.0
Precision:0.538
F1_Score:0.7
Batch 12:RF
Accuracy :0.875
Recall: 0.857
Precision:0.667
F1_Score:0.75
Batch 12:KNN
Accuracy :0.781
Recall: 0.714
Precision:0.5
F1_Score:0.588
Batch 12:SVM
Accuracy :0.688
Recall: 0.857
Precision:0.4
F1_Score:0.545
Batch 12:GNB
Accuracy :0.75
Recall: 0.143
Precision:0.333
F1_Score:0.2
Batch 12:XGB
Accuracy :0.812
Recall: 0.714
Precision:0.556
F1_Score:0.625
Batch 12:DT
Accuracy :0.688
Recall: 0.571
Precision:0.364
F1_Score:0.444
Batch 12:MLP
Accuracy :0.688
Recall: 0.857
Precision:0.4
F1_Score:0.545
Batch 13:LogReg
Accuracy :0.781
Recall: 1.0
Precision:0.417
F1_Score:0.588
Batch 13:RF
Accuracy :0.875
Recall: 0.8
Precision:0.571
F1_Score:0.667
Batch 13:KNN
Accuracy :0.75
Recall: 0.4
Precision:0.286
```

```
F1_Score:0.333
Batch 13:SVM
Accuracy :0.688
Recall: 0.8
Precision:0.308
F1_Score:0.444
Batch 13:GNB
Accuracy :0.875
Recall: 0.6
Precision:0.6
F1_Score:0.6
Batch 13:XGB
Accuracy :0.844
Recall: 0.8
Precision:0.5
F1_Score:0.615
Batch 13:DT
Accuracy :0.781
Recall: 0.6
Precision:0.375
F1_Score:0.462
Batch 13:MLP
Accuracy :0.719
Recall: 0.8
Precision:0.333
F1_Score:0.471
Batch 14:LogReg
Accuracy :0.688
Recall: 0.933
Precision:0.609
F1_Score:0.737
Batch 14:RF
Accuracy :0.688
Recall: 1.0
Precision:0.6
F1_Score:0.75
Batch 14:KNN
Accuracy :0.656
Recall: 0.933
Precision:0.583
F1_Score:0.718
Batch 14:SVM
Accuracy :0.562
Recall: 1.0
Precision:0.517
F1_Score:0.682
Batch 14:GNB
Accuracy :0.75
Recall: 0.867
Precision:0.684
F1_Score:0.765
Batch 14:XGB
Accuracy :0.656
Recall: 0.933
Precision:0.583
F1_Score:0.718
Batch 14:DT
Accuracy :0.5
Recall: 0.733
Precision:0.478
F1_Score:0.579
Batch 14:MLP
```

```
Accuracy :0.625
Recall: 1.0
Precision:0.556
F1_Score:0.714
Batch 15:LogReg
Accuracy :0.781
Recall: 1.0
Precision:0.781
F1_Score:0.877
Batch 15:RF
Accuracy :0.781
Recall: 1.0
Precision:0.781
F1_Score:0.877
Batch 15:KNN
Accuracy :0.844
Recall: 1.0
Precision:0.833
F1_Score:0.909
Batch 15:SVM
Accuracy :0.781
Recall: 1.0
Precision:0.781
F1_Score:0.877
Batch 15:GNB
Accuracy :0.781
Recall: 1.0
Precision:0.781
F1_Score:0.877
Batch 15:XGB
Accuracy :0.781
Recall: 1.0
Precision:0.781
F1_Score:0.877
Batch 15:DT
Accuracy :0.688
Recall: 0.84
Precision:0.778
F1_Score:0.808
Batch 15:MLP
Accuracy :0.781
Recall: 1.0
Precision:0.781
F1_Score:0.877
Batch 16:LogReg
Accuracy :0.406
Recall: 1.0
Precision:0.406
F1_Score:0.578
Batch 16:RF
Accuracy :0.625
Recall: 0.923
Precision:0.522
F1_Score:0.667
Batch 16:KNN
Accuracy :0.688
Recall: 0.923
Precision:0.571
F1_Score:0.706
Batch 16:SVM
Accuracy :0.438
Recall: 1.0
```

```
                 Precision:0.419
                 F1_Score:0.591
                 Batch 16:GNB
                 Accuracy :0.438
                 Recall: 0.846
                 Precision:0.407
                 F1_Score:0.55
                 Batch 16:XGB
                 Accuracy :0.5
                 Recall: 0.923
                 Precision:0.444
                 F1_Score:0.6
                 Batch 16:DT
                 Accuracy :0.531
                 Recall: 0.692
                 Precision:0.45
                 F1_Score:0.545
                 Batch 16:MLP
                 Accuracy :0.406
                 Recall: 1.0
                 Precision:0.406
                 F1_Score:0.578
                 Batch 17:LogReg
                 Accuracy :0.438
                 Recall: 1.0
                 Precision:0.438
                 F1_Score:0.609
                 Batch 17:RF
                 Accuracy :0.438
                 Recall: 0.571
                 Precision:0.4
                 F1_Score:0.471
                 Batch 17:KNN
                 Accuracy :0.438
                 Recall: 0.429
                 Precision:0.375
                 F1_Score:0.4
                 Batch 17:SVM
                 Accuracy :0.438
                 Recall: 0.929
                 Precision:0.433
                 F1_Score:0.591
                 Batch 17:GNB
                 Accuracy :0.438
                 Recall: 1.0
                 Precision:0.438
                 F1_Score:0.609
                 Batch 17:XGB
                 Accuracy :0.5
                 Recall: 0.929
                 Precision:0.464
                 F1_Score:0.619
                 Batch 17:DT
                 Accuracy :0.375
                 Recall: 0.429
                 Precision:0.333
                 F1_Score:0.375
                 Batch 17:MLP
                 Accuracy :0.469
                 Recall: 1.0
                 Precision:0.452
                 F1_Score:0.622
```

```
Batch 18:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 18:RF
Accuracy :0.625
Recall: 0.727
Precision:0.471
F1_Score:0.571
Batch 18:KNN
Accuracy :0.5
Recall: 0.636
Precision:0.368
F1_Score:0.467
Batch 18:SVM
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 18:GNB
Accuracy :0.406
Recall: 1.0
Precision:0.367
F1_Score:0.537
Batch 18:XGB
Accuracy :0.406
Recall: 1.0
Precision:0.367
F1_Score:0.537
Batch 18:DT
Accuracy :0.375
Recall: 0.364
Precision:0.235
F1_Score:0.286
Batch 18:MLP
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 19:LogReg
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 19:RF
Accuracy :0.281
Recall: 1.0
Precision:0.258
F1_Score:0.41
Batch 19:KNN
Accuracy :0.281
Recall: 1.0
Precision:0.258
F1_Score:0.41
Batch 19:SVM
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 19:GNB
Accuracy :0.312
```

```
Recall: 1.0
Precision:0.267
F1_Score:0.421
Batch 19:XGB
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 19:DT
Accuracy :0.344
Recall: 0.875
Precision:0.259
F1_Score:0.4
Batch 19:MLP
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 20:LogReg
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 20:RF
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 20:KNN
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 20:SVM
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 20:GNB
Accuracy :0.531
Recall: 1.0
Precision:0.348
F1_Score:0.516
Batch 20:XGB
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 20:DT
Accuracy :0.406
Recall: 0.875
Precision:0.28
F1_Score:0.424
Batch 20:MLP
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 21:LogReg
Accuracy :0.375
Recall: 1.0
Precision:0.375
```

```
F1_Score:0.545
Batch 21:RF
Accuracy :0.438
Recall: 0.917
Precision:0.393
F1_Score:0.55
Batch 21:KNN
Accuracy :0.531
Recall: 1.0
Precision:0.444
F1_Score:0.615
Batch 21:SVM
Accuracy :0.438
Recall: 1.0
Precision:0.4
F1_Score:0.571
Batch 21:GNB
Accuracy :0.75
Recall: 0.333
Precision:1.0
F1_Score:0.5
Batch 21:XGB
Accuracy :0.438
Recall: 0.917
Precision:0.393
F1_Score:0.55
Batch 21:DT
Accuracy :0.438
Recall: 0.667
Precision:0.364
F1_Score:0.471
Batch 21:MLP
Accuracy :0.406
Recall: 1.0
Precision:0.387
F1_Score:0.558
Batch 22:LogReg
Accuracy :0.312
Recall: 1.0
Precision:0.214
F1_Score:0.353
Batch 22:RF
Accuracy :0.594
Recall: 0.667
Precision:0.267
F1_Score:0.381
Batch 22:KNN
Accuracy :0.812
Recall: 0.667
Precision:0.5
F1_Score:0.571
Batch 22:SVM
Accuracy :0.594
Recall: 0.667
Precision:0.267
F1_Score:0.381
Batch 22:GNB
Accuracy :0.844
Recall: 0.333
Precision:0.667
F1_Score:0.444
Batch 22:XGB
```

```
Accuracy :0.625
Recall: 1.0
Precision:0.333
F1_Score:0.5
Batch 22:DT
Accuracy :0.438
Recall: 0.667
Precision:0.2
F1_Score:0.308
Batch 22:MLP
Accuracy :0.562
Recall: 0.833
Precision:0.278
F1_Score:0.417
Batch 23:LogReg
Accuracy :0.281
Recall: 1.0
Precision:0.148
F1_Score:0.258
Batch 23:RF
Accuracy :0.5
Recall: 1.0
Precision:0.2
F1_Score:0.333
Batch 23:KNN
Accuracy :0.531
Recall: 0.75
Precision:0.176
F1_Score:0.286
Batch 23:SVM
Accuracy :0.469
Recall: 1.0
Precision:0.19
F1_Score:0.32
Batch 23:GNB
Accuracy :0.875
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 23:XGB
Accuracy :0.5
Recall: 1.0
Precision:0.2
F1_Score:0.333
Batch 23:DT
Accuracy :0.5
Recall: 1.0
Precision:0.2
F1_Score:0.333
Batch 23:MLP
Accuracy :0.469
Recall: 1.0
Precision:0.19
F1_Score:0.32
Batch 24:LogReg
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 24:RF
Accuracy :0.344
Recall: 0.875
```

```
Precision:0.259
F1_Score:0.4
Batch 24:KNN
Accuracy :0.375
Recall: 1.0
Precision:0.286
F1_Score:0.444
Batch 24:SVM
Accuracy :0.281
Recall: 1.0
Precision:0.258
F1_Score:0.41
Batch 24:GNB
Accuracy :0.656
Recall: 0.625
Precision:0.385
F1_Score:0.476
Batch 24:XGB
Accuracy :0.312
Recall: 0.875
Precision:0.25
F1_Score:0.389
Batch 24:DT
Accuracy :0.469
Recall: 1.0
Precision:0.32
F1_Score:0.485
Batch 24:MLP
Accuracy :0.281
Recall: 1.0
Precision:0.258
F1_Score:0.41
Batch 25:LogReg
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 25:RF
Accuracy :0.344
Recall: 1.0
Precision:0.323
F1_Score:0.488
Batch 25:KNN
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 25:SVM
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 25:GNB
Accuracy :0.5
Recall: 1.0
Precision:0.385
F1_Score:0.556
Batch 25:XGB
Accuracy :0.344
Recall: 1.0
Precision:0.323
F1_Score:0.488
```

```
Batch 25:DT
Accuracy :0.438
Recall: 1.0
Precision:0.357
F1_Score:0.526
Batch 25:MLP
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 26:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 26:RF
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 26:KNN
Accuracy :0.469
Recall: 1.0
Precision:0.452
F1_Score:0.622
Batch 26:SVM
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 26:GNB
Accuracy :0.375
Recall: 0.857
Precision:0.4
F1_Score:0.545
Batch 26:XGB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 26:DT
Accuracy :0.375
Recall: 0.786
Precision:0.393
F1_Score:0.524
Batch 26:MLP
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 27:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 27:RF
Accuracy :0.469
Recall: 0.929
Precision:0.448
F1_Score:0.605
Batch 27:KNN
Accuracy :0.438
```

```
Recall: 0.857
Precision:0.429
F1_Score:0.571
Batch 27:SVM
Accuracy :0.469
Recall: 1.0
Precision:0.452
F1_Score:0.622
Batch 27:GNB
Accuracy :0.469
Recall: 1.0
Precision:0.452
F1_Score:0.622
Batch 27:XGB
Accuracy :0.469
Recall: 1.0
Precision:0.452
F1_Score:0.622
Batch 27:DT
Accuracy :0.531
Recall: 0.714
Precision:0.476
F1_Score:0.571
Batch 27:MLP
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 28:LogReg
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 28:RF
Accuracy :0.562
Recall: 0.5
Precision:0.429
F1_Score:0.462
Batch 28:KNN
Accuracy :0.562
Recall: 0.583
Precision:0.438
F1_Score:0.5
Batch 28:SVM
Accuracy :0.406
Recall: 1.0
Precision:0.387
F1_Score:0.558
Batch 28:GNB
Accuracy :0.5
Recall: 1.0
Precision:0.429
F1_Score:0.6
Batch 28:XGB
Accuracy :0.656
Recall: 0.917
Precision:0.524
F1_Score:0.667
Batch 28:DT
Accuracy :0.625
Recall: 0.75
Precision:0.5
```

```
F1_Score:0.6
Batch 28:MLP
Accuracy :0.406
Recall: 1.0
Precision:0.387
F1_Score:0.558
Batch 29:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 29:RF
Accuracy :0.656
Recall: 0.818
Precision:0.5
F1_Score:0.621
Batch 29:KNN
Accuracy :0.469
Recall: 0.818
Precision:0.375
F1_Score:0.514
Batch 29:SVM
Accuracy :0.406
Recall: 1.0
Precision:0.367
F1_Score:0.537
Batch 29:GNB
Accuracy :0.531
Recall: 0.818
Precision:0.409
F1_Score:0.545
Batch 29:XGB
Accuracy :0.438
Recall: 0.909
Precision:0.37
F1_Score:0.526
Batch 29:DT
Accuracy :0.469
Recall: 0.545
Precision:0.333
F1_Score:0.414
Batch 29:MLP
Accuracy :0.375
Recall: 1.0
Precision:0.355
F1_Score:0.524
Batch 30:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 30:RF
Accuracy :0.312
Recall: 0.636
Precision:0.28
F1_Score:0.389
Batch 30:KNN
Accuracy :0.5
Recall: 0.636
Precision:0.368
F1_Score:0.467
Batch 30:SVM
```

```
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 30:GNB
Accuracy :0.312
Recall: 0.909
Precision:0.323
F1_Score:0.476
Batch 30:XGB
Accuracy :0.375
Recall: 1.0
Precision:0.355
F1_Score:0.524
Batch 30:DT
Accuracy :0.438
Recall: 0.818
Precision:0.36
F1_Score:0.5
Batch 30:MLP
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 31:LogReg
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 31:RF
Accuracy :0.406
Recall: 1.0
Precision:0.387
F1_Score:0.558
Batch 31:KNN
Accuracy :0.406
Recall: 0.917
Precision:0.379
F1_Score:0.537
Batch 31:SVM
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 31:GNB
Accuracy :0.531
Recall: 0.833
Precision:0.435
F1_Score:0.571
Batch 31:XGB
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 31:DT
Accuracy :0.375
Recall: 0.75
Precision:0.346
F1_Score:0.474
Batch 31:MLP
Accuracy :0.375
Recall: 1.0
```

```
Precision:0.375
F1_Score:0.545
Batch 32:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 32:RF
Accuracy :0.375
Recall: 1.0
Precision:0.355
F1_Score:0.524
Batch 32:KNN
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 32:SVM
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 32:GNB
Accuracy :0.656
Recall: 0.636
Precision:0.5
F1_Score:0.56
Batch 32:XGB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 32:DT
Accuracy :0.312
Recall: 0.818
Precision:0.31
F1_Score:0.45
Batch 32:MLP
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 33:LogReg
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 33:RF
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 33:KNN
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 33:SVM
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
```

```
Batch 33:GNB
Accuracy :0.844
Recall: 0.333
Precision:0.667
F1_Score:0.444
Batch 33:XGB
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 33:DT
Accuracy :0.281
Recall: 1.0
Precision:0.207
F1_Score:0.343
Batch 33:MLP
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 34:LogReg
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 34:RF
Accuracy :0.375
Recall: 0.9
Precision:0.321
F1_Score:0.474
Batch 34:KNN
Accuracy :0.469
Recall: 1.0
Precision:0.37
F1_Score:0.541
Batch 34:SVM
Accuracy :0.375
Recall: 1.0
Precision:0.333
F1_Score:0.5
Batch 34:GNB
Accuracy :0.656
Recall: 0.1
Precision:0.333
F1_Score:0.154
Batch 34:XGB
Accuracy :0.406
Recall: 1.0
Precision:0.345
F1_Score:0.513
Batch 34:DT
Accuracy :0.406
Recall: 0.5
Precision:0.263
F1_Score:0.345
Batch 34:MLP
Accuracy :0.375
Recall: 1.0
Precision:0.333
F1_Score:0.5
Batch 35:LogReg
Accuracy :0.312
```

```
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 35:RF
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 35:KNN
Accuracy :0.344
Recall: 1.0
Precision:0.323
F1_Score:0.488
Batch 35:SVM
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 35:GNB
Accuracy :0.719
Recall: 0.8
Precision:0.533
F1_Score:0.64
Batch 35:XGB
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 35:DT
Accuracy :0.438
Recall: 1.0
Precision:0.357
F1_Score:0.526
Batch 35:MLP
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 36:LogReg
Accuracy :0.5
Recall: 1.0
Precision:0.484
F1_Score:0.652
Batch 36:RF
Accuracy :0.562
Recall: 1.0
Precision:0.517
F1_Score:0.682
Batch 36:KNN
Accuracy :0.625
Recall: 1.0
Precision:0.556
F1_Score:0.714
Batch 36:SVM
Accuracy :0.562
Recall: 1.0
Precision:0.517
F1_Score:0.682
Batch 36:GNB
Accuracy :0.656
Recall: 0.8
Precision:0.6
```

```
F1_Score:0.686
Batch 36:XGB
Accuracy :0.5
Recall: 1.0
Precision:0.484
F1_Score:0.652
Batch 36:DT
Accuracy :0.344
Recall: 0.533
Precision:0.364
F1_Score:0.432
Batch 36:MLP
Accuracy :0.531
Recall: 1.0
Precision:0.5
F1_Score:0.667
Batch 37:LogReg
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 37:RF
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 37:KNN
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 37:SVM
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 37:GNB
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 37:XGB
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 37:DT
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 37:MLP
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 38:LogReg
Accuracy :0.719
Recall: 1.0
Precision:0.719
F1_Score:0.836
Batch 38:RF
```

```
Accuracy :0.844
Recall: 0.957
Precision:0.846
F1_Score:0.898
Batch 38:KNN
Accuracy :0.719
Recall: 0.783
Precision:0.818
F1_Score:0.8
Batch 38:SVM
Accuracy :0.719
Recall: 1.0
Precision:0.719
F1_Score:0.836
Batch 38:GNB
Accuracy :0.719
Recall: 1.0
Precision:0.719
F1_Score:0.836
Batch 38:XGB
Accuracy :0.719
Recall: 0.957
Precision:0.733
F1_Score:0.83
Batch 38:DT
Accuracy :0.719
Recall: 0.87
Precision:0.769
F1_Score:0.816
Batch 38:MLP
Accuracy :0.719
Recall: 1.0
Precision:0.719
F1_Score:0.836
Batch 39:LogReg
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 39:RF
Accuracy :0.5
Recall: 0.45
Precision:0.643
F1_Score:0.529
Batch 39:KNN
Accuracy :0.406
Recall: 0.3
Precision:0.545
F1_Score:0.387
Batch 39:SVM
Accuracy :0.656
Recall: 1.0
Precision:0.645
F1_Score:0.784
Batch 39:GNB
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 39:XGB
Accuracy :0.594
Recall: 0.85
```

```
Precision:0.63
F1_Score:0.723
Batch 39:DT
Accuracy :0.531
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 39:MLP
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 40:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:RF
Accuracy :0.781
Recall: 0.571
Precision:0.889
F1_Score:0.696
Batch 40:KNN
Accuracy :0.688
Recall: 0.5
Precision:0.7
F1_Score:0.583
Batch 40:SVM
Accuracy :0.531
Recall: 1.0
Precision:0.483
F1_Score:0.651
Batch 40:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:XGB
Accuracy :0.688
Recall: 0.929
Precision:0.591
F1_Score:0.722
Batch 40:DT
Accuracy :0.656
Recall: 0.786
Precision:0.579
F1_Score:0.667
Batch 40:MLP
Accuracy :0.469
Recall: 1.0
Precision:0.452
F1_Score:0.622
Batch 41:LogReg
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 41:RF
Accuracy :0.625
Recall: 0.5
Precision:0.333
F1_Score:0.4
```

```
Batch 41:KNN
Accuracy :0.75
Recall: 0.25
Precision:0.5
F1_Score:0.333
Batch 41:SVM
Accuracy :0.312
Recall: 0.875
Precision:0.25
F1_Score:0.389
Batch 41:GNB
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 41:XGB
Accuracy :0.438
Recall: 0.75
Precision:0.273
F1_Score:0.4
Batch 41:DT
Accuracy :0.5
Recall: 0.5
Precision:0.25
F1_Score:0.333
Batch 41:MLP
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 42:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 42:RF
Accuracy :0.469
Recall: 0.857
Precision:0.444
F1_Score:0.585
Batch 42:KNN
Accuracy :0.469
Recall: 0.714
Precision:0.435
F1_Score:0.541
Batch 42:SVM
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 42:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 42:XGB
Accuracy :0.406
Recall: 0.929
Precision:0.419
F1_Score:0.578
Batch 42:DT
Accuracy :0.5
```

```
Recall: 0.786
Precision:0.458
F1_Score:0.579
Batch 42:MLP
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 43:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 43:RF
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 43:KNN
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 43:SVM
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 43:GNB
Accuracy :0.469
Recall: 0.786
Precision:0.44
F1_Score:0.564
Batch 43:XGB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 43:DT
Accuracy :0.406
Recall: 0.857
Precision:0.414
F1_Score:0.558
Batch 43:MLP
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 44:LogReg
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 44:RF
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 44:KNN
Accuracy :0.094
Recall: 1.0
Precision:0.094
```

```
F1_Score:0.171
Batch 44:SVM
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 44:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.143
F1_Score:0.25
Batch 44:XGB
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 44:DT
Accuracy :0.156
Recall: 1.0
Precision:0.1
F1_Score:0.182
Batch 44:MLP
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 45:LogReg
Accuracy :0.125
Recall: 1.0
Precision:0.125
F1_Score:0.222
Batch 45:RF
Accuracy :0.438
Recall: 1.0
Precision:0.182
F1_Score:0.308
Batch 45:KNN
Accuracy :0.469
Recall: 1.0
Precision:0.19
F1_Score:0.32
Batch 45:SVM
Accuracy :0.25
Recall: 1.0
Precision:0.143
F1_Score:0.25
Batch 45:GNB
Accuracy :0.875
Recall: 0.25
Precision:0.5
F1_Score:0.333
Batch 45:XGB
Accuracy :0.156
Recall: 1.0
Precision:0.129
F1_Score:0.229
Batch 45:DT
Accuracy :0.531
Recall: 1.0
Precision:0.211
F1_Score:0.348
Batch 45:MLP
```

```
Accuracy :0.219
Recall: 1.0
Precision:0.138
F1_Score:0.242
Batch 46:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 46:RF
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 46:KNN
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 46:SVM
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 46:GNB
Accuracy :0.562
Recall: 0.545
Precision:0.4
F1_Score:0.462
Batch 46:XGB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 46:DT
Accuracy :0.438
Recall: 0.727
Precision:0.348
F1_Score:0.471
Batch 46:MLP
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 47:LogReg
Accuracy :0.156
Recall: 1.0
Precision:0.156
F1_Score:0.27
Batch 47:RF
Accuracy :0.156
Recall: 1.0
Precision:0.156
F1_Score:0.27
Batch 47:KNN
Accuracy :0.156
Recall: 1.0
Precision:0.156
F1_Score:0.27
Batch 47:SVM
Accuracy :0.156
Recall: 1.0
```

```
Precision:0.156
F1_Score:0.27
Batch 47:GNB
Accuracy :0.594
Recall: 1.0
Precision:0.278
F1_Score:0.435
Batch 47:XGB
Accuracy :0.156
Recall: 1.0
Precision:0.156
F1_Score:0.27
Batch 47:DT
Accuracy :0.281
Recall: 1.0
Precision:0.179
F1_Score:0.303
Batch 47:MLP
Accuracy :0.156
Recall: 1.0
Precision:0.156
F1_Score:0.27
Batch 48:LogReg
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 48:RF
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 48:KNN
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 48:SVM
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 48:GNB
Accuracy :0.625
Recall: 1.0
Precision:0.613
F1_Score:0.76
Batch 48:XGB
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 48:DT
Accuracy :0.625
Recall: 0.947
Precision:0.621
F1_Score:0.75
Batch 48:MLP
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
```

```
Batch 49:LogReg
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 49:RF
Accuracy :0.688
Recall: 0.947
Precision:0.667
F1_Score:0.783
Batch 49:KNN
Accuracy :0.594
Recall: 0.789
Precision:0.625
F1_Score:0.698
Batch 49:SVM
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 49:GNB
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 49:XGB
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 49:DT
Accuracy :0.625
Recall: 0.842
Precision:0.64
F1_Score:0.727
Batch 49:MLP
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 50:LogReg
Accuracy :0.531
Recall: 1.0
Precision:0.531
F1_Score:0.694
Batch 50:RF
Accuracy :0.531
Recall: 0.588
Precision:0.556
F1_Score:0.571
Batch 50:KNN
Accuracy :0.594
Recall: 0.647
Precision:0.611
F1_Score:0.629
Batch 50:SVM
Accuracy :0.531
Recall: 1.0
Precision:0.531
F1_Score:0.694
Batch 50:GNB
Accuracy :0.531
```

```
Recall: 1.0
Precision:0.531
F1_Score:0.694
Batch 50:XGB
Accuracy :0.562
Recall: 1.0
Precision:0.548
F1_Score:0.708
Batch 50:DT
Accuracy :0.594
Recall: 0.765
Precision:0.591
F1_Score:0.667
Batch 50:MLP
Accuracy :0.531
Recall: 1.0
Precision:0.531
F1_Score:0.694
Batch 51:LogReg
Accuracy :0.406
Recall: 1.0
Precision:0.406
F1_Score:0.578
Batch 51:RF
Accuracy :0.562
Recall: 0.154
Precision:0.4
F1_Score:0.222
Batch 51:KNN
Accuracy :0.562
Recall: 0.077
Precision:0.333
F1_Score:0.125
Batch 51:SVM
Accuracy :0.594
Recall: 0.923
Precision:0.5
F1_Score:0.649
Batch 51:GNB
Accuracy :0.406
Recall: 1.0
Precision:0.406
F1_Score:0.578
Batch 51:XGB
Accuracy :0.5
Recall: 0.385
Precision:0.385
F1_Score:0.385
Batch 51:DT
Accuracy :0.5
Recall: 0.308
Precision:0.364
F1_Score:0.333
Batch 51:MLP
Accuracy :0.531
Recall: 0.923
Precision:0.462
F1_Score:0.615
Batch 52:LogReg
Accuracy :0.281
Recall: 1.0
Precision:0.281
```

```
F1_Score:0.439
Batch 52:RF
Accuracy :0.531
Recall: 0.556
Precision:0.312
F1_Score:0.4
Batch 52:KNN
Accuracy :0.594
Recall: 0.111
Precision:0.167
F1_Score:0.133
Batch 52:SVM
Accuracy :0.281
Recall: 1.0
Precision:0.281
F1_Score:0.439
Batch 52:GNB
Accuracy :0.281
Recall: 1.0
Precision:0.281
F1_Score:0.439
Batch 52:XGB
Accuracy :0.406
Recall: 1.0
Precision:0.321
F1_Score:0.486
Batch 52:DT
Accuracy :0.531
Recall: 0.778
Precision:0.35
F1_Score:0.483
Batch 52:MLP
Accuracy :0.281
Recall: 1.0
Precision:0.281
F1_Score:0.439
Batch 53:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 53:RF
Accuracy :0.344
Recall: 0.818
Precision:0.321
F1_Score:0.462
Batch 53:KNN
Accuracy :0.406
Recall: 0.818
Precision:0.346
F1_Score:0.486
Batch 53:SVM
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 53:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 53:XGB
```

```
Accuracy :0.375
Recall: 1.0
Precision:0.355
F1_Score:0.524
Batch 53:DT
Accuracy :0.375
Recall: 0.909
Precision:0.345
F1_Score:0.5
Batch 53:MLP
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 54:LogReg
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 54:RF
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 54:KNN
Accuracy :0.125
Recall: 1.0
Precision:0.097
F1_Score:0.176
Batch 54:SVM
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 54:GNB
Accuracy :0.156
Recall: 1.0
Precision:0.1
F1_Score:0.182
Batch 54:XGB
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 54:DT
Accuracy :0.188
Recall: 1.0
Precision:0.103
F1_Score:0.188
Batch 54:MLP
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 55:LogReg
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 55:RF
Accuracy :0.188
Recall: 1.0
```

```
Precision:0.188
F1_Score:0.316
Batch 55:KNN
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 55:SVM
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 55:GNB
Accuracy :0.281
Recall: 0.667
Precision:0.16
F1_Score:0.258
Batch 55:XGB
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 55:DT
Accuracy :0.344
Recall: 1.0
Precision:0.222
F1_Score:0.364
Batch 55:MLP
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 56:LogReg
Accuracy :0.083
Recall: 1.0
Precision:0.083
F1_Score:0.154
Batch 56:RF
Accuracy :0.167
Recall: 1.0
Precision:0.091
F1_Score:0.167
Batch 56:KNN
Accuracy :0.167
Recall: 1.0
Precision:0.091
F1_Score:0.167
Batch 56:SVM
Accuracy :0.083
Recall: 1.0
Precision:0.083
F1_Score:0.154
Batch 56:GNB
Accuracy :0.833
Recall: 1.0
Precision:0.333
F1_Score:0.5
Batch 56:XGB
Accuracy :0.083
Recall: 1.0
Precision:0.083
F1_Score:0.154
```

```
Batch 56:DT
Accuracy :0.333
Recall: 1.0
Precision:0.111
F1_Score:0.2
Batch 56:MLP
Accuracy :0.083
Recall: 1.0
Precision:0.083
F1_Score:0.154
```

In [104…
```
plt_classification_results(df,df2)
```

Gradual Drift Bottom 25 %

In [105…
```
batches_d=make_batches(df_drifted_bottom25_all)

all_excede_list_d,exceed_count_L2_instThresh_d ,exceed_count_L2_countThresh_d,avg_mse
```

```
**************

Batch Number : 0
```

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 5, 17, 18]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 1

Data Points Exceeding Layer 1 Encoder Instance Threshold : [16, 22, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 2

Data Points Exceeding Layer 1 Encoder Instance Threshold : [24, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 3

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 18, 19, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 4

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 15, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 5

Data Points Exceeding Layer 1 Encoder Instance Threshold : [12]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 6

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 7

Data Points Exceeding Layer 1 Encoder Instance Threshold : [5, 6, 15]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 8

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 9

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 10

Data Points Exceeding Layer 1 Encoder Instance Threshold : [9, 10, 12, 17]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 11

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 3, 20, 21, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 12

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 13, 24]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 13

Data Points Exceeding Layer 1 Encoder Instance Threshold : [24]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 14

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 15

Data Points Exceeding Layer 1 Encoder Instance Threshold : [9, 11, 12, 21, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

```
**************

Batch Number : 16

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 17

Data Points Exceeding Layer 1 Encoder Instance Threshold : [11, 13, 14, 21, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [21, 28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 2


**************

Batch Number : 18

Data Points Exceeding Layer 1 Encoder Instance Threshold : [4, 9, 10, 20, 21, 26, 29,
30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 19

Data Points Exceeding Layer 1 Encoder Instance Threshold : []

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 20

Data Points Exceeding Layer 1 Encoder Instance Threshold : [19, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0
```

```
**************

Batch Number : 21

Data Points Exceeding Layer 1 Encoder Instance Threshold : [11]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 22

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 4, 18, 22, 26, 27, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 3, 4, 5, 9, 10, 21, 22,
26, 27, 28, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 12


**************

Batch Number : 23

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 24

Data Points Exceeding Layer 1 Encoder Instance Threshold : [21, 26]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 25

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 8, 17, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0
```

```
**************

Batch Number : 26

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 27

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 28

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 29

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7, 8, 17]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 30

Data Points Exceeding Layer 1 Encoder Instance Threshold : [6, 18]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************
```

```
Batch Number : 31

Data Points Exceeding Layer 1 Encoder Instance Threshold : [14, 15, 26, 28, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 32

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 3, 4, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 33

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 7, 8, 21, 22, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 34

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 24, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 35

Data Points Exceeding Layer 1 Encoder Instance Threshold : [22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0


**************

Batch Number : 36
```

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 37

Data Points Exceeding Layer 1 Encoder Instance Threshold : [4, 17, 18, 21, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 3, 4, 5, 7, 8, 12, 1
7, 18, 19, 24, 27]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 13

****

Batch Number : 38

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 10, 13]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 39

Data Points Exceeding Layer 1 Encoder Instance Threshold : [17, 26, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 40

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 2, 5, 14, 25, 29, 30,
31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [2, 8, 9, 23]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 4

****

Batch Number : 41

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 4, 7, 23]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [2, 3, 7, 10]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 4

****

Batch Number : 42

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 19]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 43

Data Points Exceeding Layer 1 Encoder Instance Threshold : [16, 22, 24, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 44

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 15, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 45

Data Points Exceeding Layer 1 Encoder Instance Threshold : [8, 9, 13, 14, 15, 17, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 8, 9, 13, 14, 15, 17, 19, 20, 28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 10

****

Batch Number : 46

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 10, 12, 13, 18, 20, 21
, 29, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 4, 5, 11, 12, 13, 14
, 18, 19, 20, 21, 22, 25, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 15

****

Batch Number : 47

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7, 13, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 48

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 4, 9, 10, 14, 15, 19,
20]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 3, 4, 5, 6, 9, 10, 1
2, 13, 14, 15, 17, 18, 19, 20, 21, 23, 24, 26, 27, 29, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 23

****

Batch Number : 49

Data Points Exceeding Layer 1 Encoder Instance Threshold : [5, 6, 7, 8, 12]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 50

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7, 11, 24]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 51

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 3, 14]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 2, 3, 4, 5, 7, 8, 9, 13
, 14, 15, 19, 24, 30]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 14

****

Batch Number : 52

Data Points Exceeding Layer 1 Encoder Instance Threshold : [11, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 53

Data Points Exceeding Layer 1 Encoder Instance Threshold : [29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 54

Data Points Exceeding Layer 1 Encoder Instance Threshold : [11, 16, 27, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 55

Data Points Exceeding Layer 1 Encoder Instance Threshold : [13, 17, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

****

Batch Number : 56

```
Data Points Exceeding Layer 1 Encoder Instance Threshold : [7, 19]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 0

 Drift Detection at Batch Level

 Threshold exceeds at batch : 22
[22]
Warning Level at Batch 22
 Threshold exceeds at batch : 37
[37]
Warning Level at Batch 37
 Threshold exceeds at batch : 40
[40]
Warning Level at Batch 40
 Threshold exceeds at batch : 41
[40, 41]
Warning Level at Batch 41
 Threshold exceeds at batch : 45
[45]
Warning Level at Batch 45
 Threshold exceeds at batch : 46
[45, 46]
Warning Level at Batch 46
 Threshold exceeds at batch : 48
[48]
Warning Level at Batch 48
 Threshold exceeds at batch : 51
[51]
Warning Level at Batch 51
```

In [106…
```
perform_t_test()
```

```
Layer 1 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is -1.547295
p-value for two tailed test is 0.124613
Accept H0: There is no drift in the dataset

Layer 1 Exceed Count   Values for Normal and Drifted Data
Test statistic is 1.770596
p-value for two tailed test is 0.079349
Accept H0: There is no drift in the dataset

Layer 2 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 1.210250
p-value for two tailed test is 0.228731
Accept H0: There is no drift in the dataset

Layer 2 Exceed Count   Values for Normal and Drifted Data
Test statistic is 2.649352
p-value for two tailed test is 0.009230
Conclusion :
Since p-value(=0.009230) < alpha(=0.05) We reject the null hypothesis H0 and Accept H
1 . So we conclude that
There is a drift in the dataset at 0.05 level of significance.
```

In [107…
```
df_plotting=visual_analysis()
```

In [108…

```python
df,df2=classify_batches(models,df_drifted_bottom25_all ,stream,'class',batch_size=32)
```

```
Batch 0:LogReg
Accuracy :0.938
Recall: 0.714
Precision:1.0
F1_Score:0.833
Batch 0:RF
Accuracy :0.906
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 0:KNN
Accuracy :0.875
Recall: 0.714
Precision:0.714
F1_Score:0.714
Batch 0:SVM
Accuracy :0.938
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 0:GNB
Accuracy :0.781
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 0:XGB
Accuracy :0.906
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 0:DT
Accuracy :0.844
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 0:MLP
Accuracy :0.938
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 1:LogReg
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
```

```
Batch 1:RF
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:KNN
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 1:SVM
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 1:GNB
Accuracy :0.688
Recall: 0.182
Precision:0.667
F1_Score:0.286
Batch 1:XGB
Accuracy :0.75
Recall: 0.364
Precision:0.8
F1_Score:0.5
Batch 1:DT
Accuracy :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
Batch 1:MLP
Accuracy :0.719
Recall: 0.273
Precision:0.75
F1_Score:0.4
Batch 2:LogReg
Accuracy :0.656
Recall: 0.333
Precision:0.833
F1_Score:0.476
Batch 2:RF
Accuracy :0.844
Recall: 0.8
Precision:0.857
F1_Score:0.828
Batch 2:KNN
Accuracy :0.75
Recall: 0.667
Precision:0.769
F1_Score:0.714
Batch 2:SVM
Accuracy :0.75
Recall: 0.6
Precision:0.818
F1_Score:0.692
Batch 2:GNB
Accuracy :0.625
Recall: 0.467
Precision:0.636
F1_Score:0.538
Batch 2:XGB
Accuracy :0.719
```

```
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 2:DT
Accuracy :0.719
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 2:MLP
Accuracy :0.781
Recall: 0.6
Precision:0.9
F1_Score:0.72
Batch 3:LogReg
Accuracy :0.719
Recall: 0.571
Precision:1.0
F1_Score:0.727
Batch 3:RF
Accuracy :0.938
Recall: 0.952
Precision:0.952
F1_Score:0.952
Batch 3:KNN
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 3:SVM
Accuracy :0.906
Recall: 0.905
Precision:0.95
F1_Score:0.927
Batch 3:GNB
Accuracy :0.688
Recall: 0.667
Precision:0.824
F1_Score:0.737
Batch 3:XGB
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 3:DT
Accuracy :0.812
Recall: 0.857
Precision:0.857
F1_Score:0.857
Batch 3:MLP
Accuracy :0.906
Recall: 0.857
Precision:1.0
F1_Score:0.923
Batch 4:LogReg
Accuracy :0.719
Recall: 0.65
Precision:0.867
F1_Score:0.743
Batch 4:RF
Accuracy :0.781
Recall: 0.7
Precision:0.933
```

```
F1_Score:0.8
Batch 4:KNN
Accuracy :0.75
Recall: 0.65
Precision:0.929
F1_Score:0.765
Batch 4:SVM
Accuracy :0.812
Recall: 0.7
Precision:1.0
F1_Score:0.824
Batch 4:GNB
Accuracy :0.75
Recall: 0.95
Precision:0.731
F1_Score:0.826
Batch 4:XGB
Accuracy :0.781
Recall: 0.75
Precision:0.882
F1_Score:0.811
Batch 4:DT
Accuracy :0.688
Recall: 0.5
Precision:1.0
F1_Score:0.667
Batch 4:MLP
Accuracy :0.781
Recall: 0.65
Precision:1.0
F1_Score:0.788
Batch 5:LogReg
Accuracy :0.625
Recall: 0.615
Precision:0.533
F1_Score:0.571
Batch 5:RF
Accuracy :0.781
Recall: 0.538
Precision:0.875
F1_Score:0.667
Batch 5:KNN
Accuracy :0.719
Recall: 0.462
Precision:0.75
F1_Score:0.571
Batch 5:SVM
Accuracy :0.719
Recall: 0.462
Precision:0.75
F1_Score:0.571
Batch 5:GNB
Accuracy :0.5
Recall: 1.0
Precision:0.448
F1_Score:0.619
Batch 5:XGB
Accuracy :0.688
Recall: 0.462
Precision:0.667
F1_Score:0.545
Batch 5:DT
```

```
Accuracy :0.688
Recall: 0.538
Precision:0.636
F1_Score:0.583
Batch 5:MLP
Accuracy :0.781
Recall: 0.462
Precision:1.0
F1_Score:0.632
Batch 6:LogReg
Accuracy :0.5
Recall: 0.667
Precision:0.316
F1_Score:0.429
Batch 6:RF
Accuracy :0.688
Recall: 0.333
Precision:0.429
F1_Score:0.375
Batch 6:KNN
Accuracy :0.656
Recall: 0.444
Precision:0.4
F1_Score:0.421
Batch 6:SVM
Accuracy :0.719
Recall: 0.222
Precision:0.5
F1_Score:0.308
Batch 6:GNB
Accuracy :0.312
Recall: 1.0
Precision:0.29
F1_Score:0.45
Batch 6:XGB
Accuracy :0.719
Recall: 0.111
Precision:0.5
F1_Score:0.182
Batch 6:DT
Accuracy :0.719
Recall: 0.444
Precision:0.5
F1_Score:0.471
Batch 6:MLP
Accuracy :0.75
Recall: 0.333
Precision:0.6
F1_Score:0.429
Batch 7:LogReg
Accuracy :0.594
Recall: 0.583
Precision:0.467
F1_Score:0.519
Batch 7:RF
Accuracy :0.75
Recall: 0.417
Precision:0.833
F1_Score:0.556
Batch 7:KNN
Accuracy :0.781
Recall: 0.5
```

```
Precision:0.857
F1_Score:0.632
Batch 7:SVM
Accuracy :0.812
Recall: 0.667
Precision:0.8
F1_Score:0.727
Batch 7:GNB
Accuracy :0.406
Recall: 0.833
Precision:0.37
F1_Score:0.513
Batch 7:XGB
Accuracy :0.688
Recall: 0.333
Precision:0.667
F1_Score:0.444
Batch 7:DT
Accuracy :0.625
Recall: 0.417
Precision:0.5
F1_Score:0.455
Batch 7:MLP
Accuracy :0.688
Recall: 0.333
Precision:0.667
F1_Score:0.444
Batch 8:LogReg
Accuracy :0.75
Recall: 0.385
Precision:1.0
F1_Score:0.556
Batch 8:RF
Accuracy :0.781
Recall: 0.538
Precision:0.875
F1_Score:0.667
Batch 8:KNN
Accuracy :0.719
Recall: 0.462
Precision:0.75
F1_Score:0.571
Batch 8:SVM
Accuracy :0.812
Recall: 0.538
Precision:1.0
F1_Score:0.7
Batch 8:GNB
Accuracy :0.688
Recall: 0.846
Precision:0.579
F1_Score:0.688
Batch 8:XGB
Accuracy :0.75
Recall: 0.385
Precision:1.0
F1_Score:0.556
Batch 8:DT
Accuracy :0.812
Recall: 0.692
Precision:0.818
F1_Score:0.75
```

```
Batch 8:MLP
Accuracy :0.781
Recall: 0.462
Precision:1.0
F1_Score:0.632
Batch 9:LogReg
Accuracy :0.844
Recall: 0.5
Precision:0.8
F1_Score:0.615
Batch 9:RF
Accuracy :0.844
Recall: 0.625
Precision:0.714
F1_Score:0.667
Batch 9:KNN
Accuracy :0.75
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 9:SVM
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 9:GNB
Accuracy :0.781
Recall: 0.125
Precision:1.0
F1_Score:0.222
Batch 9:XGB
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 9:DT
Accuracy :0.625
Recall: 0.5
Precision:0.333
F1_Score:0.4
Batch 9:MLP
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 10:LogReg
Accuracy :0.688
Recall: 0.25
Precision:0.333
F1_Score:0.286
Batch 10:RF
Accuracy :0.844
Recall: 0.5
Precision:0.8
F1_Score:0.615
Batch 10:KNN
Accuracy :0.75
Recall: 0.625
Precision:0.5
F1_Score:0.556
Batch 10:SVM
Accuracy :0.812
```

```
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 10:GNB
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 10:XGB
Accuracy :0.844
Recall: 0.375
Precision:1.0
F1_Score:0.545
Batch 10:DT
Accuracy :0.781
Recall: 0.375
Precision:0.6
F1_Score:0.462
Batch 10:MLP
Accuracy :0.812
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 11:LogReg
Accuracy :0.812
Recall: 0.714
Precision:0.556
F1_Score:0.625
Batch 11:RF
Accuracy :0.844
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 11:KNN
Accuracy :0.875
Recall: 0.714
Precision:0.714
F1_Score:0.714
Batch 11:SVM
Accuracy :0.844
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 11:GNB
Accuracy :0.781
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 11:XGB
Accuracy :0.844
Recall: 0.857
Precision:0.6
F1_Score:0.706
Batch 11:DT
Accuracy :0.781
Recall: 0.286
Precision:0.5
F1_Score:0.364
Batch 11:MLP
Accuracy :0.812
Recall: 0.714
Precision:0.556
```

```
F1_Score:0.625
Batch 12:LogReg
Accuracy :0.812
Recall: 0.429
Precision:0.6
F1_Score:0.5
Batch 12:RF
Accuracy :0.844
Recall: 0.429
Precision:0.75
F1_Score:0.545
Batch 12:KNN
Accuracy :0.875
Recall: 0.571
Precision:0.8
F1_Score:0.667
Batch 12:SVM
Accuracy :0.875
Recall: 0.429
Precision:1.0
F1_Score:0.6
Batch 12:GNB
Accuracy :0.75
Recall: 0.143
Precision:0.333
F1_Score:0.2
Batch 12:XGB
Accuracy :0.875
Recall: 0.571
Precision:0.8
F1_Score:0.667
Batch 12:DT
Accuracy :0.781
Recall: 0.571
Precision:0.5
F1_Score:0.533
Batch 12:MLP
Accuracy :0.906
Recall: 0.571
Precision:1.0
F1_Score:0.727
Batch 13:LogReg
Accuracy :0.875
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 13:RF
Accuracy :0.906
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 13:KNN
Accuracy :0.875
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 13:SVM
Accuracy :0.906
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 13:GNB
```

```
Accuracy :0.844
Recall: 0.2
Precision:0.5
F1_Score:0.286
Batch 13:XGB
Accuracy :0.875
Recall: 0.4
Precision:0.667
F1_Score:0.5
Batch 13:DT
Accuracy :0.812
Recall: 0.2
Precision:0.333
F1_Score:0.25
Batch 13:MLP
Accuracy :0.906
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 14:LogReg
Accuracy :0.594
Recall: 0.2
Precision:0.75
F1_Score:0.316
Batch 14:RF
Accuracy :0.75
Recall: 0.467
Precision:1.0
F1_Score:0.636
Batch 14:KNN
Accuracy :0.688
Recall: 0.6
Precision:0.692
F1_Score:0.643
Batch 14:SVM
Accuracy :0.719
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 14:GNB
Accuracy :0.75
Recall: 0.733
Precision:0.733
F1_Score:0.733
Batch 14:XGB
Accuracy :0.688
Recall: 0.333
Precision:1.0
F1_Score:0.5
Batch 14:DT
Accuracy :0.781
Recall: 0.667
Precision:0.833
F1_Score:0.741
Batch 14:MLP
Accuracy :0.719
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 15:LogReg
Accuracy :0.688
Recall: 0.72
```

```
Precision:0.857
F1_Score:0.783
Batch 15:RF
Accuracy :0.875
Recall: 0.96
Precision:0.889
F1_Score:0.923
Batch 15:KNN
Accuracy :0.812
Recall: 0.92
Precision:0.852
F1_Score:0.885
Batch 15:SVM
Accuracy :0.844
Recall: 0.92
Precision:0.885
F1_Score:0.902
Batch 15:GNB
Accuracy :0.719
Recall: 0.88
Precision:0.786
F1_Score:0.83
Batch 15:XGB
Accuracy :0.875
Recall: 0.92
Precision:0.92
F1_Score:0.92
Batch 15:DT
Accuracy :0.719
Recall: 0.68
Precision:0.944
F1_Score:0.791
Batch 15:MLP
Accuracy :0.844
Recall: 0.88
Precision:0.917
F1_Score:0.898
Batch 16:LogReg
Accuracy :0.719
Recall: 0.923
Precision:0.6
F1_Score:0.727
Batch 16:RF
Accuracy :0.75
Recall: 0.692
Precision:0.692
F1_Score:0.692
Batch 16:KNN
Accuracy :0.594
Recall: 0.615
Precision:0.5
F1_Score:0.552
Batch 16:SVM
Accuracy :0.75
Recall: 0.769
Precision:0.667
F1_Score:0.714
Batch 16:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.419
F1_Score:0.591
```

```
Batch 16:XGB
Accuracy :0.75
Recall: 0.615
Precision:0.727
F1_Score:0.667
Batch 16:DT
Accuracy :0.656
Recall: 0.538
Precision:0.583
F1_Score:0.56
Batch 16:MLP
Accuracy :0.719
Recall: 0.615
Precision:0.667
F1_Score:0.64
Batch 17:LogReg
Accuracy :0.531
Recall: 0.929
Precision:0.481
F1_Score:0.634
Batch 17:RF
Accuracy :0.562
Recall: 0.571
Precision:0.5
F1_Score:0.533
Batch 17:KNN
Accuracy :0.438
Recall: 0.571
Precision:0.4
F1_Score:0.471
Batch 17:SVM
Accuracy :0.656
Recall: 0.857
Precision:0.571
F1_Score:0.686
Batch 17:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 17:XGB
Accuracy :0.562
Recall: 0.786
Precision:0.5
F1_Score:0.611
Batch 17:DT
Accuracy :0.438
Recall: 0.357
Precision:0.357
F1_Score:0.357
Batch 17:MLP
Accuracy :0.625
Recall: 0.643
Precision:0.562
F1_Score:0.6
Batch 18:LogReg
Accuracy :0.406
Recall: 0.909
Precision:0.357
F1_Score:0.513
Batch 18:RF
Accuracy :0.594
```

```
Recall: 0.818
Precision:0.45
F1_Score:0.581
Batch 18:KNN
Accuracy :0.344
Recall: 0.545
Precision:0.273
F1_Score:0.364
Batch 18:SVM
Accuracy :0.562
Recall: 0.818
Precision:0.429
F1_Score:0.562
Batch 18:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 18:XGB
Accuracy :0.531
Recall: 0.818
Precision:0.409
F1_Score:0.545
Batch 18:DT
Accuracy :0.438
Recall: 0.545
Precision:0.316
F1_Score:0.4
Batch 18:MLP
Accuracy :0.562
Recall: 0.818
Precision:0.429
F1_Score:0.562
Batch 19:LogReg
Accuracy :0.812
Recall: 0.625
Precision:0.625
F1_Score:0.625
Batch 19:RF
Accuracy :0.781
Recall: 0.875
Precision:0.538
F1_Score:0.667
Batch 19:KNN
Accuracy :0.625
Recall: 0.875
Precision:0.389
F1_Score:0.538
Batch 19:SVM
Accuracy :0.688
Recall: 0.875
Precision:0.438
F1_Score:0.583
Batch 19:GNB
Accuracy :0.406
Recall: 1.0
Precision:0.296
F1_Score:0.457
Batch 19:XGB
Accuracy :0.781
Recall: 0.875
Precision:0.538
```

```
F1_Score:0.667
Batch 19:DT
Accuracy :0.656
Recall: 0.875
Precision:0.412
F1_Score:0.56
Batch 19:MLP
Accuracy :0.719
Recall: 0.875
Precision:0.467
F1_Score:0.609
Batch 20:LogReg
Accuracy :0.844
Recall: 1.0
Precision:0.615
F1_Score:0.762
Batch 20:RF
Accuracy :0.875
Recall: 1.0
Precision:0.667
F1_Score:0.8
Batch 20:KNN
Accuracy :0.781
Recall: 1.0
Precision:0.533
F1_Score:0.696
Batch 20:SVM
Accuracy :0.75
Recall: 0.875
Precision:0.5
F1_Score:0.636
Batch 20:GNB
Accuracy :0.594
Recall: 1.0
Precision:0.381
F1_Score:0.552
Batch 20:XGB
Accuracy :0.875
Recall: 0.875
Precision:0.7
F1_Score:0.778
Batch 20:DT
Accuracy :0.594
Recall: 0.75
Precision:0.353
F1_Score:0.48
Batch 20:MLP
Accuracy :0.844
Recall: 0.875
Precision:0.636
F1_Score:0.737
Batch 21:LogReg
Accuracy :0.906
Recall: 1.0
Precision:0.8
F1_Score:0.889
Batch 21:RF
Accuracy :0.719
Recall: 0.667
Precision:0.615
F1_Score:0.64
Batch 21:KNN
```

```
Accuracy :0.75
Recall: 0.75
Precision:0.643
F1_Score:0.692
Batch 21:SVM
Accuracy :0.781
Recall: 0.667
Precision:0.727
F1_Score:0.696
Batch 21:GNB
Accuracy :0.688
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 21:XGB
Accuracy :0.719
Recall: 0.667
Precision:0.615
F1_Score:0.64
Batch 21:DT
Accuracy :0.719
Recall: 0.667
Precision:0.615
F1_Score:0.64
Batch 21:MLP
Accuracy :0.75
Recall: 0.667
Precision:0.667
F1_Score:0.667
Batch 22:LogReg
Accuracy :0.688
Recall: 0.5
Precision:0.3
F1_Score:0.375
Batch 22:RF
Accuracy :0.906
Recall: 0.833
Precision:0.714
F1_Score:0.769
Batch 22:KNN
Accuracy :0.812
Recall: 0.667
Precision:0.5
F1_Score:0.571
Batch 22:SVM
Accuracy :0.906
Recall: 0.667
Precision:0.8
F1_Score:0.727
Batch 22:GNB
Accuracy :0.844
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 22:XGB
Accuracy :0.906
Recall: 0.667
Precision:0.8
F1_Score:0.727
Batch 22:DT
Accuracy :0.875
Recall: 0.667
```

```
Precision:0.667
F1_Score:0.667
Batch 22:MLP
Accuracy :0.906
Recall: 0.667
Precision:0.8
F1_Score:0.727
Batch 23:LogReg
Accuracy :0.781
Recall: 0.75
Precision:0.333
F1_Score:0.462
Batch 23:RF
Accuracy :0.875
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 23:KNN
Accuracy :0.812
Recall: 0.75
Precision:0.375
F1_Score:0.5
Batch 23:SVM
Accuracy :0.875
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 23:GNB
Accuracy :0.844
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 23:XGB
Accuracy :0.906
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 23:DT
Accuracy :0.75
Recall: 0.75
Precision:0.3
F1_Score:0.429
Batch 23:MLP
Accuracy :0.875
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 24:LogReg
Accuracy :0.844
Recall: 0.875
Precision:0.636
F1_Score:0.737
Batch 24:RF
Accuracy :0.812
Recall: 0.75
Precision:0.6
F1_Score:0.667
Batch 24:KNN
Accuracy :0.812
Recall: 0.875
Precision:0.583
F1_Score:0.7
```

```
Batch 24:SVM
Accuracy :0.812
Recall: 0.75
Precision:0.6
F1_Score:0.667
Batch 24:GNB
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 24:XGB
Accuracy :0.812
Recall: 0.75
Precision:0.6
F1_Score:0.667
Batch 24:DT
Accuracy :0.781
Recall: 0.75
Precision:0.545
F1_Score:0.632
Batch 24:MLP
Accuracy :0.781
Recall: 0.75
Precision:0.545
F1_Score:0.632
Batch 25:LogReg
Accuracy :0.625
Recall: 0.6
Precision:0.429
F1_Score:0.5
Batch 25:RF
Accuracy :0.781
Recall: 0.8
Precision:0.615
F1_Score:0.696
Batch 25:KNN
Accuracy :0.781
Recall: 0.9
Precision:0.6
F1_Score:0.72
Batch 25:SVM
Accuracy :0.688
Recall: 0.7
Precision:0.5
F1_Score:0.583
Batch 25:GNB
Accuracy :0.625
Recall: 0.9
Precision:0.45
F1_Score:0.6
Batch 25:XGB
Accuracy :0.781
Recall: 0.8
Precision:0.615
F1_Score:0.696
Batch 25:DT
Accuracy :0.562
Recall: 0.6
Precision:0.375
F1_Score:0.462
Batch 25:MLP
Accuracy :0.719
```

```
Recall: 0.7
Precision:0.538
F1_Score:0.609
Batch 26:LogReg
Accuracy :0.719
Recall: 0.5
Precision:0.778
F1_Score:0.609
Batch 26:RF
Accuracy :0.688
Recall: 0.643
Precision:0.643
F1_Score:0.643
Batch 26:KNN
Accuracy :0.719
Recall: 0.643
Precision:0.692
F1_Score:0.667
Batch 26:SVM
Accuracy :0.719
Recall: 0.5
Precision:0.778
F1_Score:0.609
Batch 26:GNB
Accuracy :0.5
Recall: 0.786
Precision:0.458
F1_Score:0.579
Batch 26:XGB
Accuracy :0.719
Recall: 0.571
Precision:0.727
F1_Score:0.64
Batch 26:DT
Accuracy :0.688
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 26:MLP
Accuracy :0.719
Recall: 0.5
Precision:0.778
F1_Score:0.609
Batch 27:LogReg
Accuracy :0.812
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 27:RF
Accuracy :0.781
Recall: 0.786
Precision:0.733
F1_Score:0.759
Batch 27:KNN
Accuracy :0.688
Recall: 0.857
Precision:0.6
F1_Score:0.706
Batch 27:SVM
Accuracy :0.844
Recall: 0.857
Precision:0.8
```

```
F1_Score:0.828
Batch 27:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 27:XGB
Accuracy :0.812
Recall: 0.857
Precision:0.75
F1_Score:0.8
Batch 27:DT
Accuracy :0.812
Recall: 0.714
Precision:0.833
F1_Score:0.769
Batch 27:MLP
Accuracy :0.75
Recall: 0.643
Precision:0.75
F1_Score:0.692
Batch 28:LogReg
Accuracy :0.438
Recall: 0.917
Precision:0.393
F1_Score:0.55
Batch 28:RF
Accuracy :0.719
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 28:KNN
Accuracy :0.656
Recall: 0.583
Precision:0.538
F1_Score:0.56
Batch 28:SVM
Accuracy :0.781
Recall: 0.833
Precision:0.667
F1_Score:0.741
Batch 28:GNB
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 28:XGB
Accuracy :0.844
Recall: 0.75
Precision:0.818
F1_Score:0.783
Batch 28:DT
Accuracy :0.688
Recall: 0.583
Precision:0.583
F1_Score:0.583
Batch 28:MLP
Accuracy :0.75
Recall: 0.917
Precision:0.611
F1_Score:0.733
Batch 29:LogReg
```

```
Accuracy :0.531
Recall: 1.0
Precision:0.423
F1_Score:0.595
Batch 29:RF
Accuracy :0.719
Recall: 0.727
Precision:0.571
F1_Score:0.64
Batch 29:KNN
Accuracy :0.656
Recall: 0.636
Precision:0.5
F1_Score:0.56
Batch 29:SVM
Accuracy :0.75
Recall: 0.909
Precision:0.588
F1_Score:0.714
Batch 29:GNB
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 29:XGB
Accuracy :0.844
Recall: 0.818
Precision:0.75
F1_Score:0.783
Batch 29:DT
Accuracy :0.562
Recall: 0.364
Precision:0.364
F1_Score:0.364
Batch 29:MLP
Accuracy :0.781
Recall: 0.727
Precision:0.667
F1_Score:0.696
Batch 30:LogReg
Accuracy :0.531
Recall: 0.909
Precision:0.417
F1_Score:0.571
Batch 30:RF
Accuracy :0.531
Recall: 0.545
Precision:0.375
F1_Score:0.444
Batch 30:KNN
Accuracy :0.5
Recall: 0.545
Precision:0.353
F1_Score:0.429
Batch 30:SVM
Accuracy :0.562
Recall: 0.909
Precision:0.435
F1_Score:0.588
Batch 30:GNB
Accuracy :0.312
Recall: 0.909
```

```
Precision:0.323
F1_Score:0.476
Batch 30:XGB
Accuracy :0.562
Recall: 0.727
Precision:0.421
F1_Score:0.533
Batch 30:DT
Accuracy :0.562
Recall: 0.545
Precision:0.4
F1_Score:0.462
Batch 30:MLP
Accuracy :0.594
Recall: 0.909
Precision:0.455
F1_Score:0.606
Batch 31:LogReg
Accuracy :0.688
Recall: 0.583
Precision:0.583
F1_Score:0.583
Batch 31:RF
Accuracy :0.688
Recall: 0.667
Precision:0.571
F1_Score:0.615
Batch 31:KNN
Accuracy :0.562
Recall: 0.583
Precision:0.438
F1_Score:0.5
Batch 31:SVM
Accuracy :0.75
Recall: 0.75
Precision:0.643
F1_Score:0.692
Batch 31:GNB
Accuracy :0.562
Recall: 0.917
Precision:0.458
F1_Score:0.611
Batch 31:XGB
Accuracy :0.625
Recall: 0.583
Precision:0.5
F1_Score:0.538
Batch 31:DT
Accuracy :0.531
Recall: 0.667
Precision:0.421
F1_Score:0.516
Batch 31:MLP
Accuracy :0.719
Recall: 0.75
Precision:0.6
F1_Score:0.667
Batch 32:LogReg
Accuracy :0.656
Recall: 0.818
Precision:0.5
F1_Score:0.621
```

```
Batch 32:RF
Accuracy :0.594
Recall: 0.818
Precision:0.45
F1_Score:0.581
Batch 32:KNN
Accuracy :0.688
Recall: 0.909
Precision:0.526
F1_Score:0.667
Batch 32:SVM
Accuracy :0.625
Recall: 0.818
Precision:0.474
F1_Score:0.6
Batch 32:GNB
Accuracy :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
Batch 32:XGB
Accuracy :0.625
Recall: 0.818
Precision:0.474
F1_Score:0.6
Batch 32:DT
Accuracy :0.594
Recall: 0.818
Precision:0.45
F1_Score:0.581
Batch 32:MLP
Accuracy :0.625
Recall: 0.818
Precision:0.474
F1_Score:0.6
Batch 33:LogReg
Accuracy :0.562
Recall: 0.833
Precision:0.278
F1_Score:0.417
Batch 33:RF
Accuracy :0.688
Recall: 0.833
Precision:0.357
F1_Score:0.5
Batch 33:KNN
Accuracy :0.594
Recall: 0.833
Precision:0.294
F1_Score:0.435
Batch 33:SVM
Accuracy :0.719
Recall: 0.667
Precision:0.364
F1_Score:0.471
Batch 33:GNB
Accuracy :0.844
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 33:XGB
Accuracy :0.688
```

```
Recall: 0.667
Precision:0.333
F1_Score:0.444
Batch 33:DT
Accuracy :0.594
Recall: 0.833
Precision:0.294
F1_Score:0.435
Batch 33:MLP
Accuracy :0.656
Recall: 0.667
Precision:0.308
F1_Score:0.421
Batch 34:LogReg
Accuracy :0.594
Recall: 0.6
Precision:0.4
F1_Score:0.48
Batch 34:RF
Accuracy :0.625
Recall: 0.6
Precision:0.429
F1_Score:0.5
Batch 34:KNN
Accuracy :0.594
Recall: 0.5
Precision:0.385
F1_Score:0.435
Batch 34:SVM
Accuracy :0.688
Recall: 0.6
Precision:0.5
F1_Score:0.545
Batch 34:GNB
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 34:XGB
Accuracy :0.625
Recall: 0.5
Precision:0.417
F1_Score:0.455
Batch 34:DT
Accuracy :0.781
Recall: 0.8
Precision:0.615
F1_Score:0.696
Batch 34:MLP
Accuracy :0.656
Recall: 0.6
Precision:0.462
F1_Score:0.522
Batch 35:LogReg
Accuracy :0.781
Recall: 1.0
Precision:0.588
F1_Score:0.741
Batch 35:RF
Accuracy :0.75
Recall: 1.0
Precision:0.556
```

```
F1_Score:0.714
Batch 35:KNN
Accuracy :0.656
Recall: 0.9
Precision:0.474
F1_Score:0.621
Batch 35:SVM
Accuracy :0.781
Recall: 1.0
Precision:0.588
F1_Score:0.741
Batch 35:GNB
Accuracy :0.844
Recall: 0.8
Precision:0.727
F1_Score:0.762
Batch 35:XGB
Accuracy :0.719
Recall: 1.0
Precision:0.526
F1_Score:0.69
Batch 35:DT
Accuracy :0.656
Recall: 0.9
Precision:0.474
F1_Score:0.621
Batch 35:MLP
Accuracy :0.75
Recall: 1.0
Precision:0.556
F1_Score:0.714
Batch 36:LogReg
Accuracy :0.781
Recall: 1.0
Precision:0.682
F1_Score:0.811
Batch 36:RF
Accuracy :0.781
Recall: 0.867
Precision:0.722
F1_Score:0.788
Batch 36:KNN
Accuracy :0.844
Recall: 0.867
Precision:0.812
F1_Score:0.839
Batch 36:SVM
Accuracy :0.812
Recall: 1.0
Precision:0.714
F1_Score:0.833
Batch 36:GNB
Accuracy :0.625
Recall: 0.6
Precision:0.6
F1_Score:0.6
Batch 36:XGB
Accuracy :0.781
Recall: 0.933
Precision:0.7
F1_Score:0.8
Batch 36:DT
```

```
Accuracy :0.812
Recall: 0.8
Precision:0.8
F1_Score:0.8
Batch 36:MLP
Accuracy :0.781
Recall: 1.0
Precision:0.682
F1_Score:0.811
Batch 37:LogReg
Accuracy :0.844
Recall: 0.85
Precision:0.895
F1_Score:0.872
Batch 37:RF
Accuracy :0.844
Recall: 1.0
Precision:0.8
F1_Score:0.889
Batch 37:KNN
Accuracy :0.719
Recall: 0.85
Precision:0.739
F1_Score:0.791
Batch 37:SVM
Accuracy :0.844
Recall: 0.95
Precision:0.826
F1_Score:0.884
Batch 37:GNB
Accuracy :0.75
Recall: 1.0
Precision:0.714
F1_Score:0.833
Batch 37:XGB
Accuracy :0.875
Recall: 1.0
Precision:0.833
F1_Score:0.909
Batch 37:DT
Accuracy :0.75
Recall: 0.85
Precision:0.773
F1_Score:0.81
Batch 37:MLP
Accuracy :0.844
Recall: 0.9
Precision:0.857
F1_Score:0.878
Batch 38:LogReg
Accuracy :0.688
Recall: 0.87
Precision:0.741
F1_Score:0.8
Batch 38:RF
Accuracy :0.75
Recall: 0.87
Precision:0.8
F1_Score:0.833
Batch 38:KNN
Accuracy :0.719
Recall: 0.826
```

```
Precision:0.792
F1_Score:0.809
Batch 38:SVM
Accuracy :0.75
Recall: 0.913
Precision:0.778
F1_Score:0.84
Batch 38:GNB
Accuracy :0.719
Recall: 1.0
Precision:0.719
F1_Score:0.836
Batch 38:XGB
Accuracy :0.75
Recall: 0.957
Precision:0.759
F1_Score:0.846
Batch 38:DT
Accuracy :0.75
Recall: 0.87
Precision:0.8
F1_Score:0.833
Batch 38:MLP
Accuracy :0.688
Recall: 0.826
Precision:0.76
F1_Score:0.792
Batch 39:LogReg
Accuracy :0.688
Recall: 1.0
Precision:0.667
F1_Score:0.8
Batch 39:RF
Accuracy :0.469
Recall: 0.45
Precision:0.6
F1_Score:0.514
Batch 39:KNN
Accuracy :0.594
Recall: 0.8
Precision:0.64
F1_Score:0.711
Batch 39:SVM
Accuracy :0.719
Recall: 0.85
Precision:0.739
F1_Score:0.791
Batch 39:GNB
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 39:XGB
Accuracy :0.625
Recall: 0.7
Precision:0.7
F1_Score:0.7
Batch 39:DT
Accuracy :0.406
Recall: 0.3
Precision:0.545
F1_Score:0.387
```

```
Batch 39:MLP
Accuracy :0.75
Recall: 0.9
Precision:0.75
F1_Score:0.818
Batch 40:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:RF
Accuracy :0.781
Recall: 0.714
Precision:0.769
F1_Score:0.741
Batch 40:KNN
Accuracy :0.625
Recall: 0.786
Precision:0.55
F1_Score:0.647
Batch 40:SVM
Accuracy :0.75
Recall: 1.0
Precision:0.636
F1_Score:0.778
Batch 40:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:XGB
Accuracy :0.719
Recall: 0.929
Precision:0.619
F1_Score:0.743
Batch 40:DT
Accuracy :0.656
Recall: 0.571
Precision:0.615
F1_Score:0.593
Batch 40:MLP
Accuracy :0.781
Recall: 1.0
Precision:0.667
F1_Score:0.8
Batch 41:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.276
F1_Score:0.432
Batch 41:RF
Accuracy :0.75
Recall: 0.75
Precision:0.5
F1_Score:0.6
Batch 41:KNN
Accuracy :0.625
Recall: 0.625
Precision:0.357
F1_Score:0.455
Batch 41:SVM
Accuracy :0.75
```

```
Recall: 0.875
Precision:0.5
F1_Score:0.636
Batch 41:GNB
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 41:XGB
Accuracy :0.656
Recall: 0.75
Precision:0.4
F1_Score:0.522
Batch 41:DT
Accuracy :0.781
Recall: 0.5
Precision:0.571
F1_Score:0.533
Batch 41:MLP
Accuracy :0.719
Recall: 0.875
Precision:0.467
F1_Score:0.609
Batch 42:LogReg
Accuracy :0.625
Recall: 1.0
Precision:0.538
F1_Score:0.7
Batch 42:RF
Accuracy :0.562
Recall: 0.857
Precision:0.5
F1_Score:0.632
Batch 42:KNN
Accuracy :0.656
Recall: 0.929
Precision:0.565
F1_Score:0.703
Batch 42:SVM
Accuracy :0.625
Recall: 0.857
Precision:0.545
F1_Score:0.667
Batch 42:GNB
Accuracy :0.469
Recall: 1.0
Precision:0.452
F1_Score:0.622
Batch 42:XGB
Accuracy :0.625
Recall: 0.857
Precision:0.545
F1_Score:0.667
Batch 42:DT
Accuracy :0.656
Recall: 0.857
Precision:0.571
F1_Score:0.686
Batch 42:MLP
Accuracy :0.656
Recall: 0.929
Precision:0.565
```

```
F1_Score:0.703
Batch 43:LogReg
Accuracy :0.625
Recall: 0.857
Precision:0.545
F1_Score:0.667
Batch 43:RF
Accuracy :0.594
Recall: 1.0
Precision:0.519
F1_Score:0.683
Batch 43:KNN
Accuracy :0.531
Recall: 1.0
Precision:0.483
F1_Score:0.651
Batch 43:SVM
Accuracy :0.531
Recall: 1.0
Precision:0.483
F1_Score:0.651
Batch 43:GNB
Accuracy :0.594
Recall: 0.857
Precision:0.522
F1_Score:0.649
Batch 43:XGB
Accuracy :0.594
Recall: 1.0
Precision:0.519
F1_Score:0.683
Batch 43:DT
Accuracy :0.5
Recall: 0.786
Precision:0.458
F1_Score:0.579
Batch 43:MLP
Accuracy :0.5
Recall: 0.929
Precision:0.464
F1_Score:0.619
Batch 44:LogReg
Accuracy :0.562
Recall: 1.0
Precision:0.176
F1_Score:0.3
Batch 44:RF
Accuracy :0.594
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 44:KNN
Accuracy :0.5
Recall: 1.0
Precision:0.158
F1_Score:0.273
Batch 44:SVM
Accuracy :0.562
Recall: 1.0
Precision:0.176
F1_Score:0.3
Batch 44:GNB
```

```
Accuracy :0.594
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 44:XGB
Accuracy :0.625
Recall: 1.0
Precision:0.2
F1_Score:0.333
Batch 44:DT
Accuracy :0.594
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 44:MLP
Accuracy :0.562
Recall: 1.0
Precision:0.176
F1_Score:0.3
Batch 45:LogReg
Accuracy :0.625
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 45:RF
Accuracy :0.812
Recall: 0.75
Precision:0.375
F1_Score:0.5
Batch 45:KNN
Accuracy :0.812
Recall: 0.5
Precision:0.333
F1_Score:0.4
Batch 45:SVM
Accuracy :0.844
Recall: 0.5
Precision:0.4
F1_Score:0.444
Batch 45:GNB
Accuracy :0.875
Recall: 0.25
Precision:0.5
F1_Score:0.333
Batch 45:XGB
Accuracy :0.781
Recall: 0.5
Precision:0.286
F1_Score:0.364
Batch 45:DT
Accuracy :0.688
Recall: 0.75
Precision:0.25
F1_Score:0.375
Batch 45:MLP
Accuracy :0.812
Recall: 0.5
Precision:0.333
F1_Score:0.4
Batch 46:LogReg
Accuracy :0.625
Recall: 0.818
```

```
Precision:0.474
F1_Score:0.6
Batch 46:RF
Accuracy :0.656
Recall: 0.909
Precision:0.5
F1_Score:0.645
Batch 46:KNN
Accuracy :0.562
Recall: 0.909
Precision:0.435
F1_Score:0.588
Batch 46:SVM
Accuracy :0.688
Recall: 0.909
Precision:0.526
F1_Score:0.667
Batch 46:GNB
Accuracy :0.594
Recall: 0.545
Precision:0.429
F1_Score:0.48
Batch 46:XGB
Accuracy :0.719
Recall: 0.909
Precision:0.556
F1_Score:0.69
Batch 46:DT
Accuracy :0.562
Recall: 1.0
Precision:0.44
F1_Score:0.611
Batch 46:MLP
Accuracy :0.656
Recall: 0.909
Precision:0.5
F1_Score:0.645
Batch 47:LogReg
Accuracy :0.656
Recall: 0.8
Precision:0.286
F1_Score:0.421
Batch 47:RF
Accuracy :0.75
Recall: 1.0
Precision:0.385
F1_Score:0.556
Batch 47:KNN
Accuracy :0.438
Recall: 0.8
Precision:0.19
F1_Score:0.308
Batch 47:SVM
Accuracy :0.844
Recall: 1.0
Precision:0.5
F1_Score:0.667
Batch 47:GNB
Accuracy :0.625
Recall: 0.8
Precision:0.267
F1_Score:0.4
```

```
Batch 47:XGB
Accuracy :0.75
Recall: 0.8
Precision:0.364
F1_Score:0.5
Batch 47:DT
Accuracy :0.469
Recall: 0.8
Precision:0.2
F1_Score:0.32
Batch 47:MLP
Accuracy :0.812
Recall: 1.0
Precision:0.455
F1_Score:0.625
Batch 48:LogReg
Accuracy :0.781
Recall: 1.0
Precision:0.731
F1_Score:0.844
Batch 48:RF
Accuracy :0.719
Recall: 1.0
Precision:0.679
F1_Score:0.809
Batch 48:KNN
Accuracy :0.781
Recall: 1.0
Precision:0.731
F1_Score:0.844
Batch 48:SVM
Accuracy :0.75
Recall: 1.0
Precision:0.704
F1_Score:0.826
Batch 48:GNB
Accuracy :0.656
Recall: 1.0
Precision:0.633
F1_Score:0.776
Batch 48:XGB
Accuracy :0.719
Recall: 1.0
Precision:0.679
F1_Score:0.809
Batch 48:DT
Accuracy :0.656
Recall: 0.895
Precision:0.654
F1_Score:0.756
Batch 48:MLP
Accuracy :0.75
Recall: 0.947
Precision:0.72
F1_Score:0.818
Batch 49:LogReg
Accuracy :0.75
Recall: 0.947
Precision:0.72
F1_Score:0.818
Batch 49:RF
Accuracy :0.781
```

```
Recall: 1.0
Precision:0.731
F1_Score:0.844
Batch 49:KNN
Accuracy :0.719
Recall: 0.842
Precision:0.727
F1_Score:0.78
Batch 49:SVM
Accuracy :0.844
Recall: 1.0
Precision:0.792
F1_Score:0.884
Batch 49:GNB
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 49:XGB
Accuracy :0.781
Recall: 0.947
Precision:0.75
F1_Score:0.837
Batch 49:DT
Accuracy :0.75
Recall: 0.842
Precision:0.762
F1_Score:0.8
Batch 49:MLP
Accuracy :0.844
Recall: 1.0
Precision:0.792
F1_Score:0.884
Batch 50:LogReg
Accuracy :0.562
Recall: 0.941
Precision:0.552
F1_Score:0.696
Batch 50:RF
Accuracy :0.625
Recall: 0.765
Precision:0.619
F1_Score:0.684
Batch 50:KNN
Accuracy :0.656
Recall: 0.941
Precision:0.615
F1_Score:0.744
Batch 50:SVM
Accuracy :0.688
Recall: 1.0
Precision:0.63
F1_Score:0.773
Batch 50:GNB
Accuracy :0.531
Recall: 1.0
Precision:0.531
F1_Score:0.694
Batch 50:XGB
Accuracy :0.562
Recall: 1.0
Precision:0.548
```

```
F1_Score:0.708
Batch 50:DT
Accuracy :0.562
Recall: 0.706
Precision:0.571
F1_Score:0.632
Batch 50:MLP
Accuracy :0.625
Recall: 1.0
Precision:0.586
F1_Score:0.739
Batch 51:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.419
F1_Score:0.591
Batch 51:RF
Accuracy :0.594
Recall: 0.231
Precision:0.5
F1_Score:0.316
Batch 51:KNN
Accuracy :0.562
Recall: 0.385
Precision:0.455
F1_Score:0.417
Batch 51:SVM
Accuracy :0.625
Recall: 0.692
Precision:0.529
F1_Score:0.6
Batch 51:GNB
Accuracy :0.406
Recall: 1.0
Precision:0.406
F1_Score:0.578
Batch 51:XGB
Accuracy :0.562
Recall: 0.308
Precision:0.444
F1_Score:0.364
Batch 51:DT
Accuracy :0.625
Recall: 0.231
Precision:0.6
F1_Score:0.333
Batch 51:MLP
Accuracy :0.625
Recall: 0.923
Precision:0.522
F1_Score:0.667
Batch 52:LogReg
Accuracy :0.312
Recall: 1.0
Precision:0.29
F1_Score:0.45
Batch 52:RF
Accuracy :0.469
Recall: 0.556
Precision:0.278
F1_Score:0.37
Batch 52:KNN
```

```
Accuracy :0.469
Recall: 0.778
Precision:0.318
F1_Score:0.452
Batch 52:SVM
Accuracy :0.531
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 52:GNB
Accuracy :0.281
Recall: 1.0
Precision:0.281
F1_Score:0.439
Batch 52:XGB
Accuracy :0.438
Recall: 0.889
Precision:0.32
F1_Score:0.471
Batch 52:DT
Accuracy :0.594
Recall: 0.778
Precision:0.389
F1_Score:0.519
Batch 52:MLP
Accuracy :0.5
Recall: 1.0
Precision:0.36
F1_Score:0.529
Batch 53:LogReg
Accuracy :0.781
Recall: 1.0
Precision:0.611
F1_Score:0.759
Batch 53:RF
Accuracy :0.625
Recall: 1.0
Precision:0.478
F1_Score:0.647
Batch 53:KNN
Accuracy :0.656
Recall: 0.909
Precision:0.5
F1_Score:0.645
Batch 53:SVM
Accuracy :0.719
Recall: 1.0
Precision:0.55
F1_Score:0.71
Batch 53:GNB
Accuracy :0.406
Recall: 1.0
Precision:0.367
F1_Score:0.537
Batch 53:XGB
Accuracy :0.594
Recall: 1.0
Precision:0.458
F1_Score:0.629
Batch 53:DT
Accuracy :0.562
Recall: 0.909
```

```
Precision:0.435
F1_Score:0.588
Batch 53:MLP
Accuracy :0.75
Recall: 1.0
Precision:0.579
F1_Score:0.733
Batch 54:LogReg
Accuracy :0.719
Recall: 0.333
Precision:0.125
F1_Score:0.182
Batch 54:RF
Accuracy :0.469
Recall: 0.667
Precision:0.111
F1_Score:0.19
Batch 54:KNN
Accuracy :0.438
Recall: 0.333
Precision:0.059
F1_Score:0.1
Batch 54:SVM
Accuracy :0.625
Recall: 0.333
Precision:0.091
F1_Score:0.143
Batch 54:GNB
Accuracy :0.25
Recall: 1.0
Precision:0.111
F1_Score:0.2
Batch 54:XGB
Accuracy :0.469
Recall: 0.333
Precision:0.062
F1_Score:0.105
Batch 54:DT
Accuracy :0.25
Recall: 0.667
Precision:0.08
F1_Score:0.143
Batch 54:MLP
Accuracy :0.656
Recall: 0.333
Precision:0.1
F1_Score:0.154
Batch 55:LogReg
Accuracy :0.844
Recall: 1.0
Precision:0.545
F1_Score:0.706
Batch 55:RF
Accuracy :0.5
Recall: 1.0
Precision:0.273
F1_Score:0.429
Batch 55:KNN
Accuracy :0.438
Recall: 1.0
Precision:0.25
F1_Score:0.4
```

```
Batch 55:SVM
Accuracy :0.688
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 55:GNB
Accuracy :0.5
Recall: 1.0
Precision:0.273
F1_Score:0.429
Batch 55:XGB
Accuracy :0.562
Recall: 1.0
Precision:0.3
F1_Score:0.462
Batch 55:DT
Accuracy :0.438
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 55:MLP
Accuracy :0.688
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 56:LogReg
Accuracy :0.708
Recall: 1.0
Precision:0.222
F1_Score:0.364
Batch 56:RF
Accuracy :0.708
Recall: 0.5
Precision:0.143
F1_Score:0.222
Batch 56:KNN
Accuracy :0.542
Recall: 0.5
Precision:0.091
F1_Score:0.154
Batch 56:SVM
Accuracy :0.875
Recall: 0.5
Precision:0.333
F1_Score:0.4
Batch 56:GNB
Accuracy :0.833
Recall: 1.0
Precision:0.333
F1_Score:0.5
Batch 56:XGB
Accuracy :0.583
Recall: 0.5
Precision:0.1
F1_Score:0.167
Batch 56:DT
Accuracy :0.667
Recall: 0.5
Precision:0.125
F1_Score:0.2
Batch 56:MLP
Accuracy :0.833
```

```
        Recall: 0.5
        Precision:0.25
        F1_Score:0.333
```

In [109…   `plt_classification_results(df,df2)`