# 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 | cl |
|---|---|---|---|---|---|---|---|---|---|
| **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]:  train, test, X_positive,X_negative , stream =normalize_encode_split(data,'class',2,1)
```

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

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

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

Out[8]:

|       | attribute1 | attribute2 | attribute3 | attribute4 | attribute5 | attribute6 | attribute7 | attribute8 | cla |
|-------|------------|------------|------------|------------|------------|------------|------------|------------|-----|
| 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]:  test['class'].value_counts()
```

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

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

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

```
In [11]:  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=
```

```
Training Autoencoder on Positive Examples
Epoch 1/100
106/106 [==============================] - 5s 17ms/step - loss: 0.0707 - val_loss:
0.0394
Epoch 2/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0303 - val_loss: 0.0
185
Epoch 3/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0170 - val_loss: 0.0
171
Epoch 4/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0166 - val_loss: 0.0
164
Epoch 5/100
```

```
106/106 [==============================] - 0s 3ms/step - loss: 0.0153 - val_loss: 0.0
156
Epoch 6/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0143 - val_loss: 0.0
146
Epoch 7/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0138 - val_loss: 0.0
135
Epoch 8/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0124 - val_loss: 0.0
122
Epoch 9/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0115 - val_loss: 0.0
113
Epoch 10/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0102 - val_loss: 0.0
104
Epoch 11/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0093 - val_loss: 0.0
098
Epoch 12/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0089 - val_loss: 0.0
094
Epoch 13/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0083 - val_loss: 0.0
091
Epoch 14/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0081 - val_loss: 0.0
089
Epoch 15/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0076 - val_loss: 0.0
086
Epoch 16/100
106/106 [==============================] - ETA: 0s - loss: 0.007 - 0s 3ms/step - loss
: 0.0075 - val_loss: 0.0085
Epoch 17/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0075 - val_loss: 0.0
084
Epoch 18/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0071 - val_loss: 0.0
083
Epoch 19/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0070 - val_loss: 0.0
083
Epoch 20/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0073 - val_loss: 0.0
079
Epoch 21/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0071 - val_loss: 0.0
082
Epoch 22/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
082
Epoch 23/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
082
Epoch 24/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
081
Epoch 25/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
083
```

```
Epoch 26/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
083
Epoch 27/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
082
Epoch 28/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
082
Epoch 29/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
082
Epoch 30/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0070 - val_loss: 0.0
082
Epoch 31/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0072 - val_loss: 0.0
081
Epoch 32/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
083
Epoch 33/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
082
Epoch 34/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
082
Epoch 35/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
081
Epoch 36/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
083
Epoch 37/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
079
Epoch 38/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
080
Epoch 39/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
083
Epoch 40/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
081
Epoch 41/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
081
Epoch 42/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
083
Epoch 43/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
082
Epoch 44/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0070 - val_loss: 0.0
081
Epoch 45/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
083
Epoch 46/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
```

```
082
Epoch 47/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
082
Epoch 48/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
084
Epoch 49/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
082
Epoch 50/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
083
Epoch 51/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
079
Epoch 52/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
082
Epoch 53/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0065 - val_loss: 0.0
079
Epoch 54/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
083
Epoch 55/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
084
Epoch 56/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
082
Epoch 57/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
084
Epoch 58/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0065 - val_loss: 0.0
078
Epoch 59/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
082
Epoch 60/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
079
Epoch 61/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
082
Epoch 62/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
085
Epoch 63/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
080
Epoch 64/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
082
Epoch 65/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
082
Epoch 66/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
084
Epoch 67/100
```

```
106/106 [==============================] - 0s 3ms/step - loss: 0.0070 - val_loss: 0.0
082
Epoch 68/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
082
Epoch 69/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
081
Epoch 70/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
082
Epoch 71/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
082
Epoch 72/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
085
Epoch 73/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
081
Epoch 74/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
082
Epoch 75/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
084
Epoch 76/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
081
Epoch 77/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
084
Epoch 78/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
082
Epoch 79/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
081
Epoch 80/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
081
Epoch 81/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0069 - val_loss: 0.0
081
Epoch 82/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
081
Epoch 83/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
084
Epoch 84/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
080
Epoch 85/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
081
Epoch 86/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
081
Epoch 87/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
084
```

```
Epoch 88/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
080
Epoch 89/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
081
Epoch 90/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
081
Epoch 91/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
081
Epoch 92/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
081
Epoch 93/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
080
Epoch 94/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
083
Epoch 95/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
082
Epoch 96/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
083
Epoch 97/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
081
Epoch 98/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0068 - val_loss: 0.0
082
Epoch 99/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0067 - val_loss: 0.0
082
Epoch 100/100
106/106 [==============================] - 0s 3ms/step - loss: 0.0066 - val_loss: 0.0
083
Training Autoencoder on Negative Examples
Epoch 1/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0655 - val_loss: 0.0
326
Epoch 2/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0288 - val_loss: 0.0
199
Epoch 3/100
252/252 [==============================] - 1s 2ms/step - loss: 0.0184 - val_loss: 0.0
126
Epoch 4/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0102 - val_loss: 0.0
088
Epoch 5/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0078 - val_loss: 0.0
085
Epoch 6/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0074 - val_loss: 0.0
084
Epoch 7/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0073 - val_loss: 0.0
084
Epoch 8/100
```

```
252/252 [==============================] - 1s 3ms/step - loss: 0.0071 - val_loss: 0.0
085
Epoch 9/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0072 - val_loss: 0.0
085
Epoch 10/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0072 - val_loss: 0.0
083
Epoch 11/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0072 - val_loss: 0.0
084
Epoch 12/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0071 - val_loss: 0.0
078
Epoch 13/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0063 - val_loss: 0.0
065
Epoch 14/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0051 - val_loss: 0.0
059
Epoch 15/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0046 - val_loss: 0.0
058
Epoch 16/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0042 - val_loss: 0.0
058
Epoch 17/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0041 - val_loss: 0.0
062
Epoch 18/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
055
Epoch 19/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
054
Epoch 20/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
054
Epoch 21/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
054
Epoch 22/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
057
Epoch 23/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
057
Epoch 24/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
057
Epoch 25/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
052
Epoch 26/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
058
Epoch 27/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
055
Epoch 28/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
054
```

```
Epoch 29/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
059
Epoch 30/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
059
Epoch 31/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
055
Epoch 32/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
057
Epoch 33/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
053
Epoch 34/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
059
Epoch 35/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
058
Epoch 36/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
056
Epoch 37/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0037 - val_loss: 0.0
057
Epoch 38/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0037 - val_loss: 0.0
057
Epoch 39/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
055
Epoch 40/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
057
Epoch 41/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
053
Epoch 42/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
057
Epoch 43/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
056
Epoch 44/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
057
Epoch 45/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
060
Epoch 46/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
059
Epoch 47/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
054
Epoch 48/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
059
Epoch 49/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
```

```
055
Epoch 50/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
055
Epoch 51/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
056
Epoch 52/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
056
Epoch 53/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
057
Epoch 54/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
055
Epoch 55/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
054
Epoch 56/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
056
Epoch 57/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
059
Epoch 58/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
054
Epoch 59/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
057
Epoch 60/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
059
Epoch 61/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
056
Epoch 62/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
056
Epoch 63/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
057
Epoch 64/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
060
Epoch 65/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
057
Epoch 66/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
055
Epoch 67/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
058
Epoch 68/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
057
Epoch 69/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0037 - val_loss: 0.0
056
Epoch 70/100
```

```
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
057
Epoch 71/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
056
Epoch 72/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
058
Epoch 73/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
059
Epoch 74/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
055
Epoch 75/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
057
Epoch 76/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
057
Epoch 77/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
056
Epoch 78/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
059
Epoch 79/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0037 - val_loss: 0.0
058
Epoch 80/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
058
Epoch 81/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
056
Epoch 82/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
058
Epoch 83/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
056
Epoch 84/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
056
Epoch 85/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
056
Epoch 86/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
056
Epoch 87/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
058
Epoch 88/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0040 - val_loss: 0.0
056
Epoch 89/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
058
Epoch 90/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
060
```

```
Epoch 91/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
056
Epoch 92/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
055
Epoch 93/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
054
Epoch 94/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0039 - val_loss: 0.0
055
Epoch 95/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
058
Epoch 96/100
252/252 [==============================] - ETA: 0s - loss: 0.003 - 1s 3ms/step - loss
: 0.0039 - val_loss: 0.0056
Epoch 97/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
057
Epoch 98/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
060
Epoch 99/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
060
Epoch 100/100
252/252 [==============================] - 1s 3ms/step - loss: 0.0038 - val_loss: 0.0
055
```

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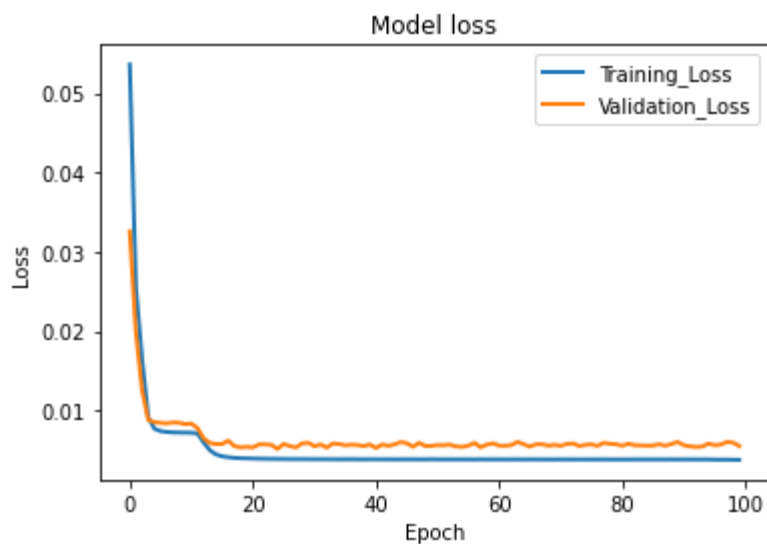
In [17]:
```python
plot_loss(history_positive_class)
```
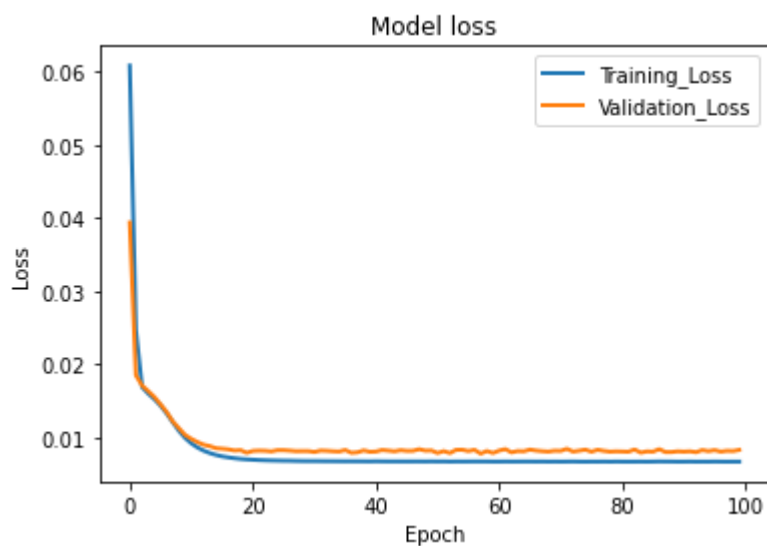


# 5. Threshold Computation & Plotting

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

In [18]:
```python
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=0.0025878975,median=0.001817 ,max=0.038983,min=3.9e-05,variance=9.5189e-06

Boxplots and Distribution plot for Reconstruction Error



MSE plot
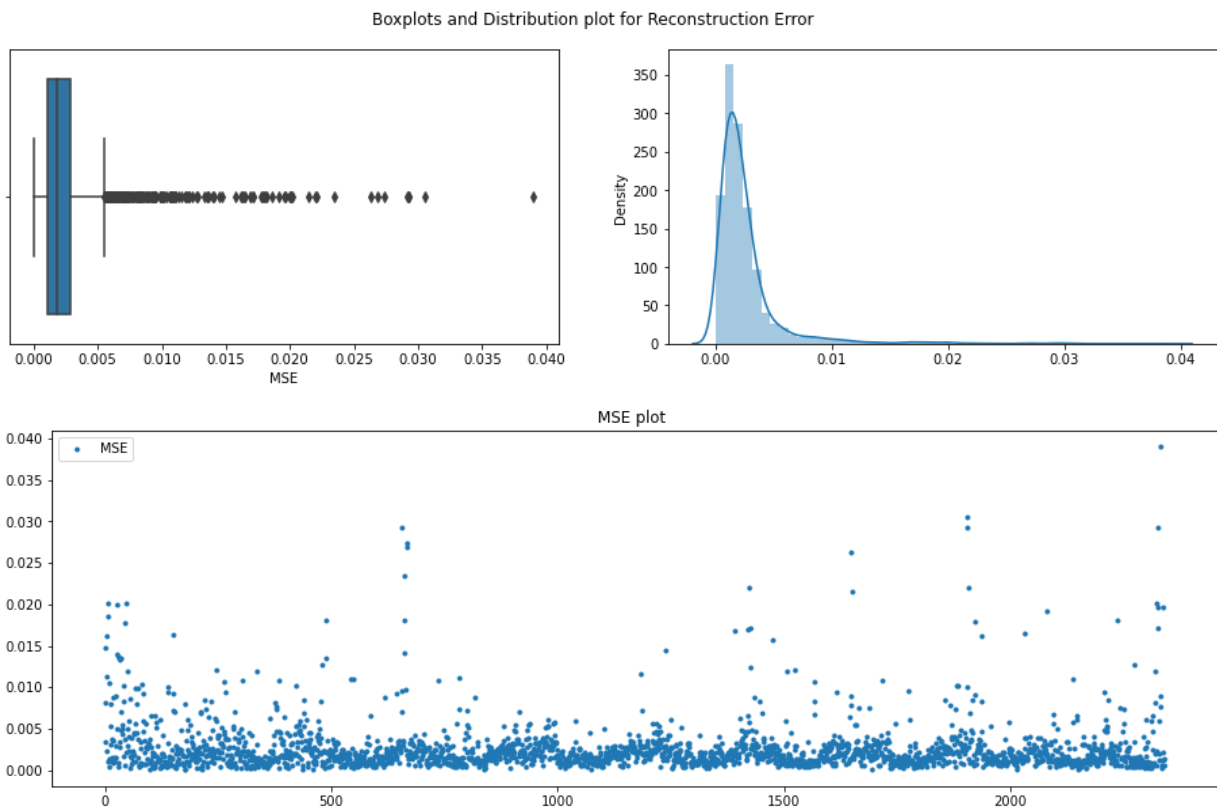


In [24]:
```python
def make_batches(test_data):
    data=np.array(test_data)
    batch_size=32
    batches={}
    count=0
    for index in range(0,data.shape[0],batch_size):
        batches[count]=data[index:min(index+batch_size,data.shape[0]),:]
        count+=1
    return batches
    #print(batch.shape)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

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(batch
```

```
 ********************
Batch: 0
mean=0.006684375,median=0.00366 ,max=0.02016,min=0.00043,variance=3.85753e-05
```


Boxplots and Distribution plot for Reconstruction Error
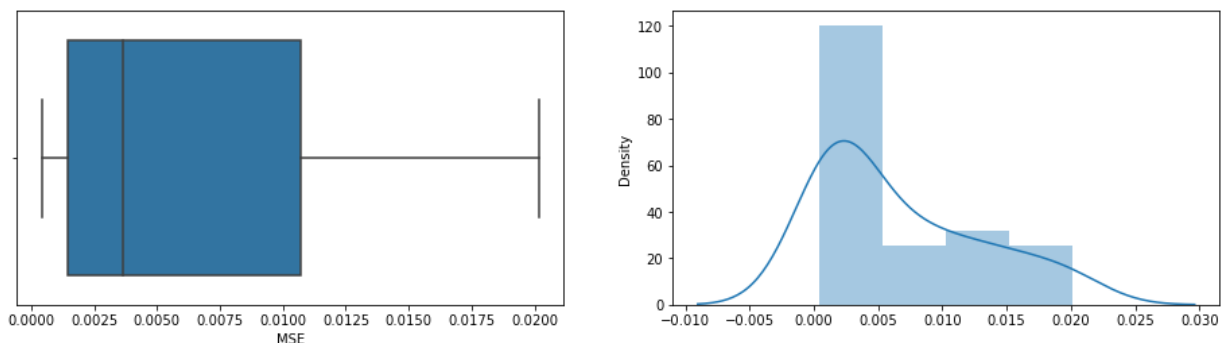

MSE plot
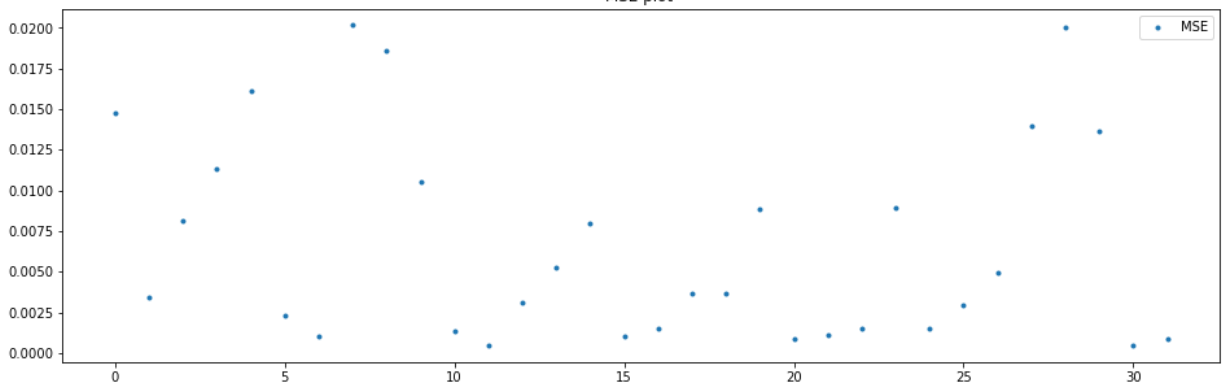
```
Anderson_Darling Test
Statistic: 1.736
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
```

```
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 1
mean=0.005588125,median=0.00397 ,max=0.02011,min=0.00034,variance=2.43676e-05
```


Boxplots and Distribution plot for Reconstruction Error


MSE plot
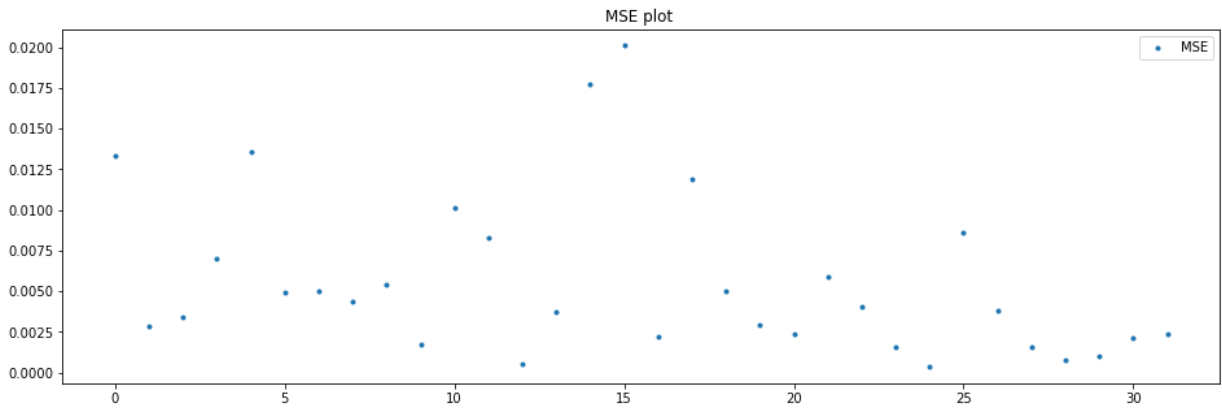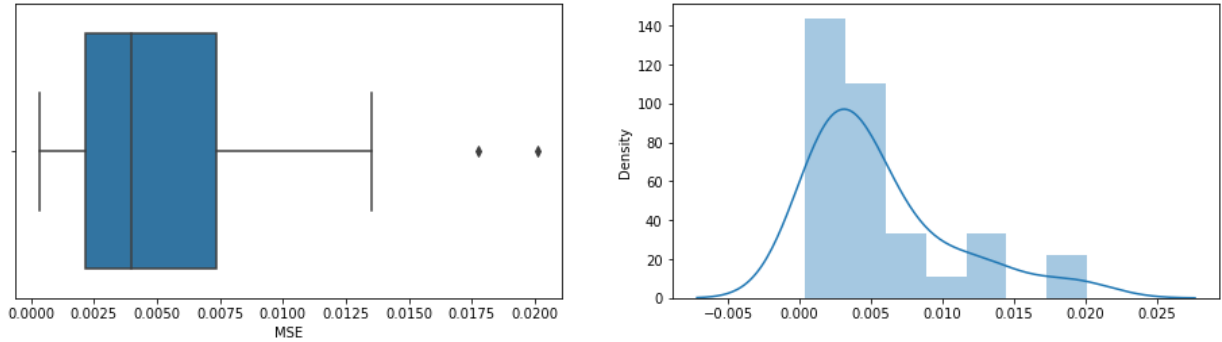
```
Anderson_Darling Test
Statistic: 1.786
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 2
mean=0.0036803125,median=0.002815 ,max=0.01039,min=0.00041,variance=8.9627e-06
```
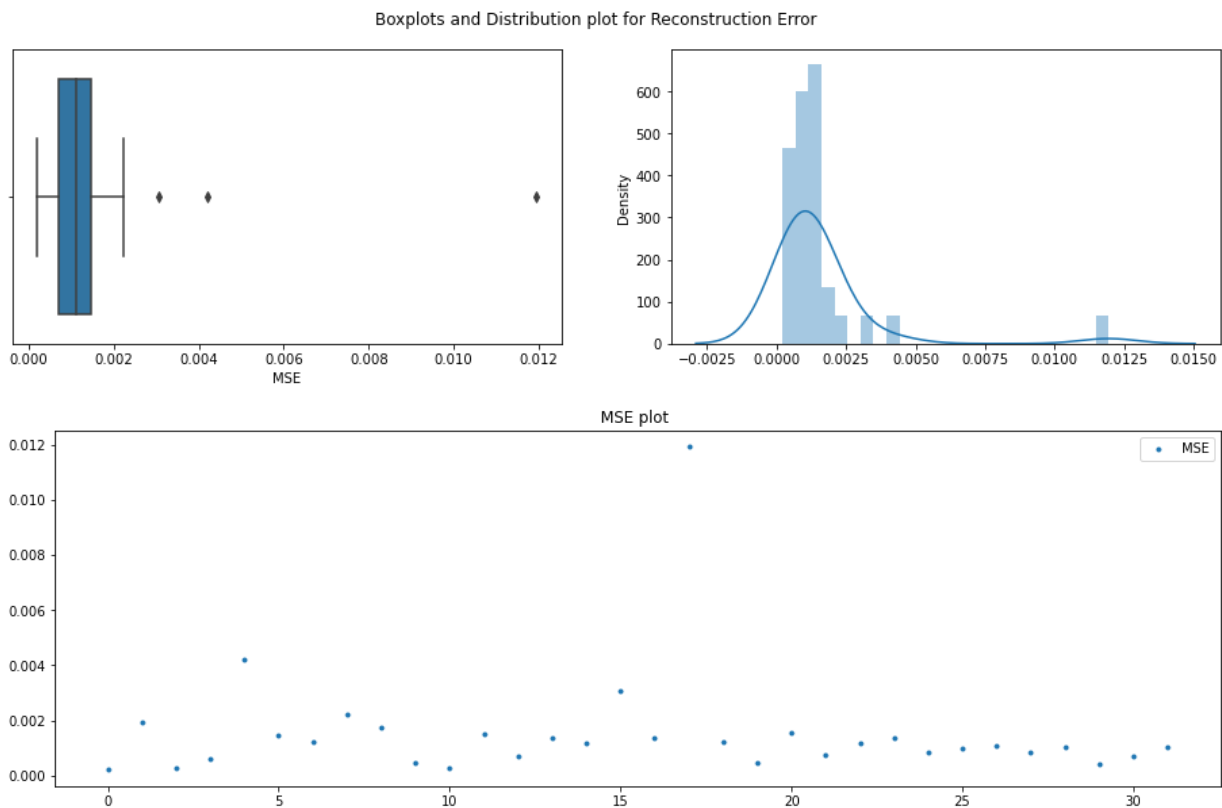

Boxplots and Distribution plot for Reconstruction Error
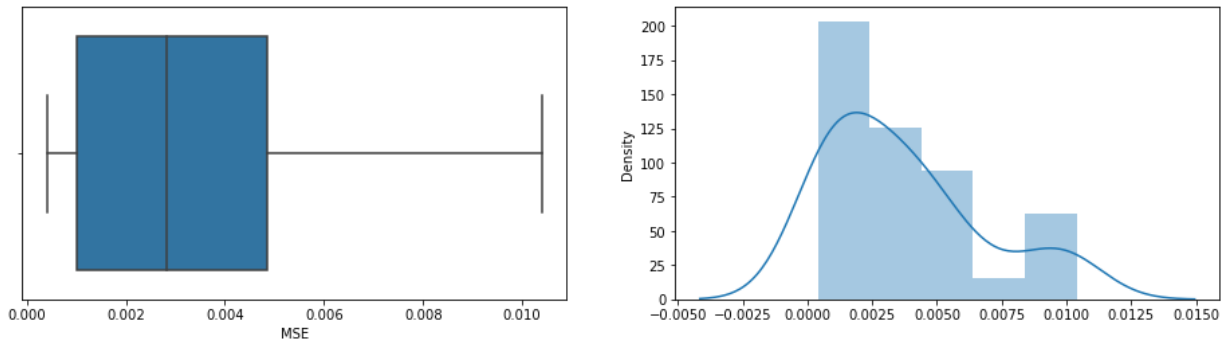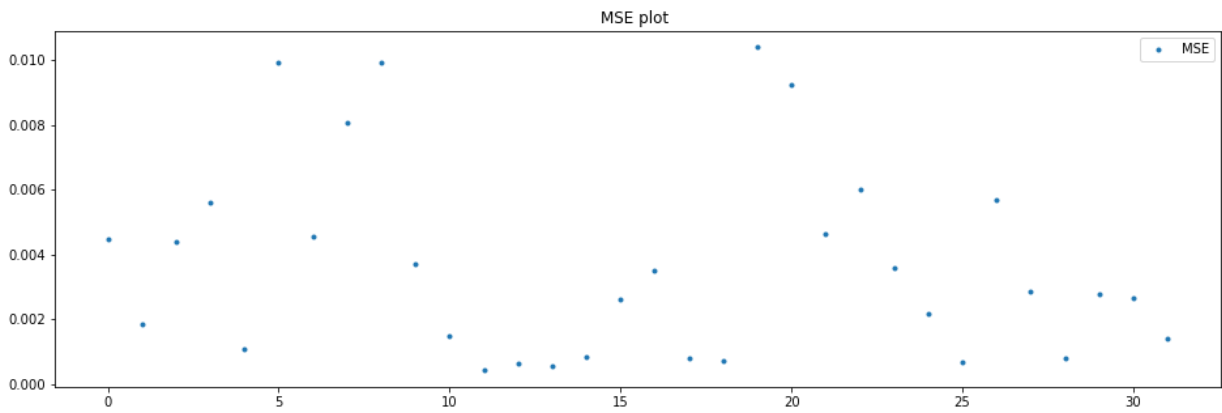
```
Anderson_Darling Test
Statistic: 1.321
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 3
mean=0.0021971875,median=0.001665 ,max=0.00663,min=0.00017,variance=3.6195e-06
```
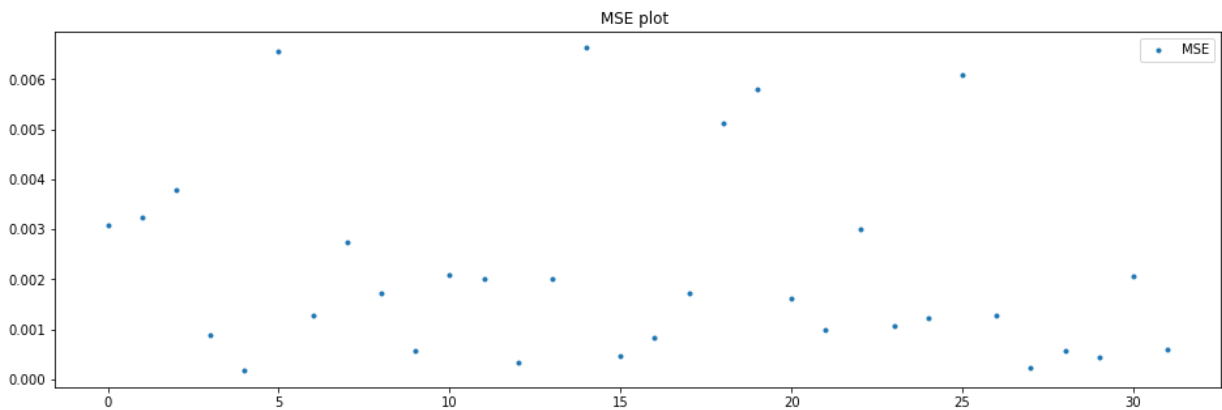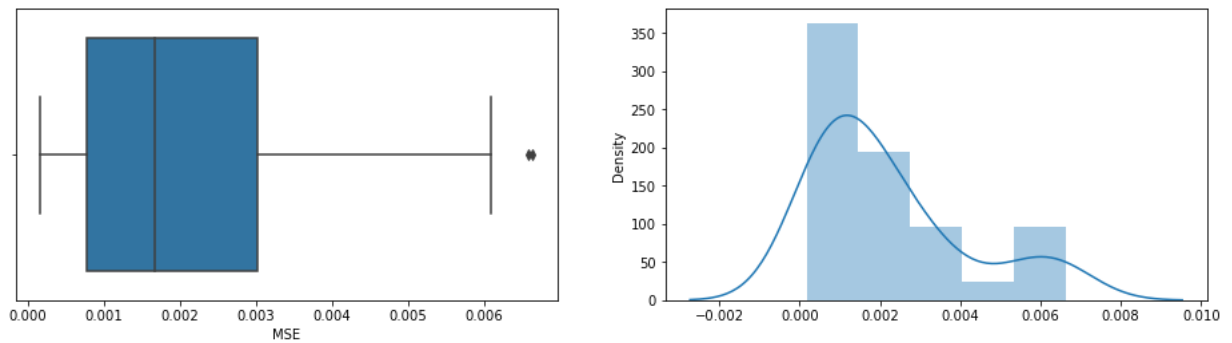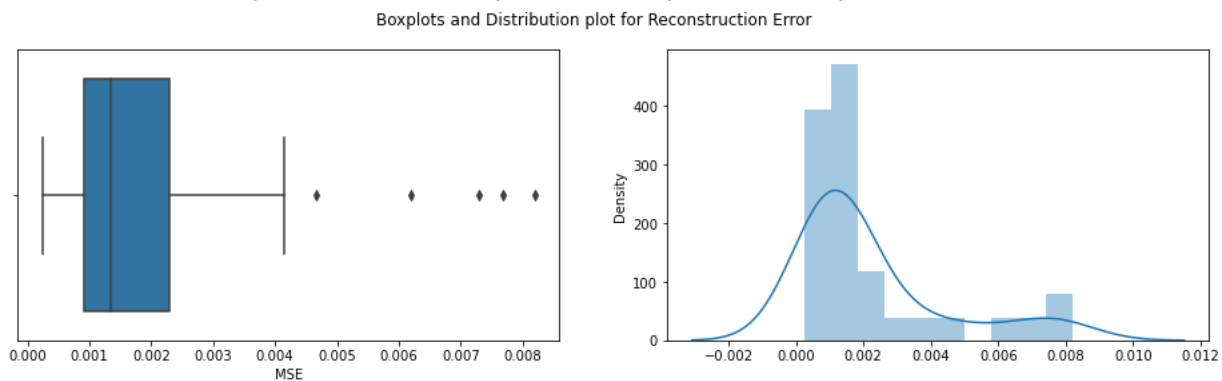




```
Anderson_Darling Test
Statistic: 1.803
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 4
mean=0.002969375,median=0.001465 ,max=0.01638,min=0.0003,variance=1.35717e-05
```
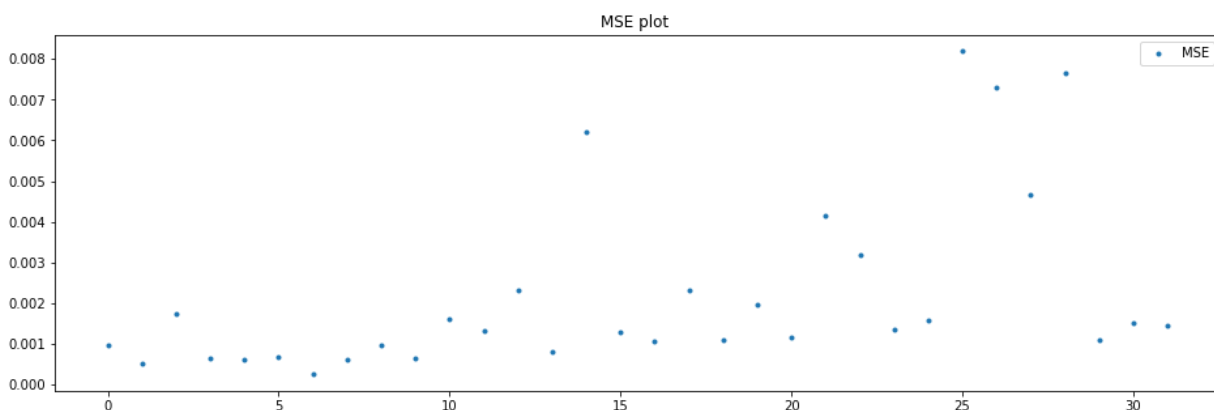
Boxplots and Distribution plot for Reconstruction Error



MSE plot
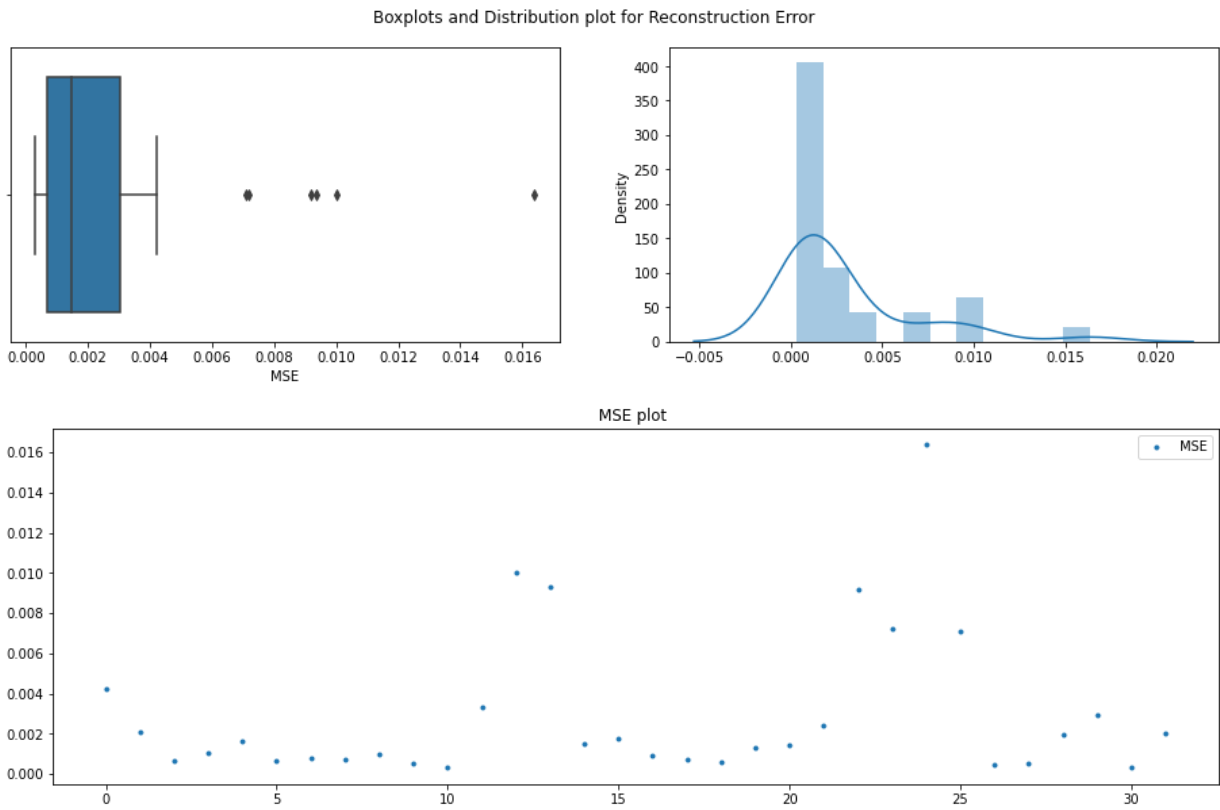


```
Anderson_Darling Test
Statistic: 3.736
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


  ********************
Batch: 5
mean=0.002325625,median=0.00205 ,max=0.008,min=4e-05,variance=3.1944e-06
```
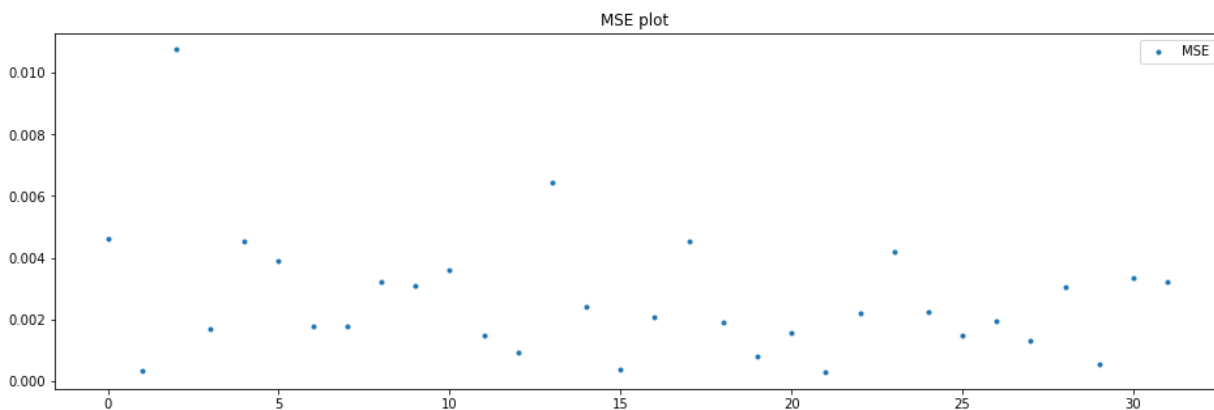
Boxplots and Distribution plot for Reconstruction Error
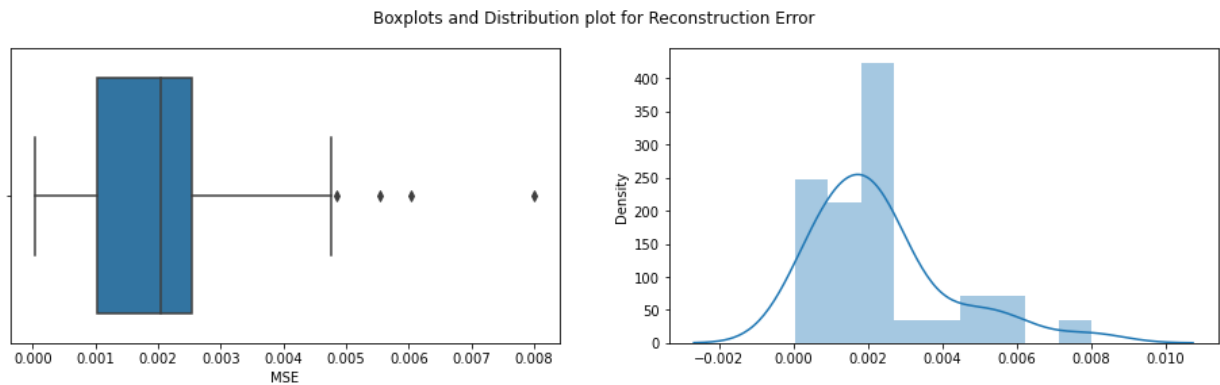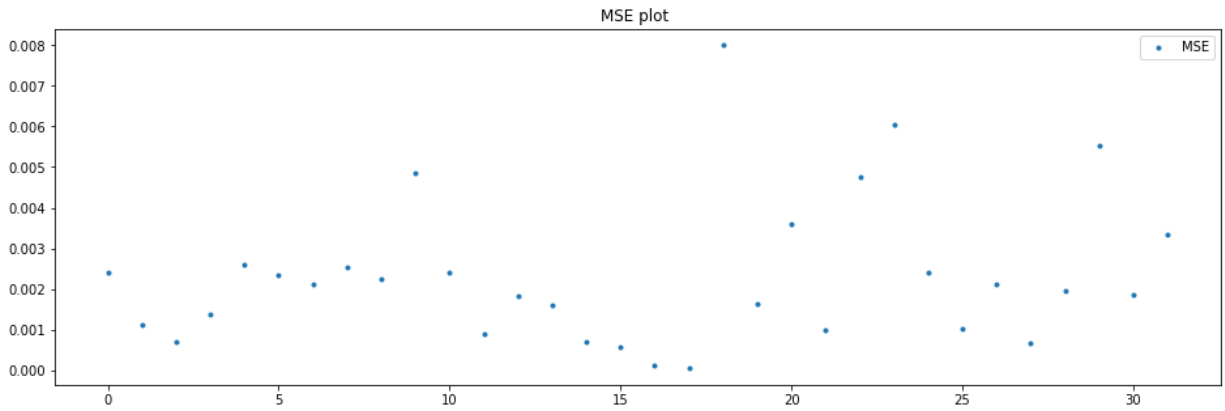
Anderson_Darling Test
Statistic: 1.381
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
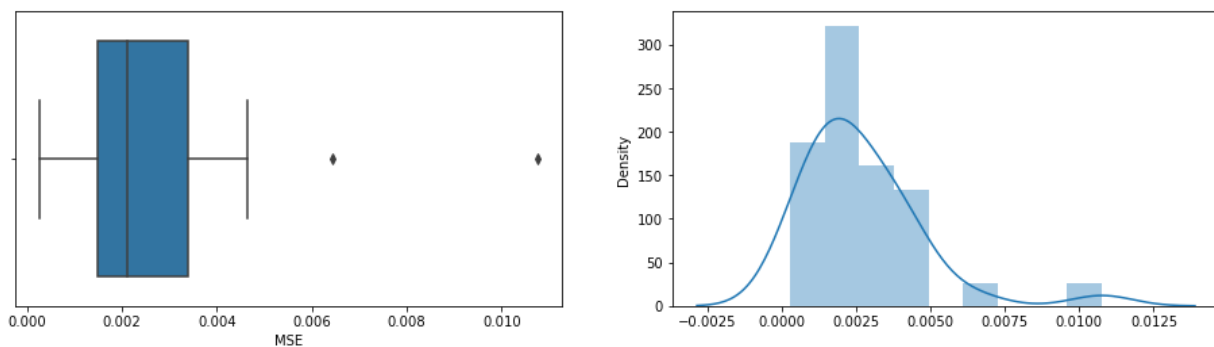5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 6
mean=0.0026815625,median=0.00208 ,max=0.00849,min=0.0001,variance=4.3452e-06



Boxplots and Distribution plot for Reconstruction Error
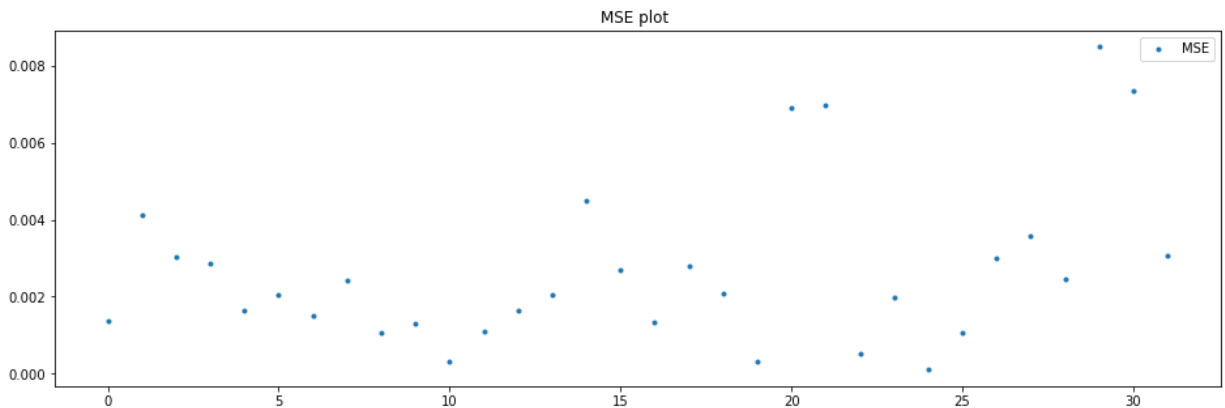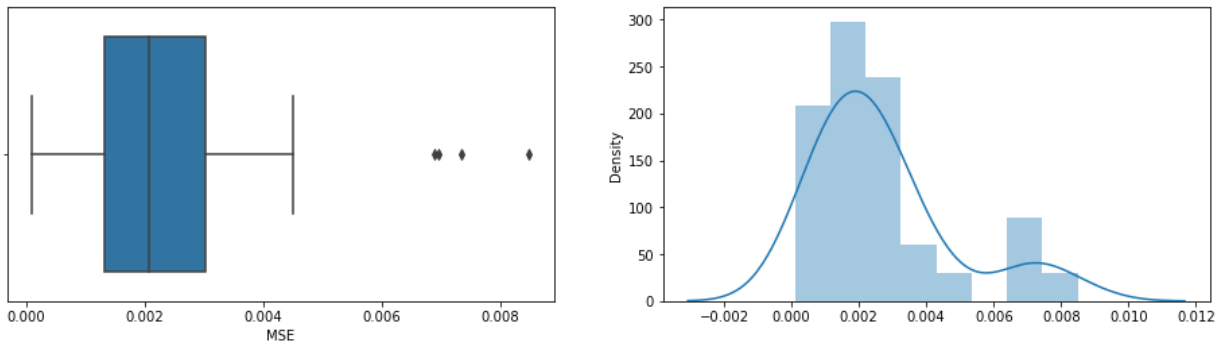


Anderson_Darling Test
Statistic: 1.677
15.000: 0.523, data does not look normal (reject H0)
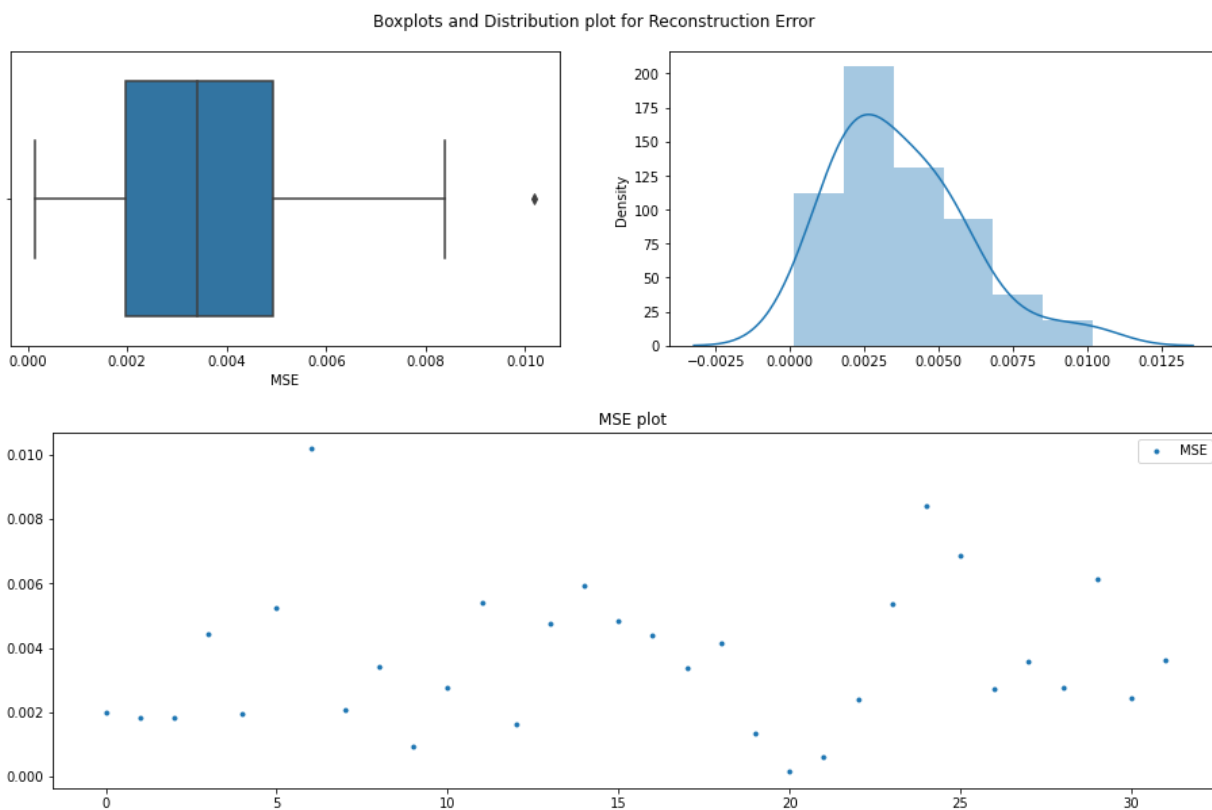10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 7
mean=0.003060625,median=0.002255 ,max=0.01213,min=0.00041,variance=6.1059e-06

Boxplots and Distribution plot for Reconstruction Error



MSE plot
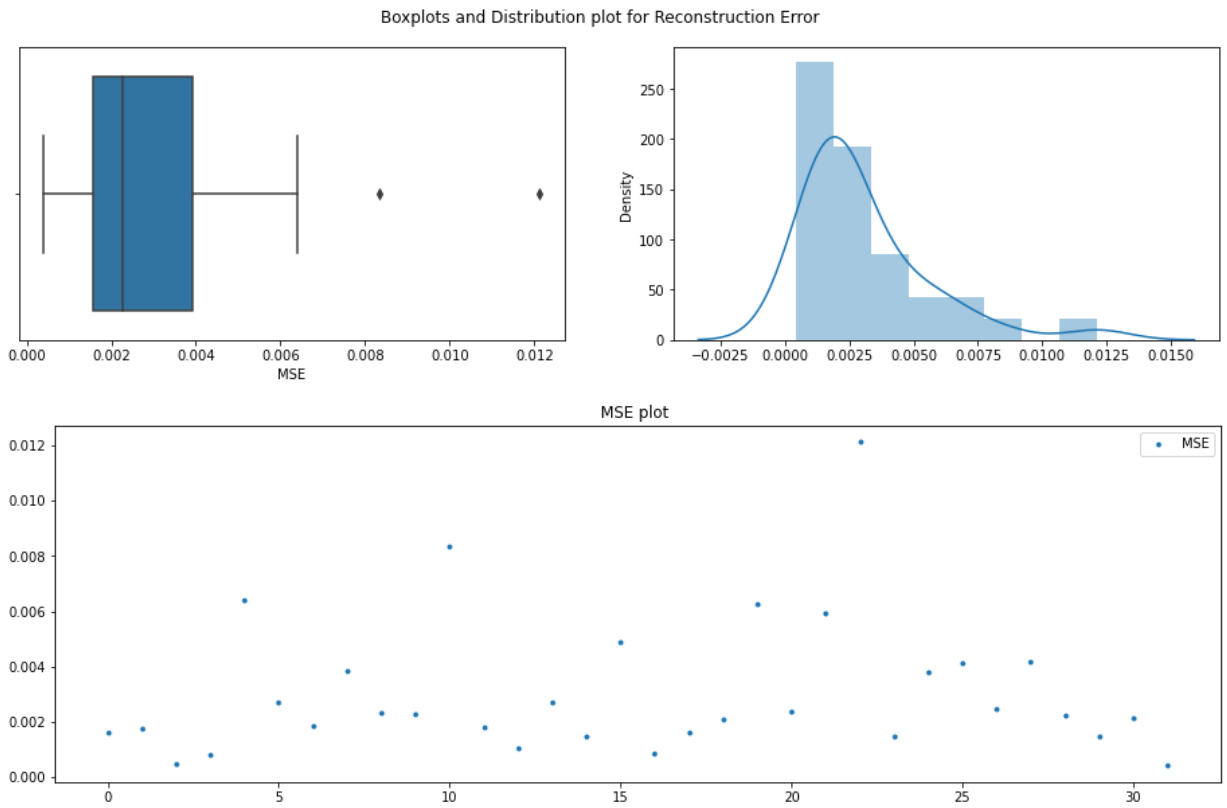


```
Anderson_Darling Test
Statistic: 2.001
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


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

Batch: 8
mean=0.0032084375,median=0.00282 ,max=0.01065,min=0.00036,variance=5.7538e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
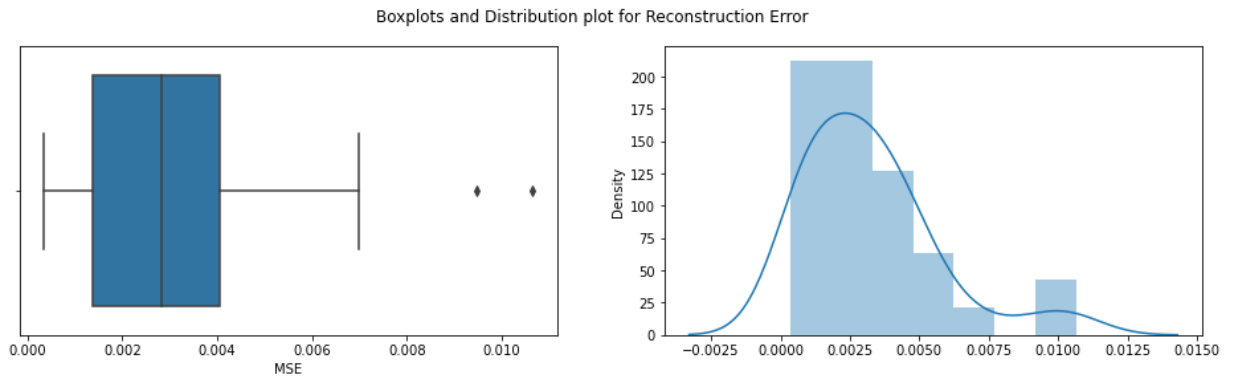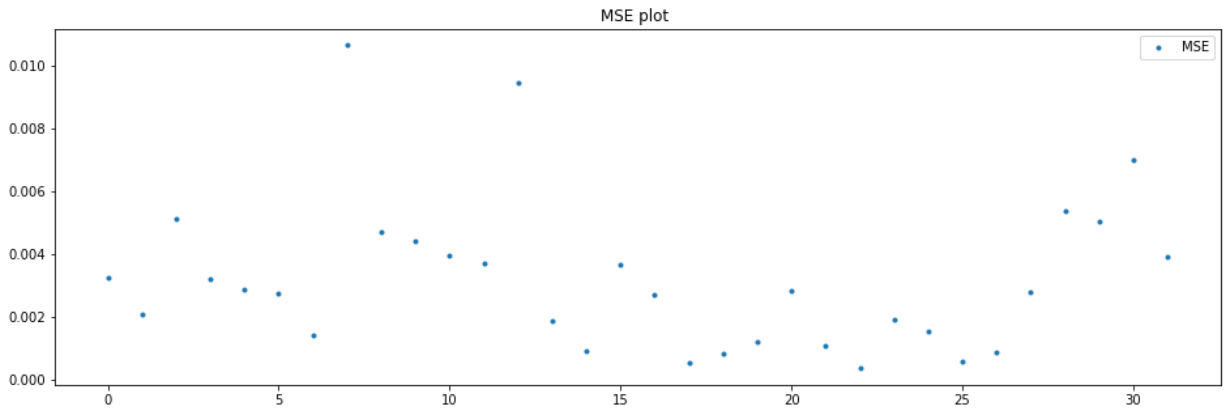
```
Anderson_Darling Test
Statistic: 1.051
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 9
mean=0.0023628125,median=0.00208 ,max=0.0108,min=0.00027,variance=4.0098e-06
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot
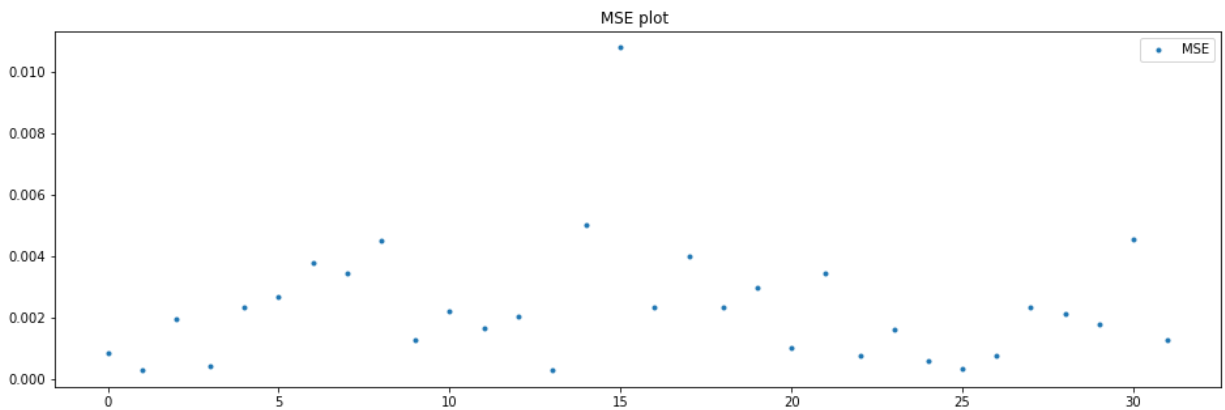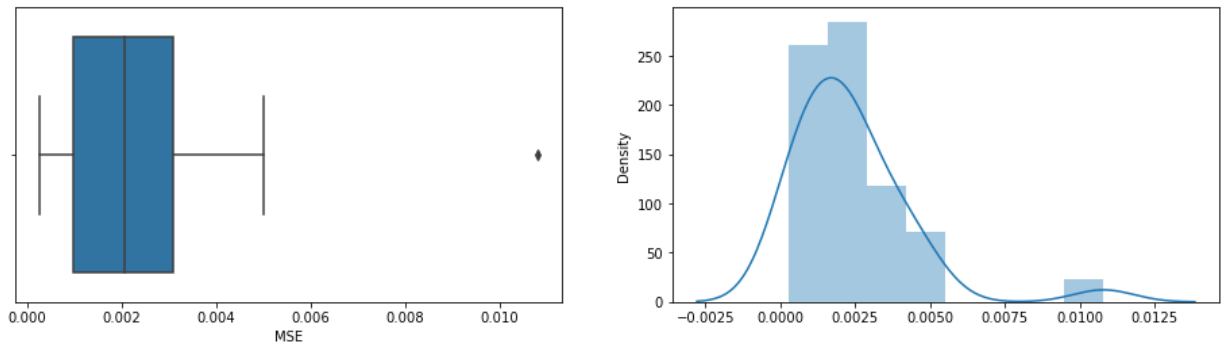


```
Anderson_Darling Test
Statistic: 1.393
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 10
mean=0.00153375,median=0.00112 ,max=0.01194,min=0.0002,variance=4.1397e-06
```
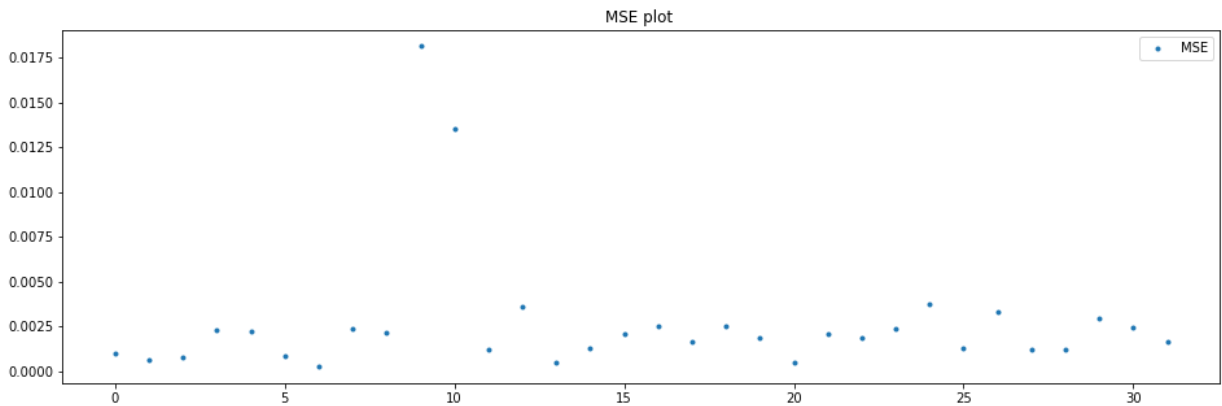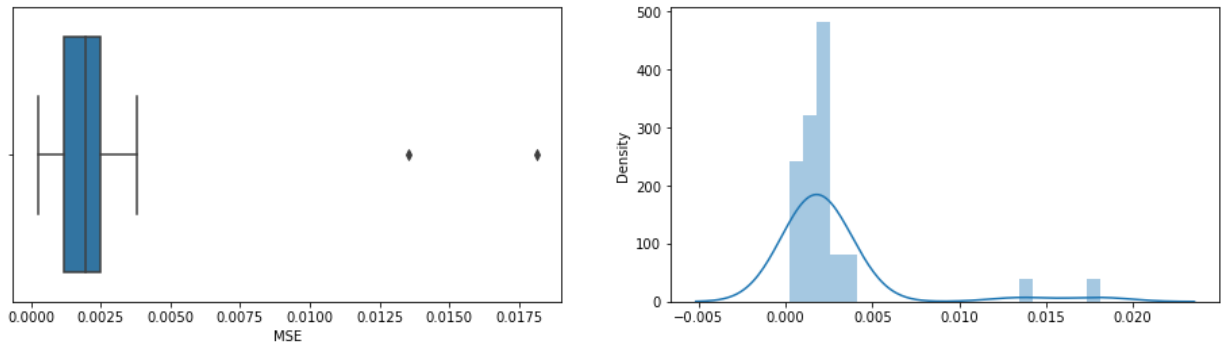
Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 5.037
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=0.0022109375,median=0.001335 ,max=0.00819,min=0.00024,variance=4.7503e-06
```
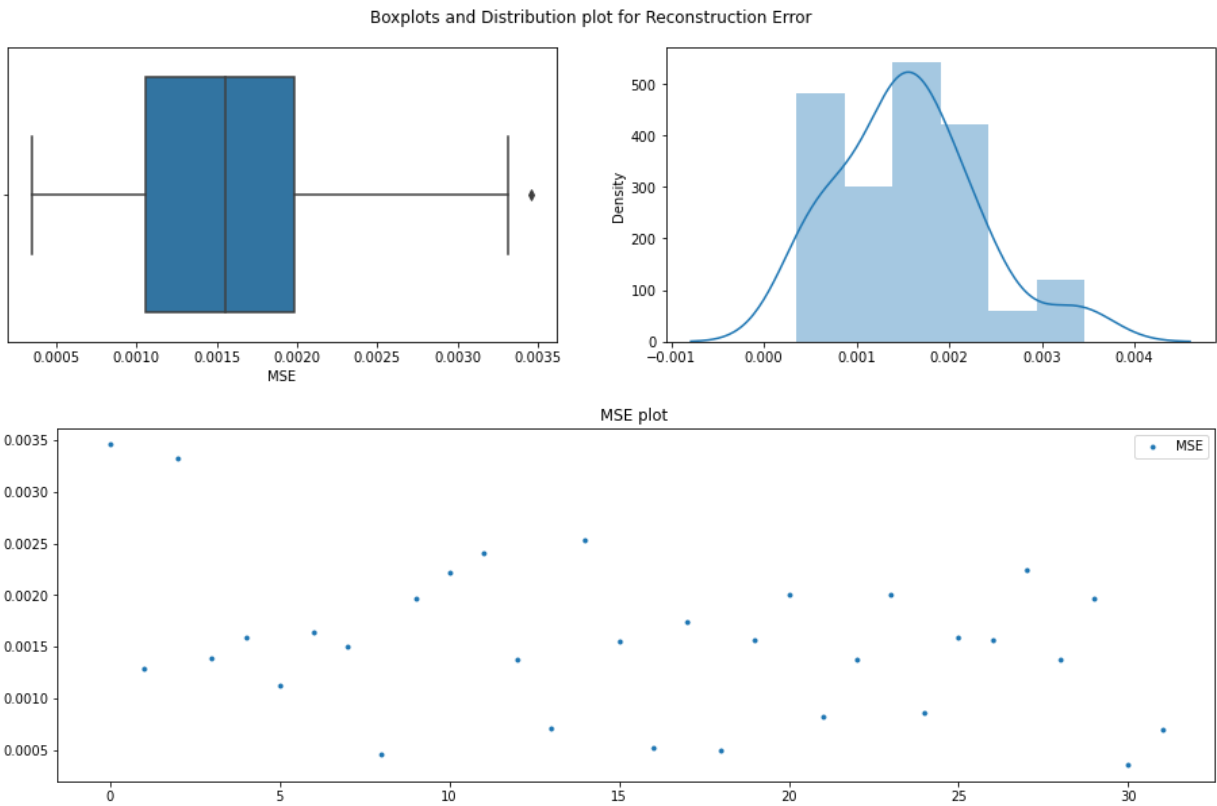
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 3.533
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=0.0026728125,median=0.002125 ,max=0.01076,min=0.00027,variance=4.2038e-06



Boxplots and Distribution plot for Reconstruction Error



MSE plot

Anderson_Darling Test
Statistic: 1.179
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=0.0036721875,median=0.003395 ,max=0.01018,min=0.00015,variance=4.9372e-06

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 0.477
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: 14
mean=0.00307875,median=0.002505 ,max=0.01269,min=0.00017,variance=5.9594e-06
```
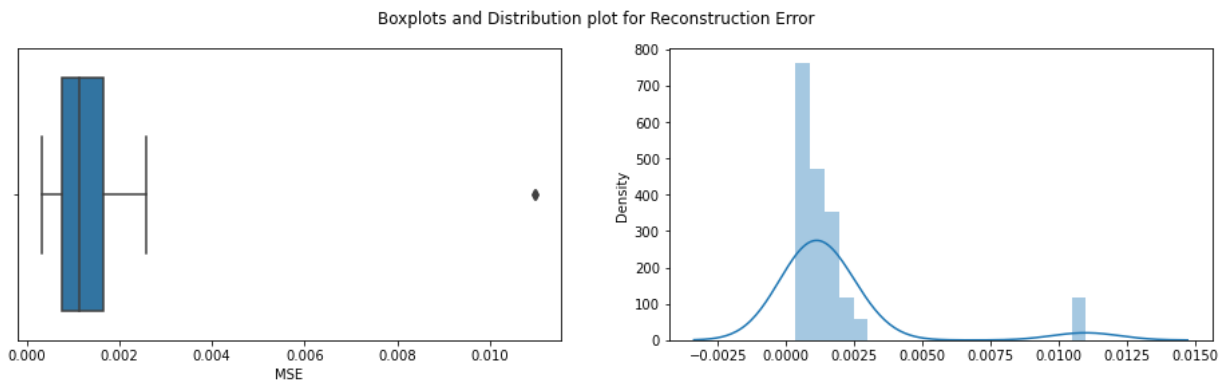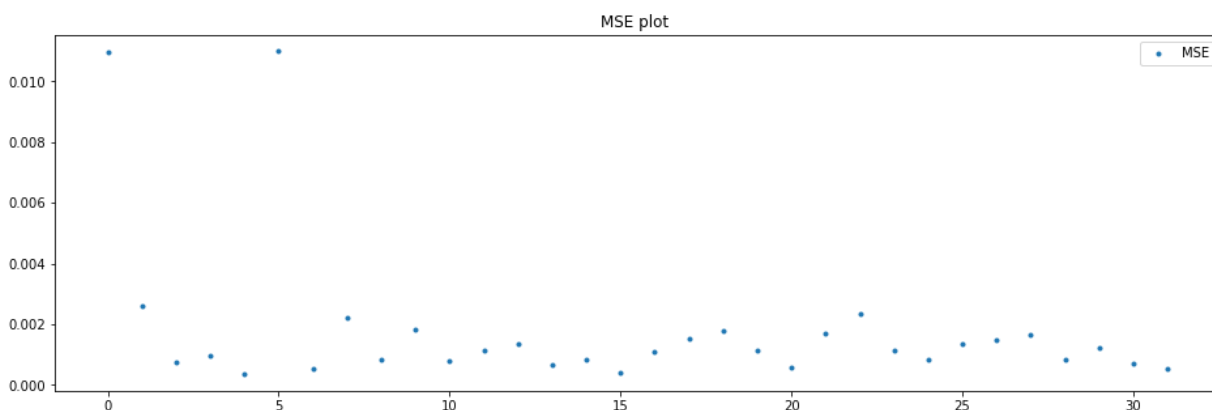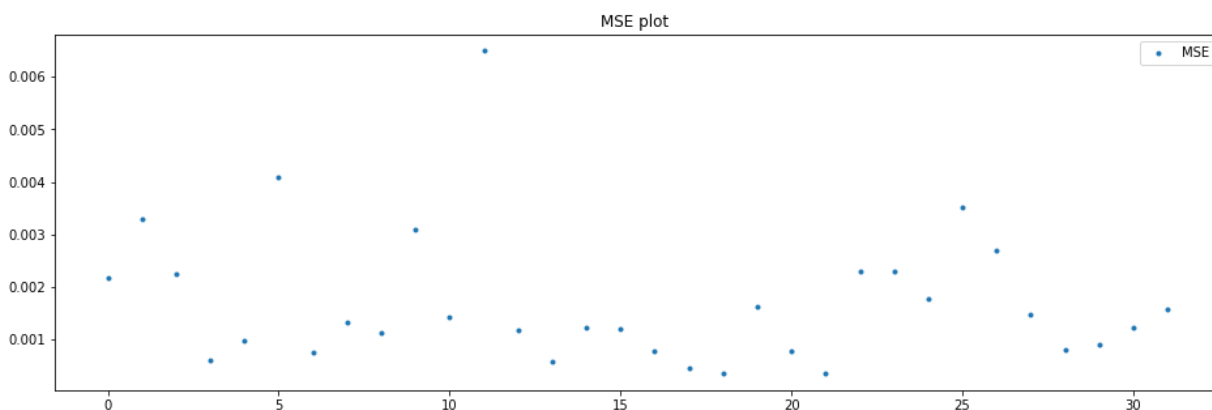
Boxplots and Distribution plot for Reconstruction Error

MSE plot
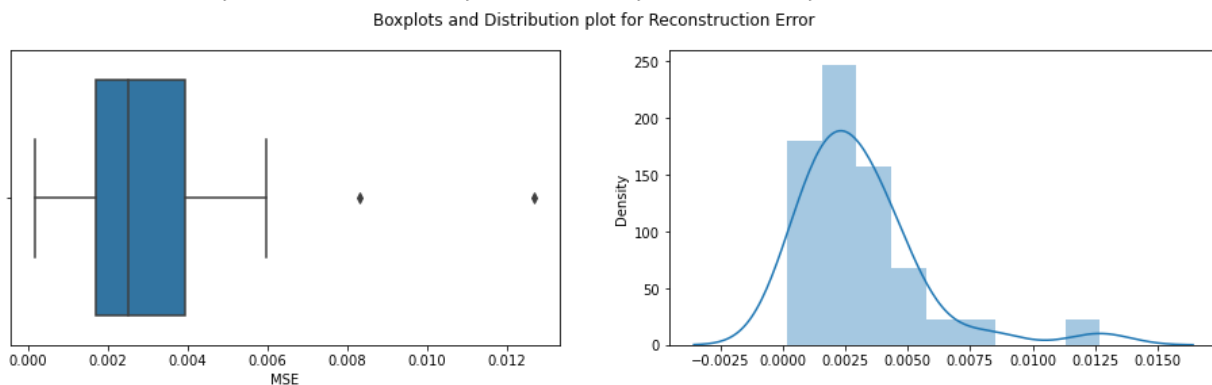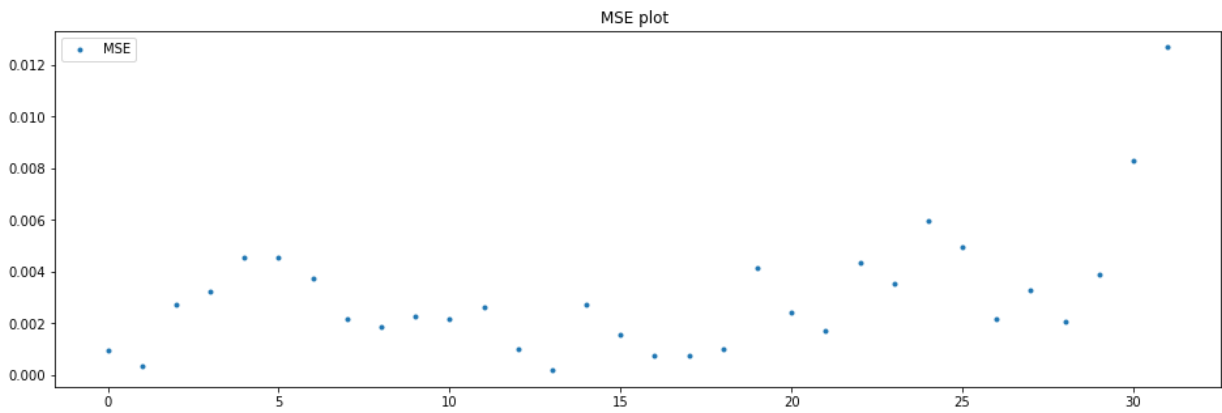
```
Anderson_Darling Test
Statistic: 1.427
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 15
mean=0.0026865625,median=0.00195 ,max=0.01813,min=0.00024,variance=1.26185e-05
```
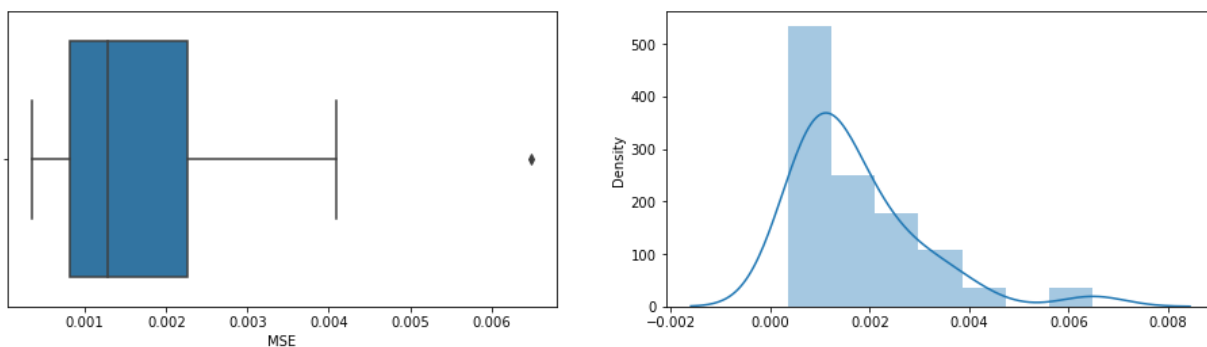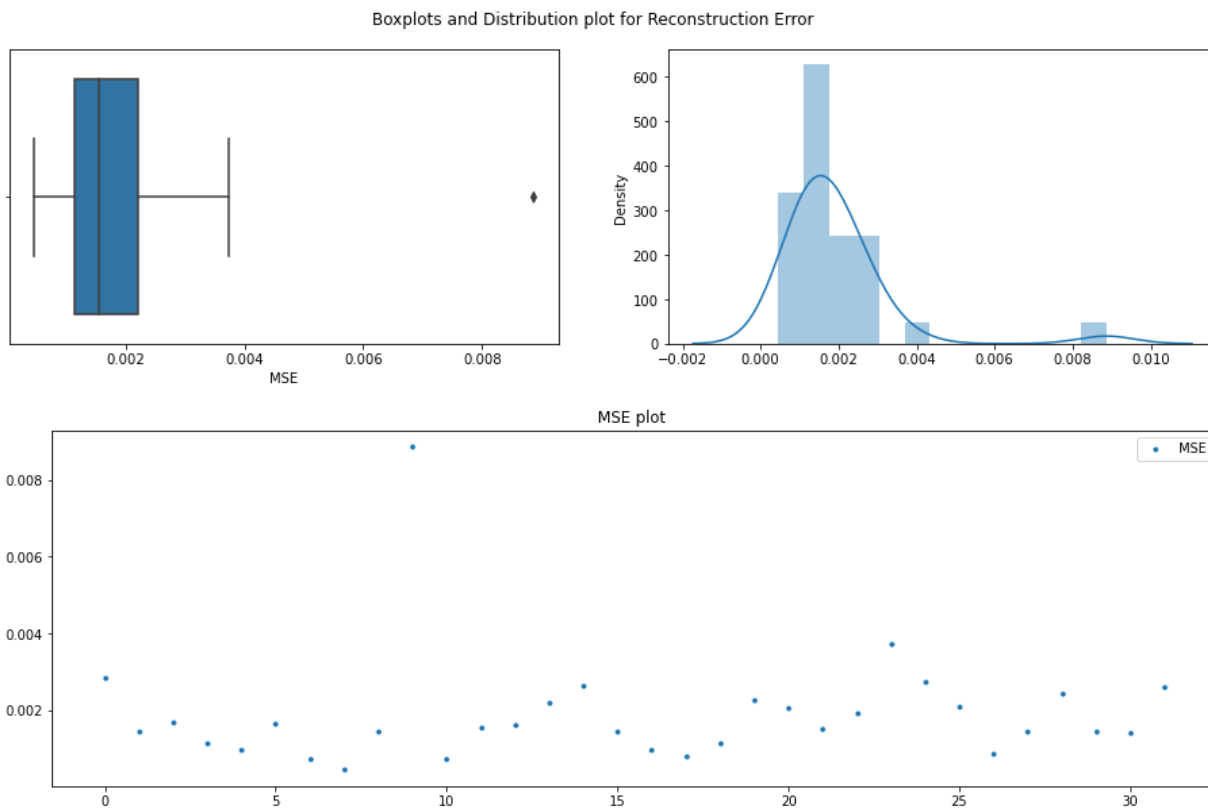
Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 5.662
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=0.0015534375,median=0.001555 ,max=0.00346,min=0.00035,variance=5.573e-07
```
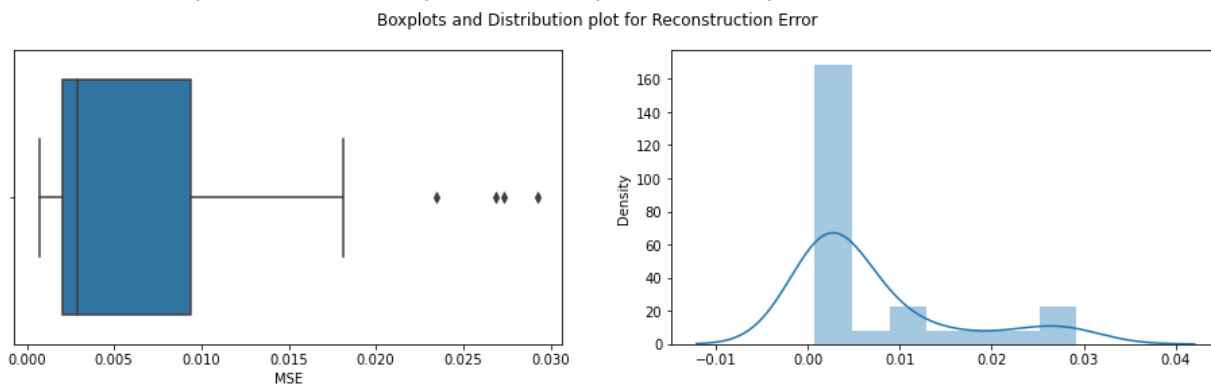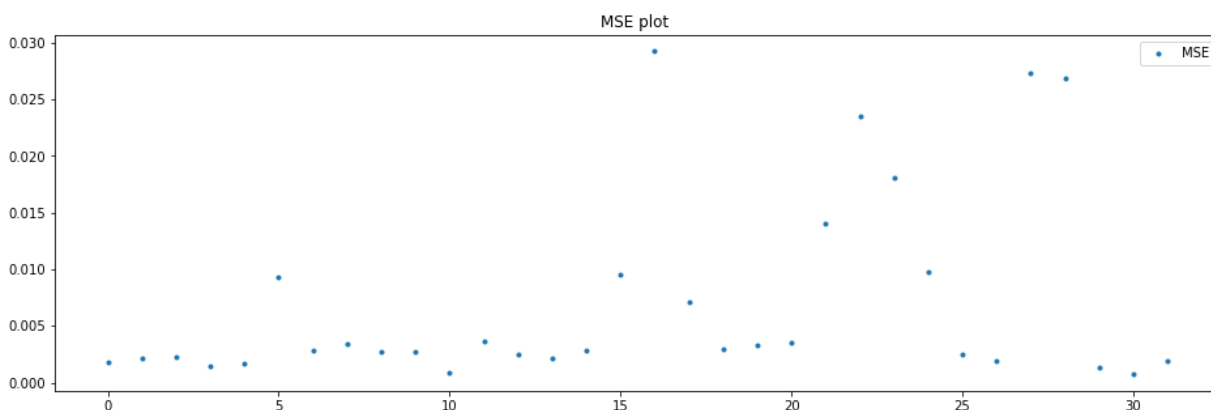
Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 0.453
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: 17
mean=0.0017784375,median=0.00113 ,max=0.01099,min=0.00034,variance=5.9401e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 6.345
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
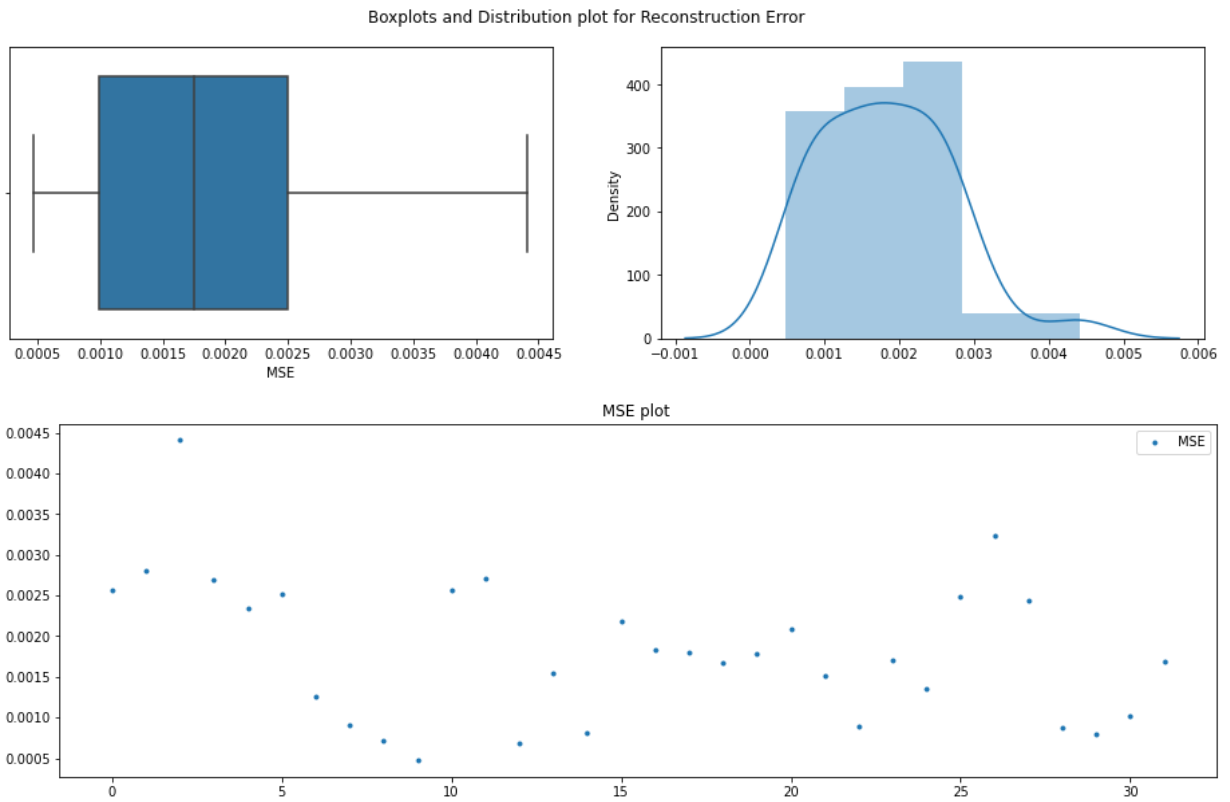5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 18
mean=0.00171375,median=0.001275 ,max=0.00649,min=0.00035,variance=1.6349e-06



Boxplots and Distribution plot for Reconstruction Error



MSE plot

Anderson_Darling Test
Statistic: 1.524
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=0.00191125,median=0.00154 ,max=0.00886,min=0.00046,variance=2.0763e-06

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 2.859
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=0.007065,median=0.00289 ,max=0.02924,min=0.00071,variance=7.07066e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 4.302
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=0.0023278125,median=0.002235 ,max=0.00428,min=0.00058,variance=8.28e-07
```



Boxplots and Distribution plot for Reconstruction Error



MSE plot
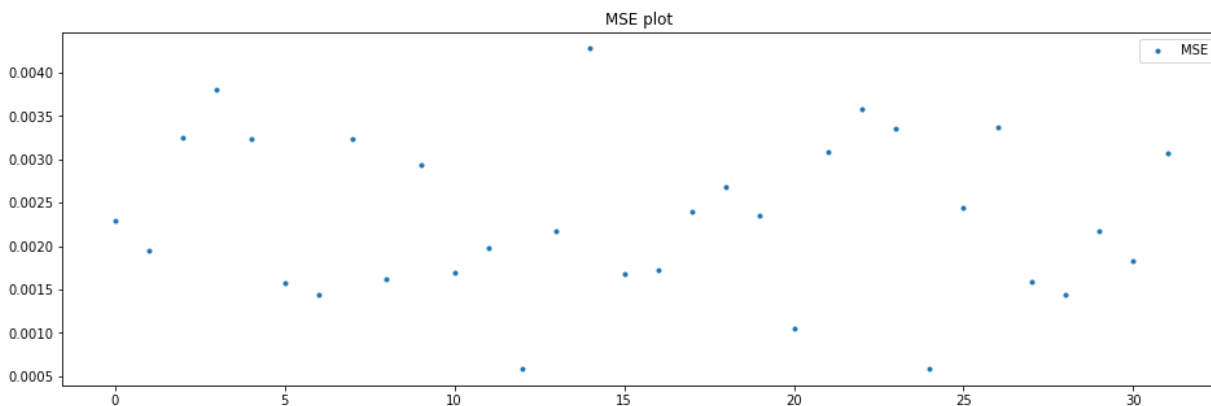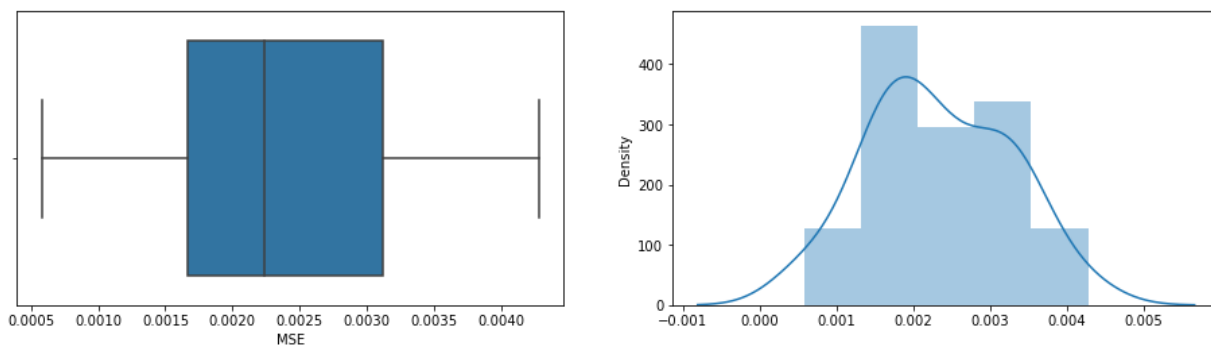
```
Anderson_Darling Test
Statistic: 0.362
15.000: 0.523, data looks normal (fail to reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 22
mean=0.0018253125,median=0.00175 ,max=0.00441,min=0.00047,variance=7.665e-07
```
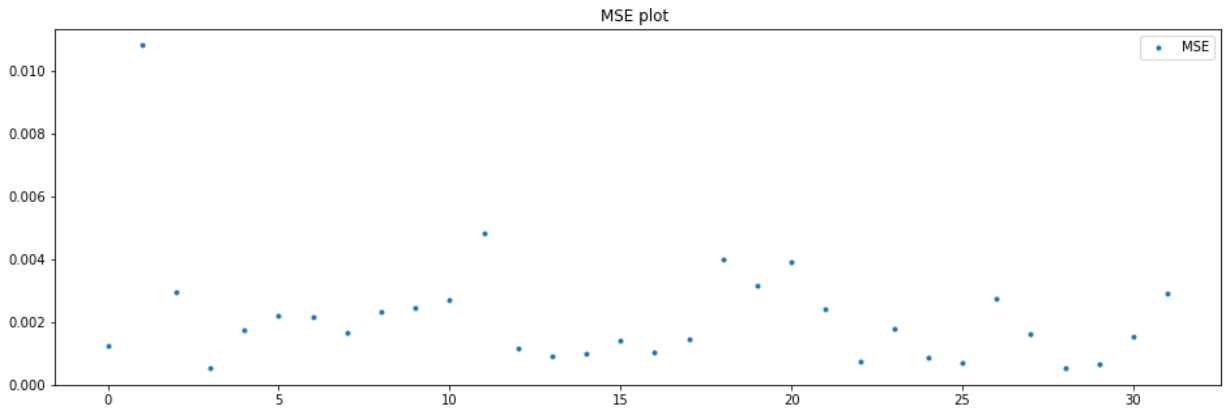
Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 0.452
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: 23
mean=0.002183125,median=0.00169 ,max=0.0108,min=0.00051,variance=3.53e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
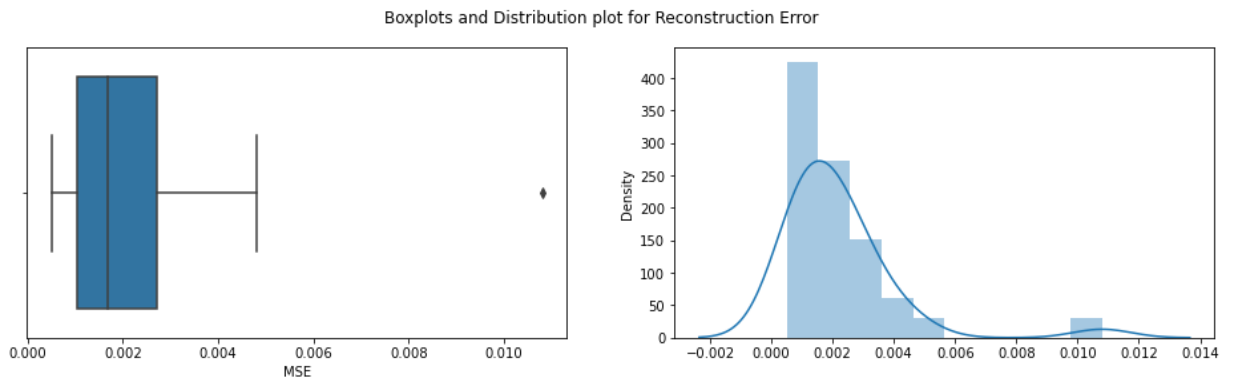
Anderson_Darling Test
Statistic: 2.267
15.000: 0.523, data does not look normal (reject H0)
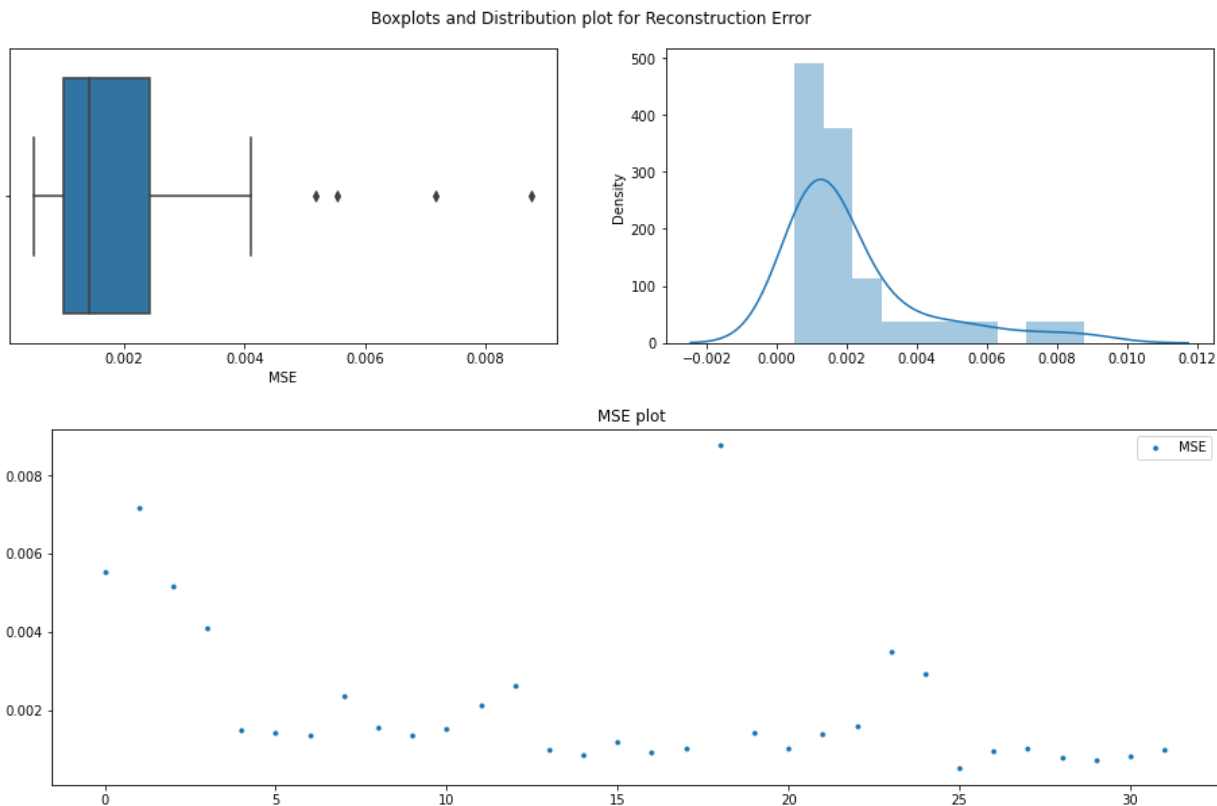10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 24
mean=0.0019209375,median=0.001165 ,max=0.01114,min=0.00036,variance=5.18e-06



Boxplots and Distribution plot for Reconstruction Error



MSE plot
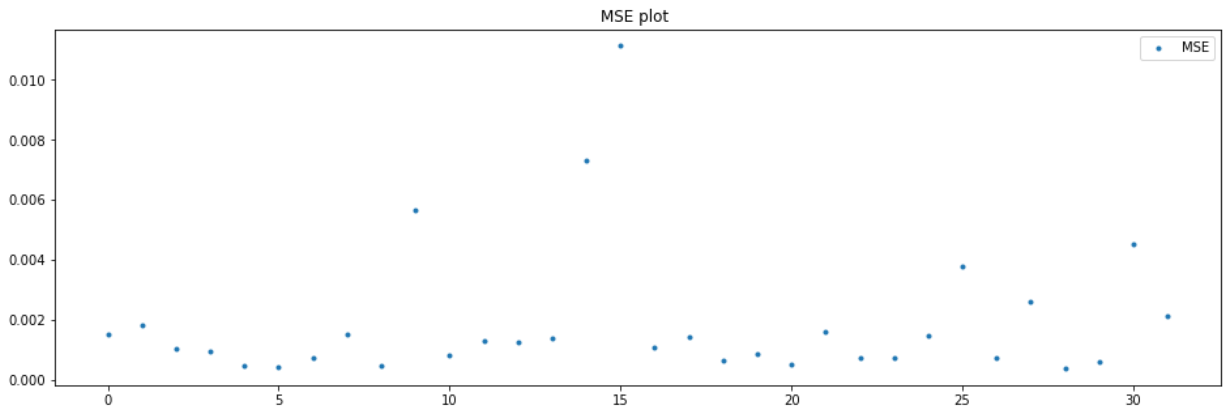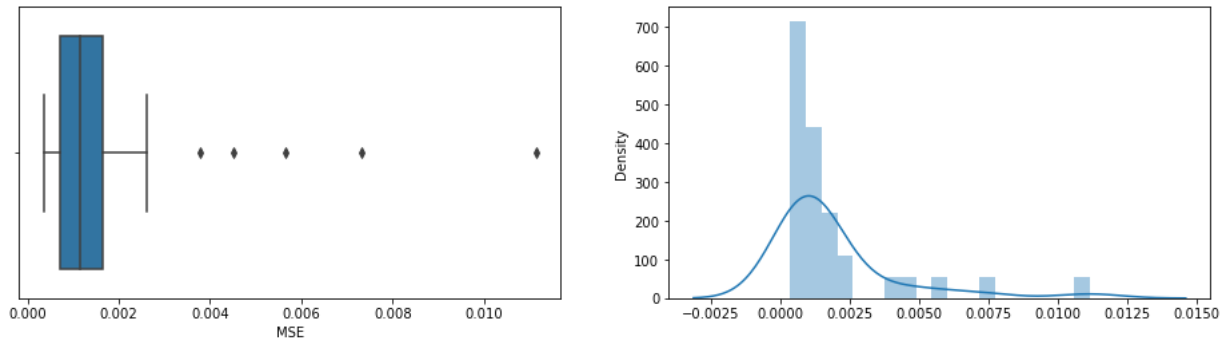
Anderson_Darling Test
Statistic: 4.218
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 25
mean=0.00215875,median=0.001405 ,max=0.00877,min=0.0005,variance=3.7902e-06

Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 3.457
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=0.0016253125,median=0.00169 ,max=0.00372,min=0.00012,variance=6.003e-07
```
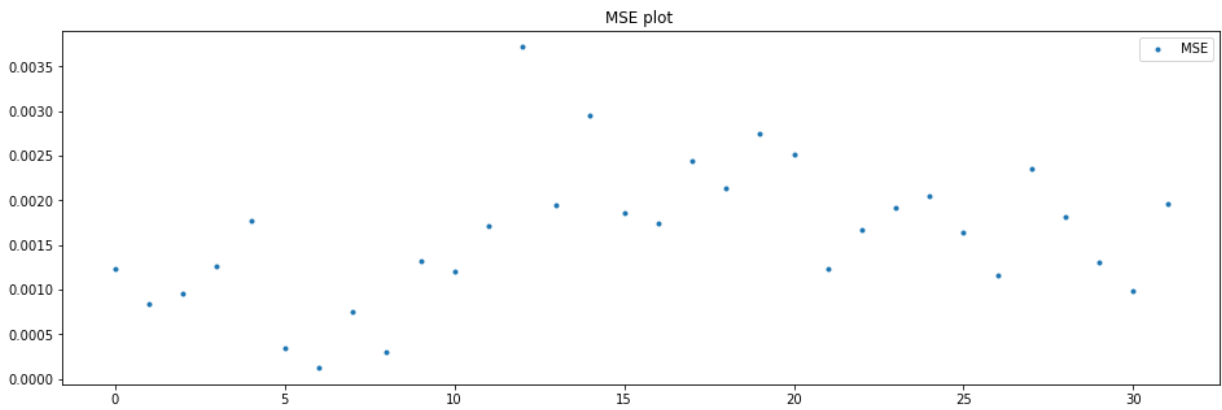
Boxplots and Distribution plot for Reconstruction Error

MSE plot
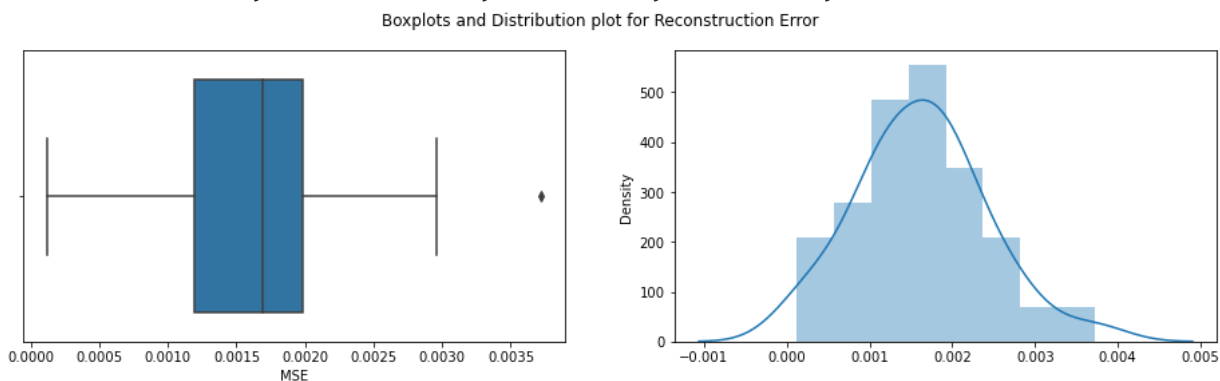
```
Anderson_Darling Test
Statistic: 0.236
15.000: 0.523, data looks normal (fail to reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 27
mean=0.0023128125,median=0.00234 ,max=0.00537,min=0.00028,variance=8.675e-07
```
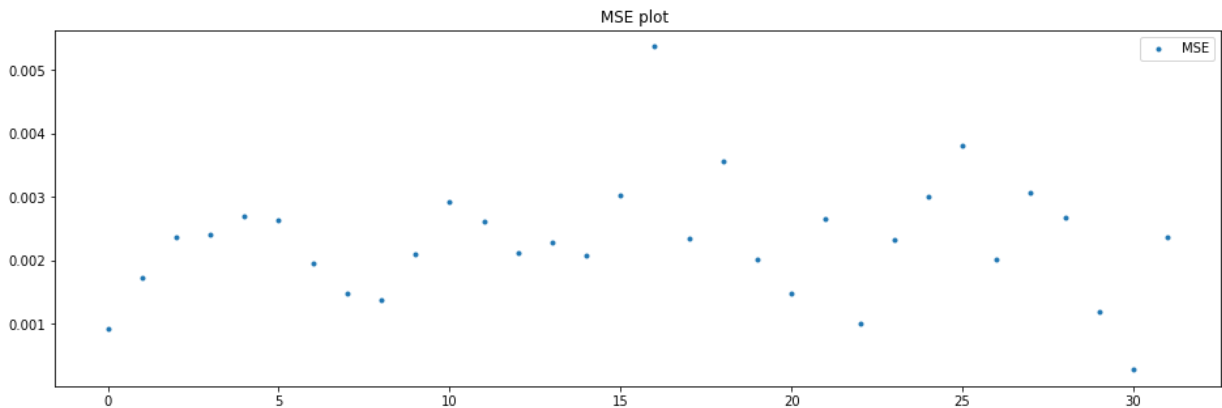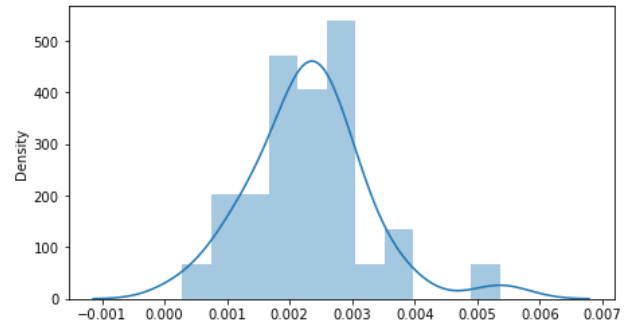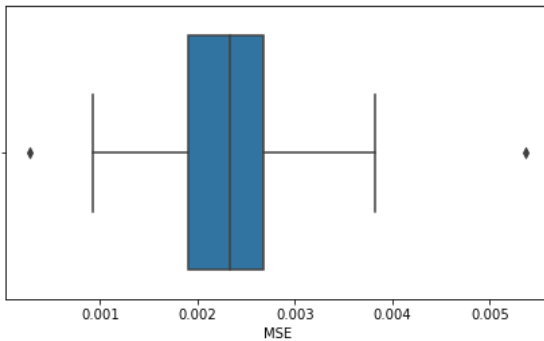


Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 0.518
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: 28
mean=0.002685,median=0.00233 ,max=0.007,min=0.00083,variance=1.7963e-06
```
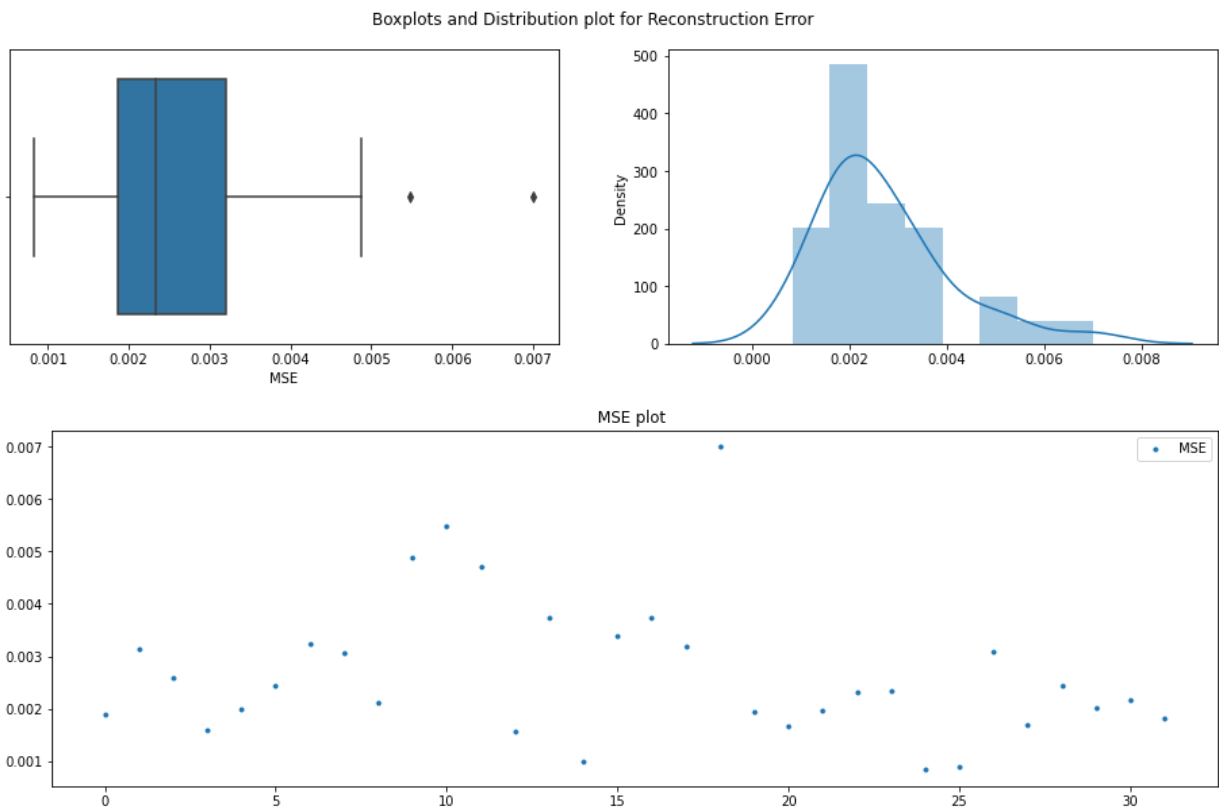
Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 1.087
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=0.0025371875,median=0.0024 ,max=0.00566,min=0.00043,variance=1.6703e-06
```
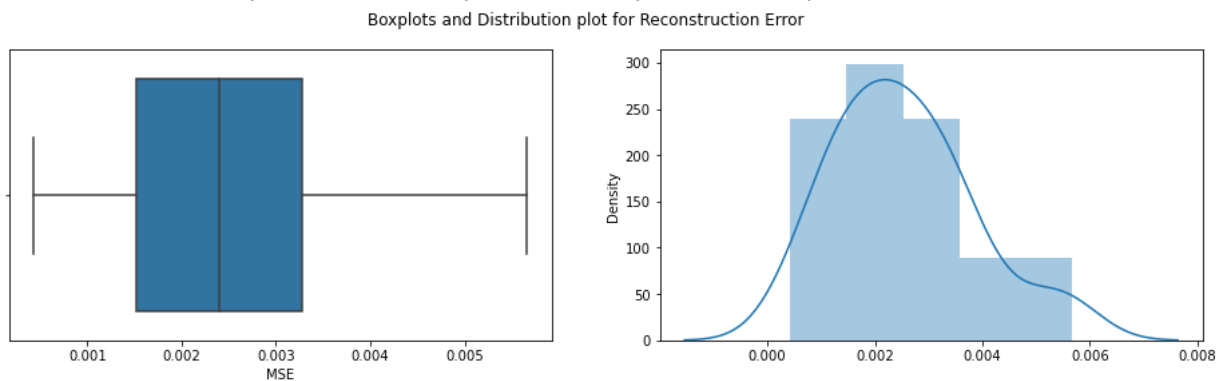
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 0.384
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: 30
mean=0.0031278125,median=0.0031 ,max=0.00616,min=0.00053,variance=1.7565e-06
```



Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 0.452
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: 31
mean=0.0015909375,median=0.001265 ,max=0.00572,min=0.00033,variance=1.3553e-06
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot
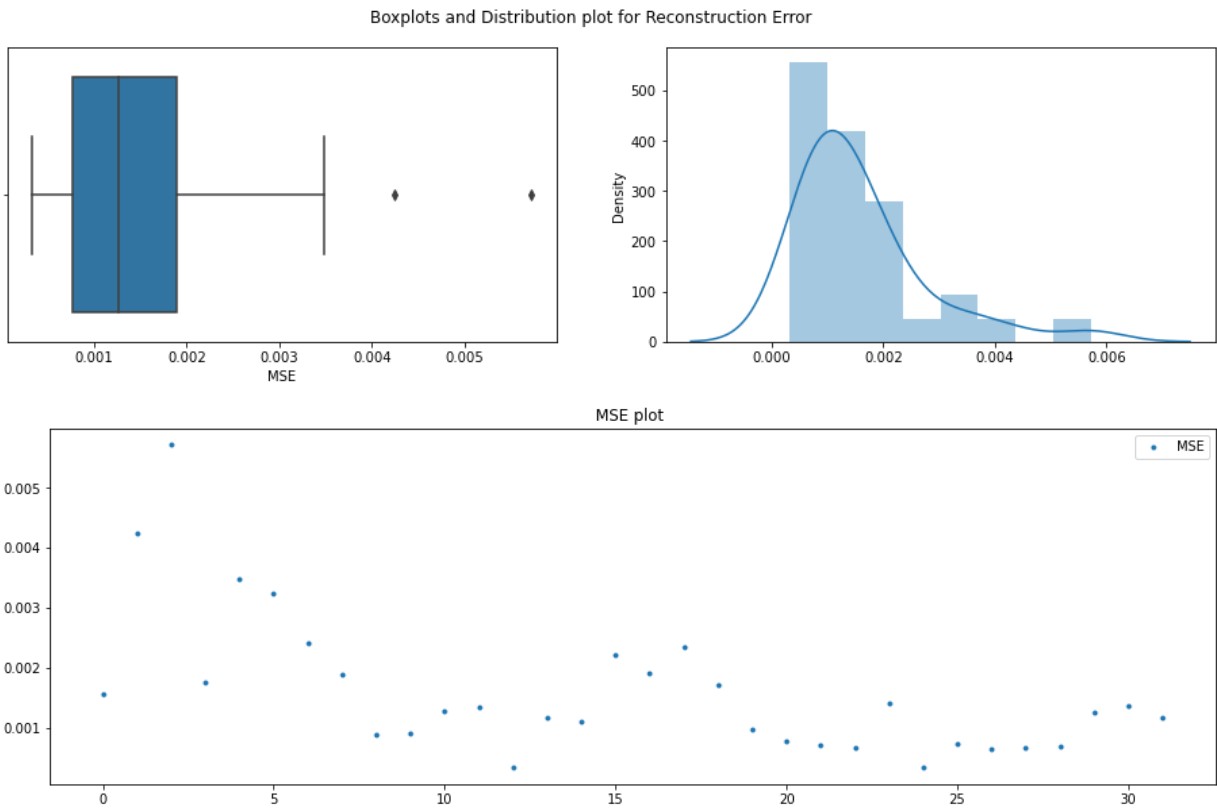
```
Anderson_Darling Test
Statistic: 1.862
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 32
mean=0.0017275,median=0.001585 ,max=0.00595,min=0.00061,variance=1.0748e-06
```
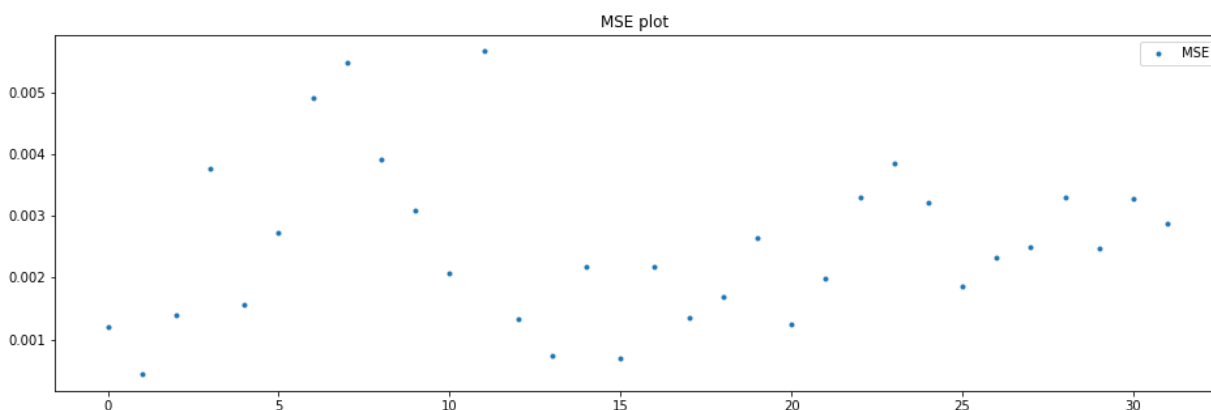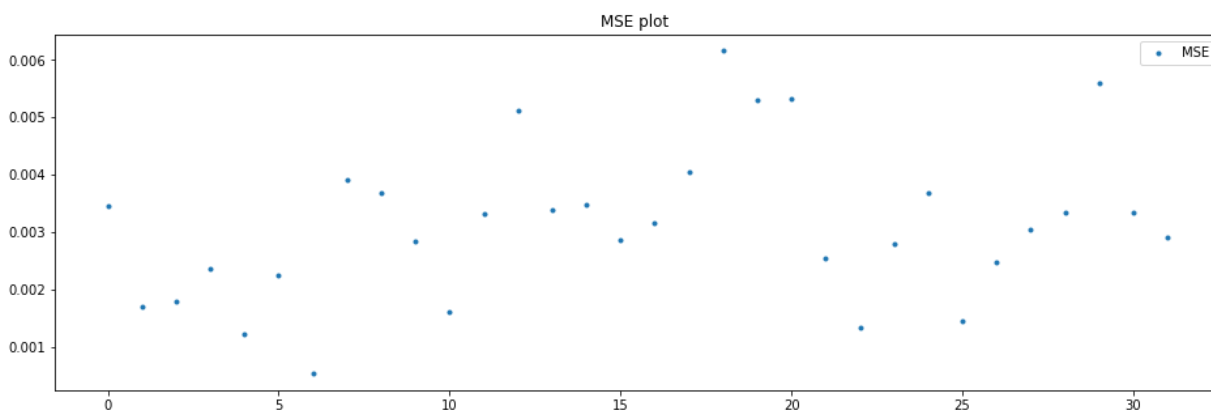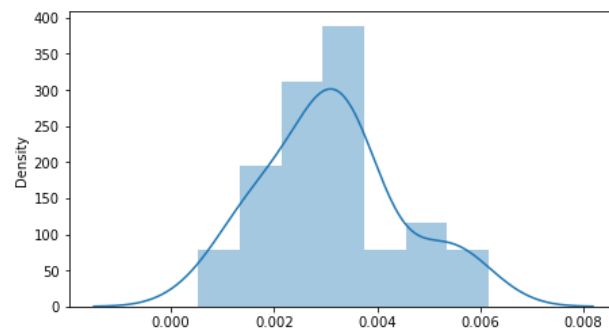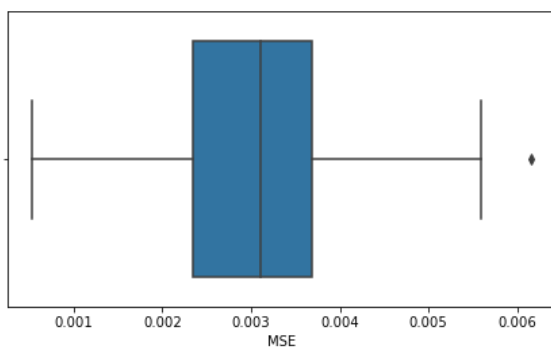
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 1.192
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: 33
mean=0.0013025,median=0.00128 ,max=0.0045,min=0.00019,variance=5.442e-07
```



Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 1.317
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=0.0015553125,median=0.00137 ,max=0.00504,min=0.00035,variance=7.88e-07
```
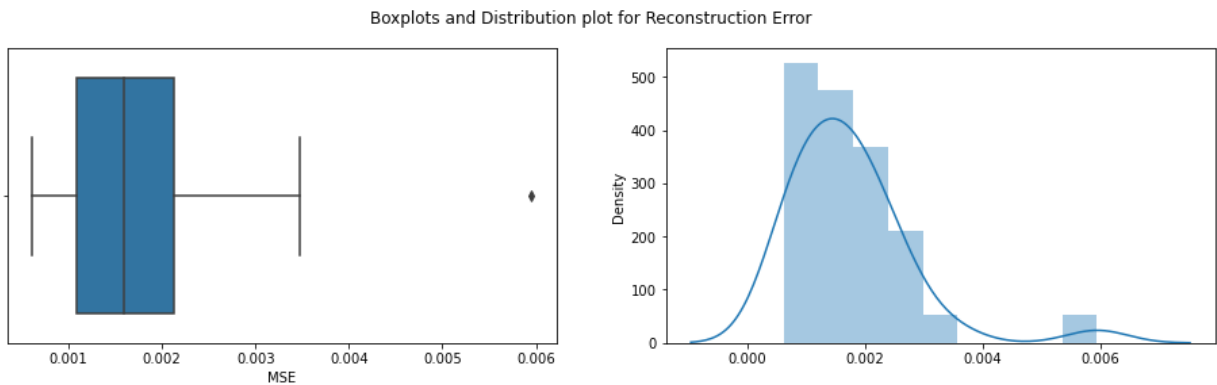
Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 1.117
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=0.001985625,median=0.002075 ,max=0.00299,min=0.00042,variance=3.684e-07
```
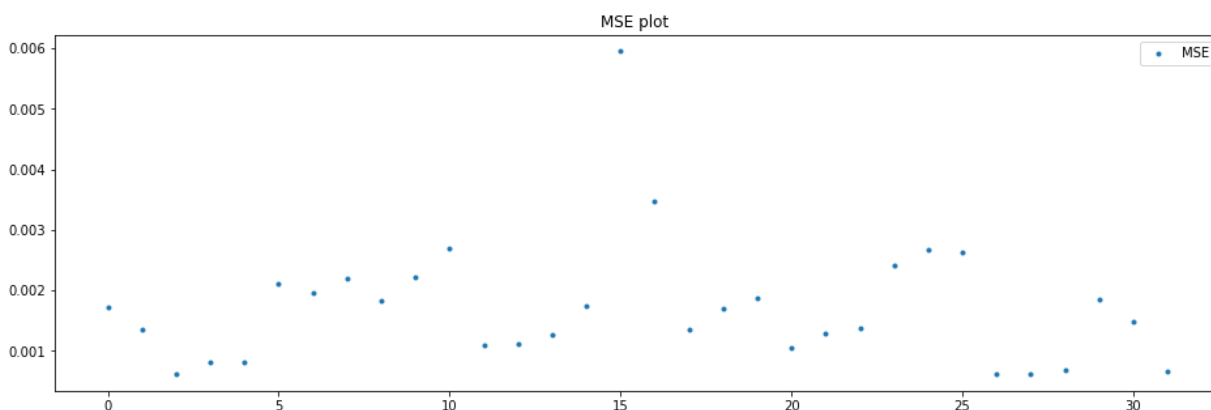
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 0.478
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: 36
mean=0.0025265625,median=0.00239 ,max=0.00434,min=0.00061,variance=6.464e-07



Boxplots and Distribution plot for Reconstruction Error



MSE plot

Anderson_Darling Test
Statistic: 0.296
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: 37
mean=0.002915,median=0.00238 ,max=0.01156,min=0.00102,variance=4.0216e-06

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 2.837
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=0.0032775,median=0.00274 ,max=0.01452,min=0.0005,variance=5.5951e-06
```
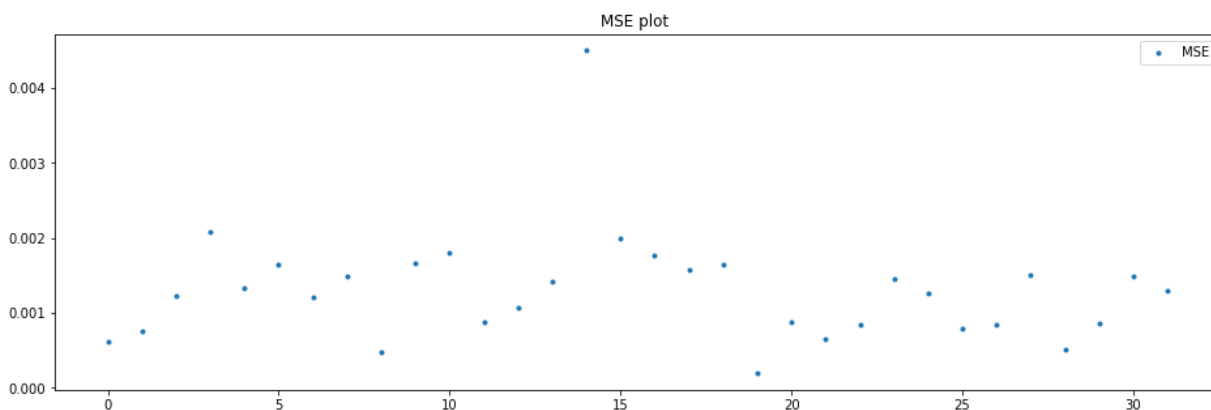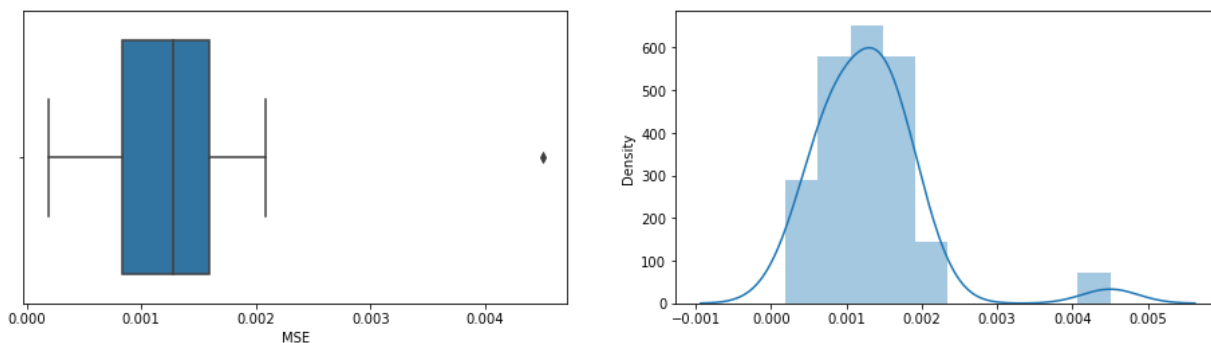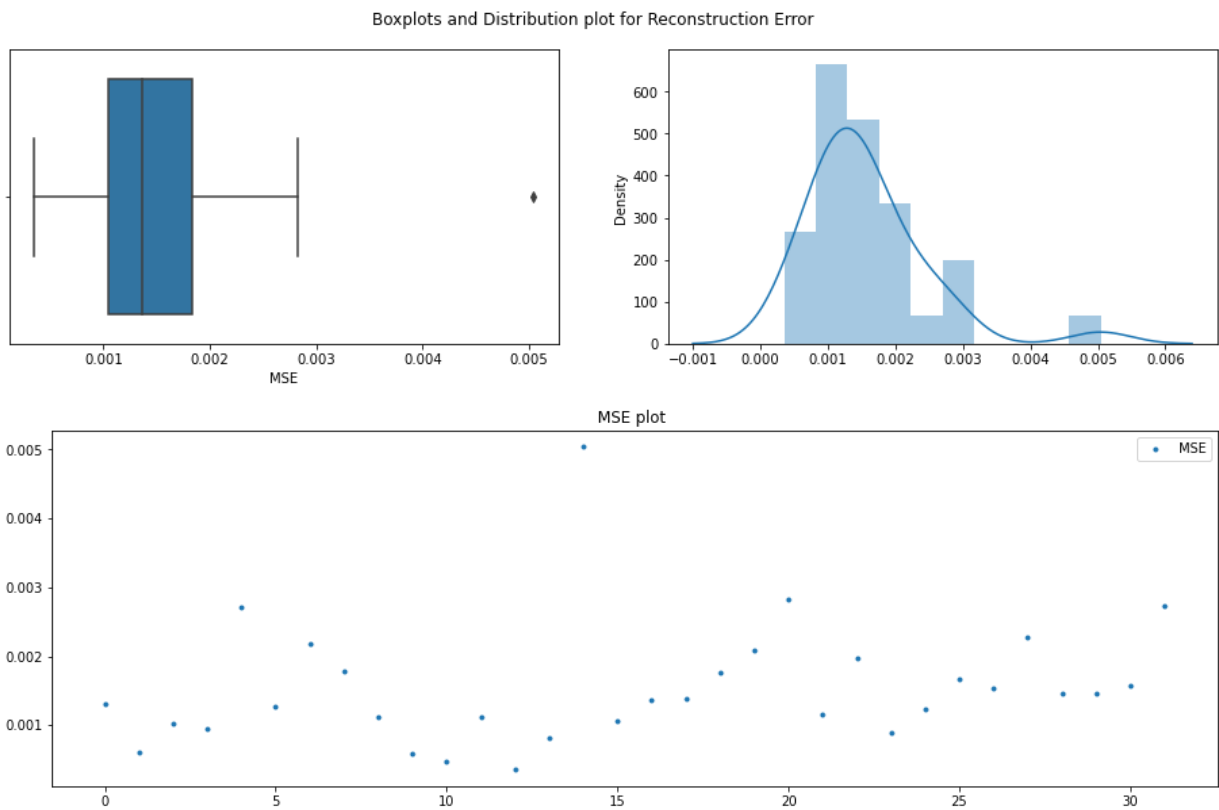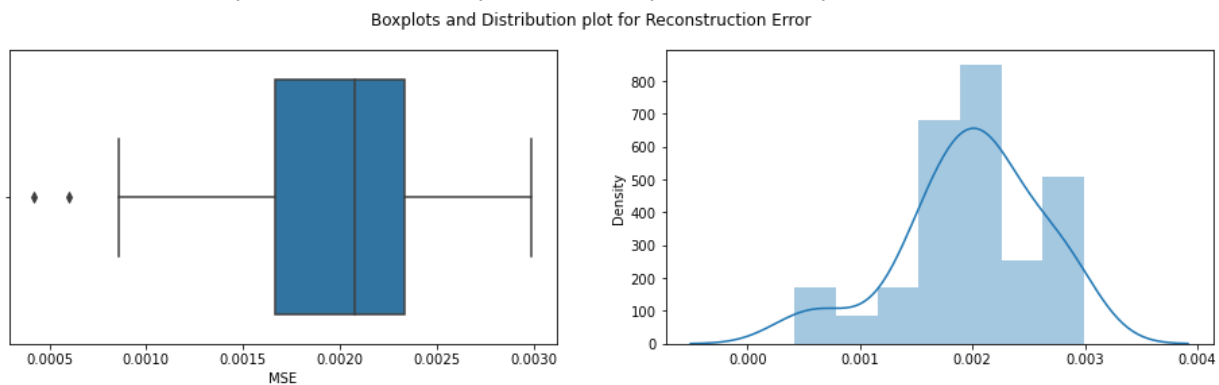
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 2.368
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=0.0018696875,median=0.00184 ,max=0.00612,min=0.00022,variance=1.7391e-06
```
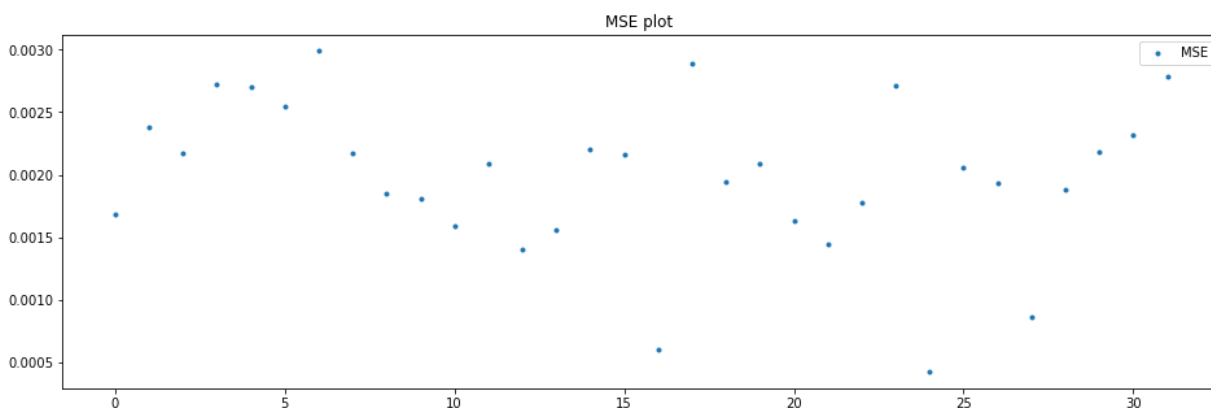


Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 0.830
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 looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 *******************
Batch: 40
mean=0.0013859375,median=0.00101 ,max=0.00333,min=0.00044,variance=6.572e-07
```
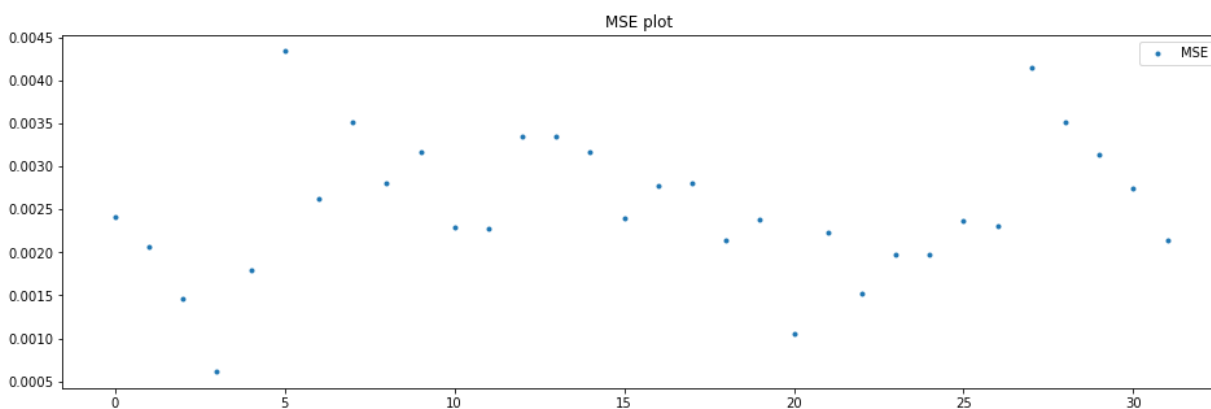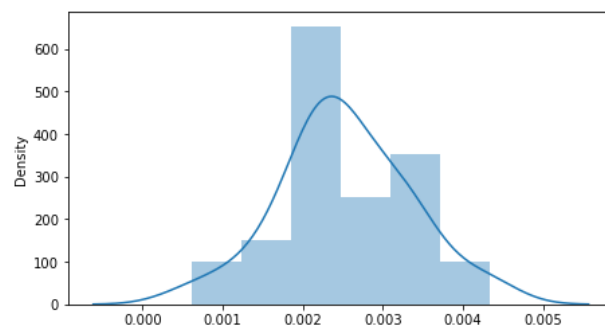
Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 1.859
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=0.001438125,median=0.00137 ,max=0.00421,min=0.00029,variance=6.281e-07
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 0.613
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: 42
mean=0.001604375,median=0.00141 ,max=0.00401,min=0.00054,variance=7.122e-07
```
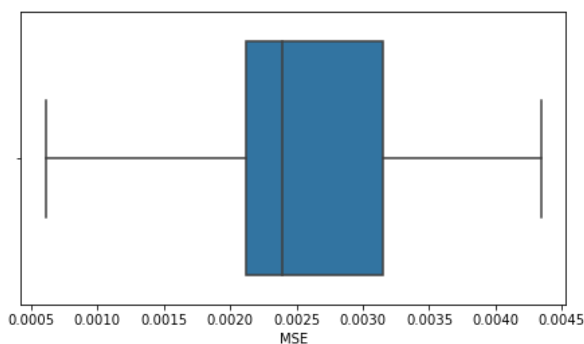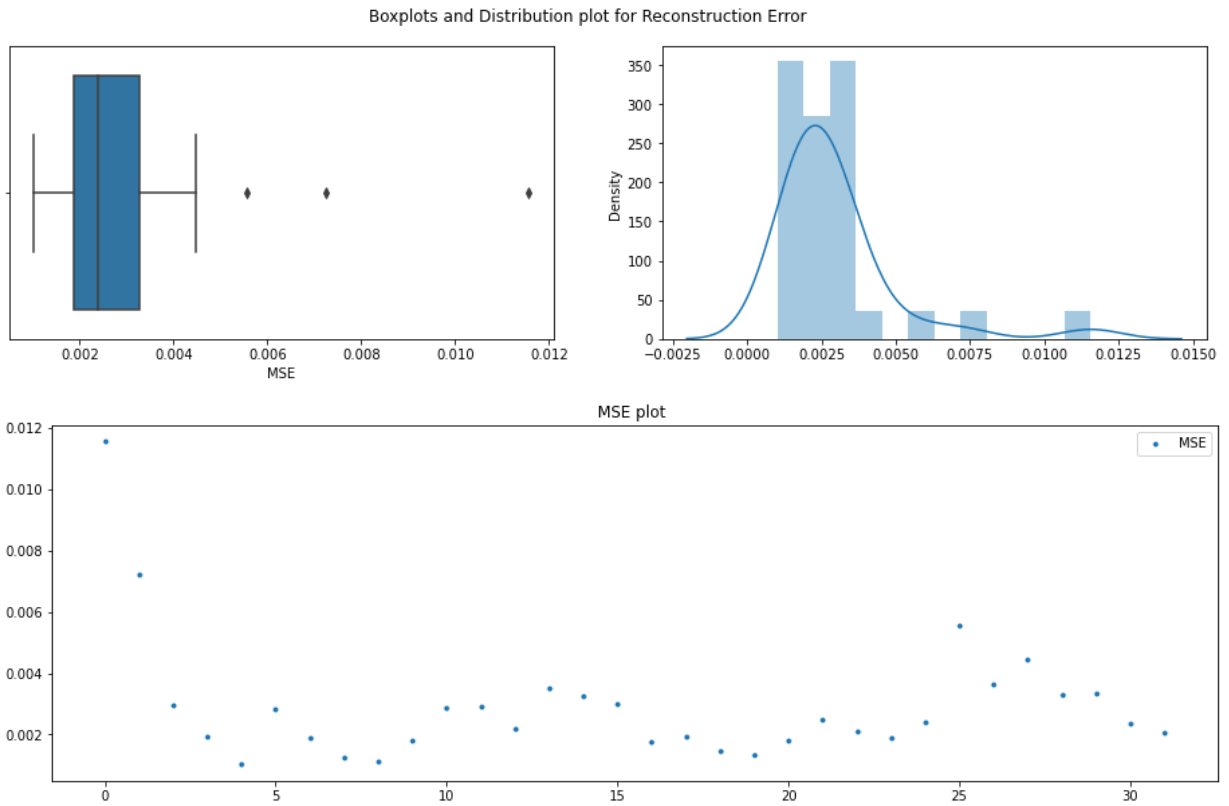


Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 0.750
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: 43
mean=0.002745,median=0.001985 ,max=0.01688,min=0.00076,variance=7.7683e-06
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 4.657
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=0.0051021875,median=0.00307 ,max=0.02203,min=0.00114,variance=2.44078e-05
```
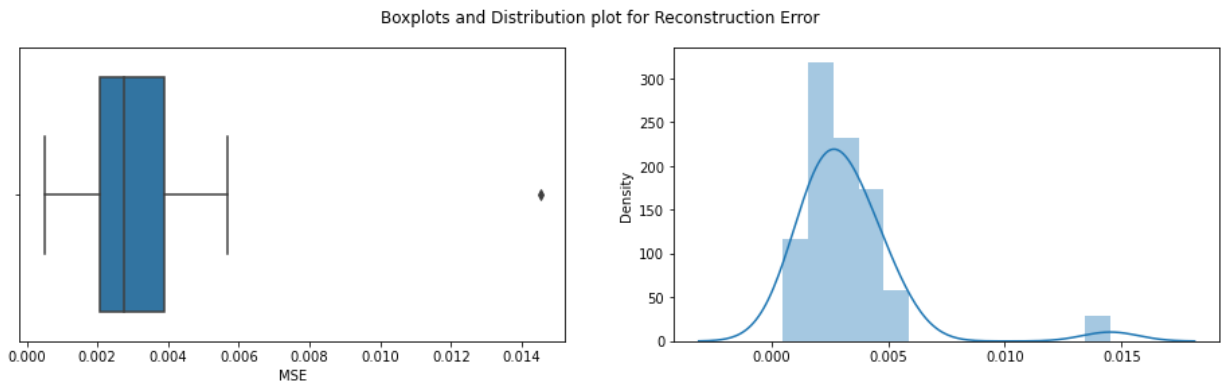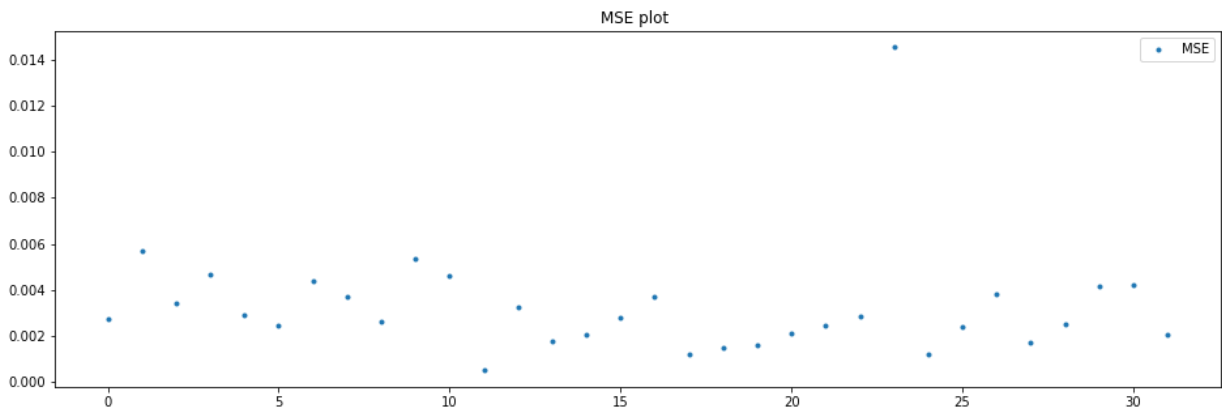
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 4.266
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
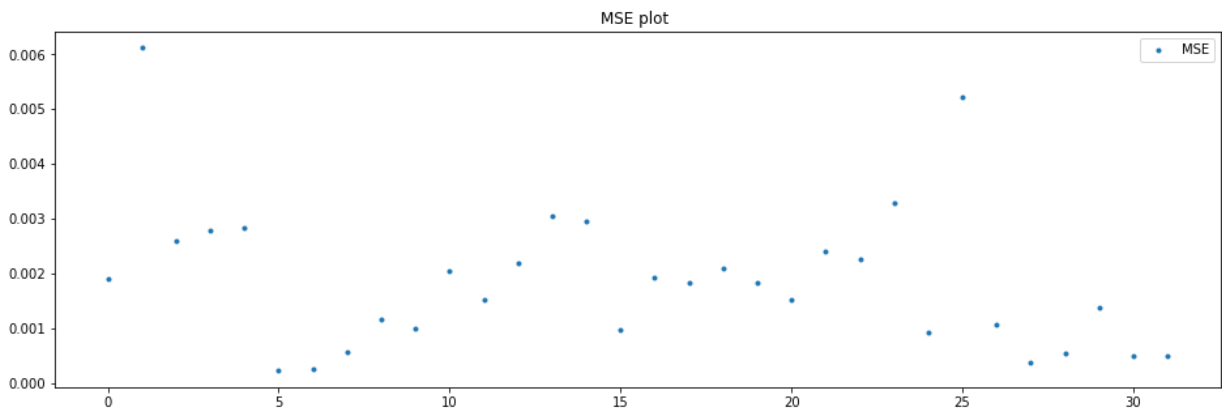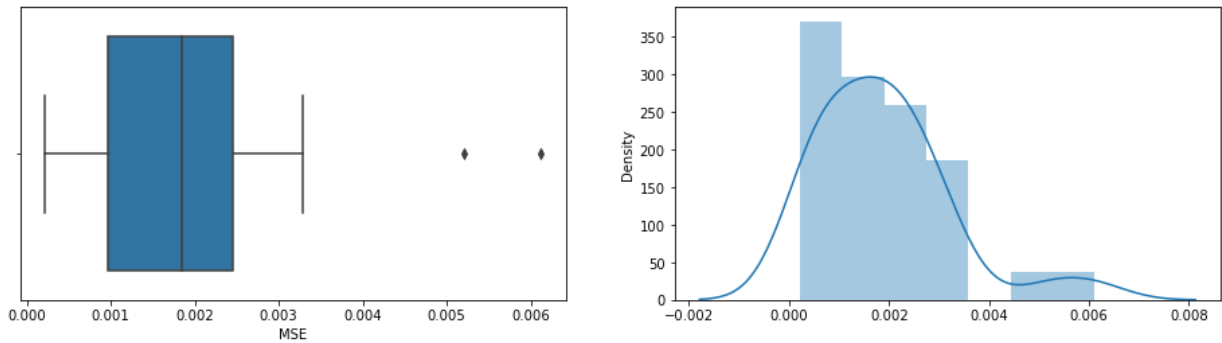5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 45
mean=0.00248125,median=0.002005 ,max=0.00824,min=0.0009,variance=2.3003e-06



Boxplots and Distribution plot for Reconstruction Error



MSE plot

Anderson_Darling Test
Statistic: 2.678
15.000: 0.523, data does not look normal (reject H0)
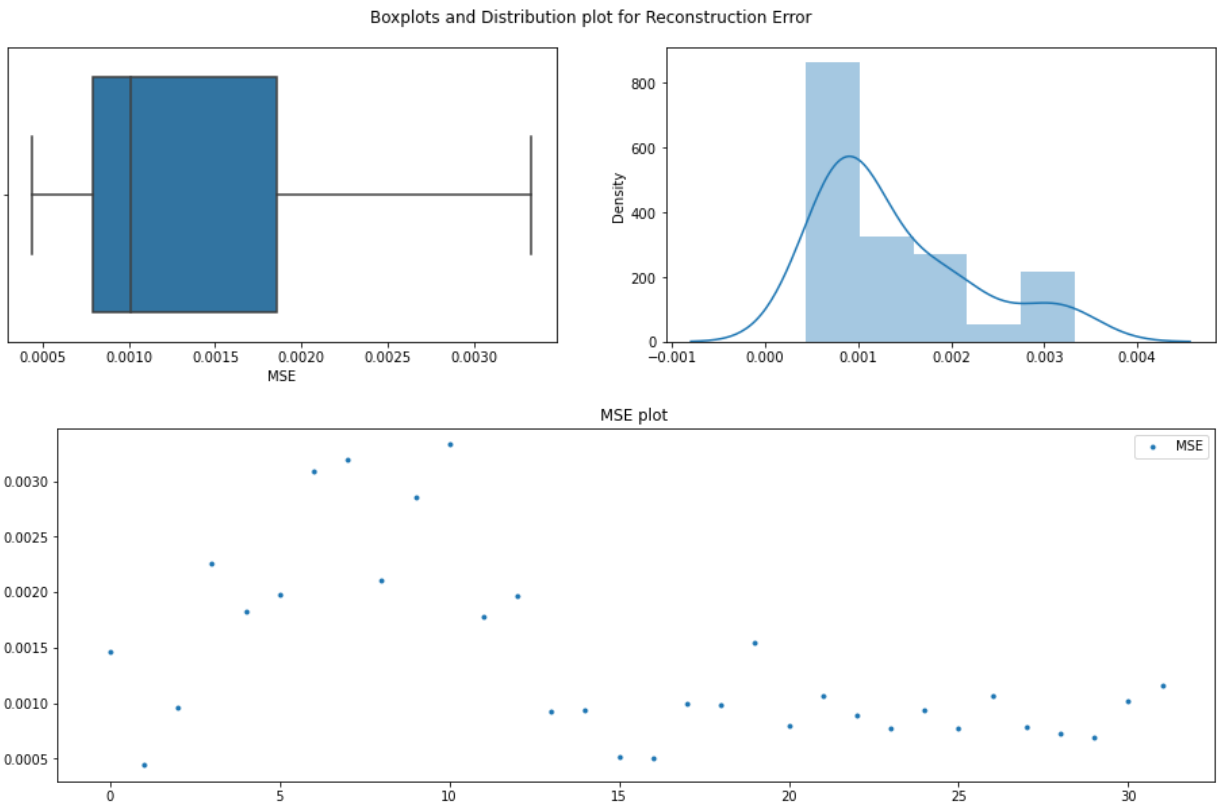10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 46
mean=0.00223125,median=0.001735 ,max=0.01573,min=0.00036,variance=6.5801e-06

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 4.909
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=0.002225,median=0.001285 ,max=0.01208,min=0.00047,variance=7.7704e-06
```
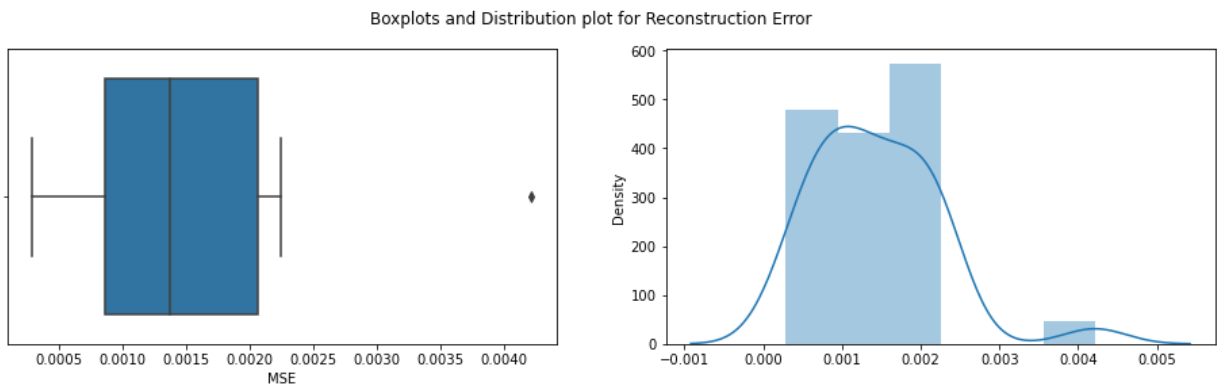
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 4.812
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=0.0015959375,median=0.000865 ,max=0.01069,min=0.00036,variance=4.6892e-06
```
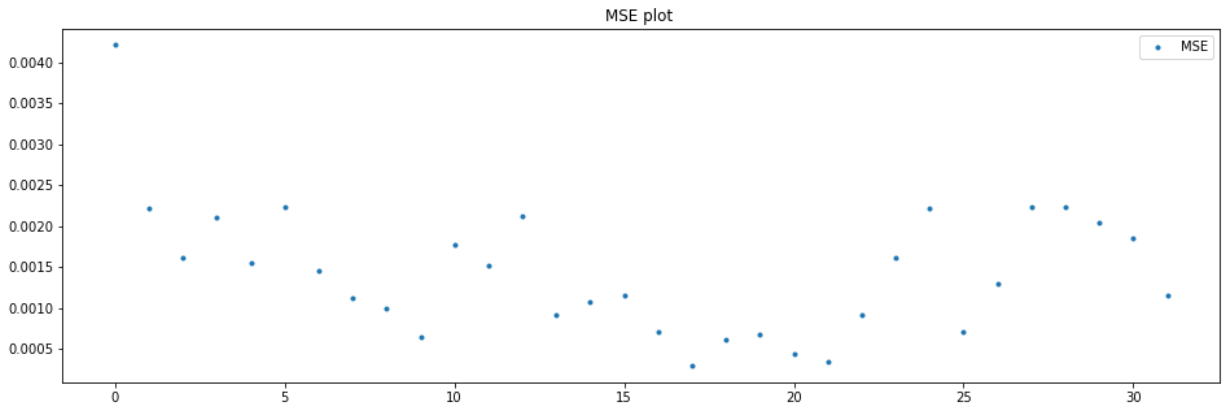


Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 5.923
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=0.0018909375,median=0.00155 ,max=0.00676,min=0.00059,variance=1.2835e-06
```
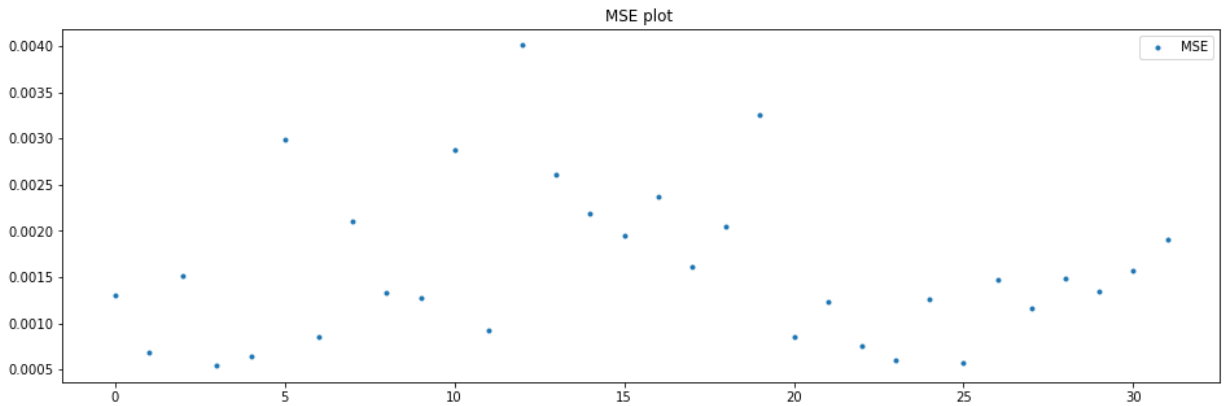
Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 1.428
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=0.00248875,median=0.00213 ,max=0.00938,min=0.00052,variance=2.4762e-06
```
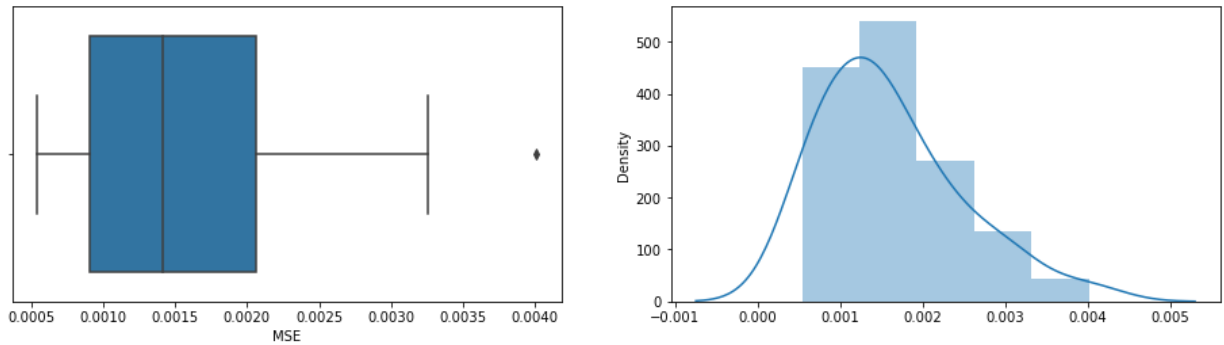
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 1.363
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=0.0042925,median=0.00252 ,max=0.02631,min=0.00074,variance=2.94931e-05
```
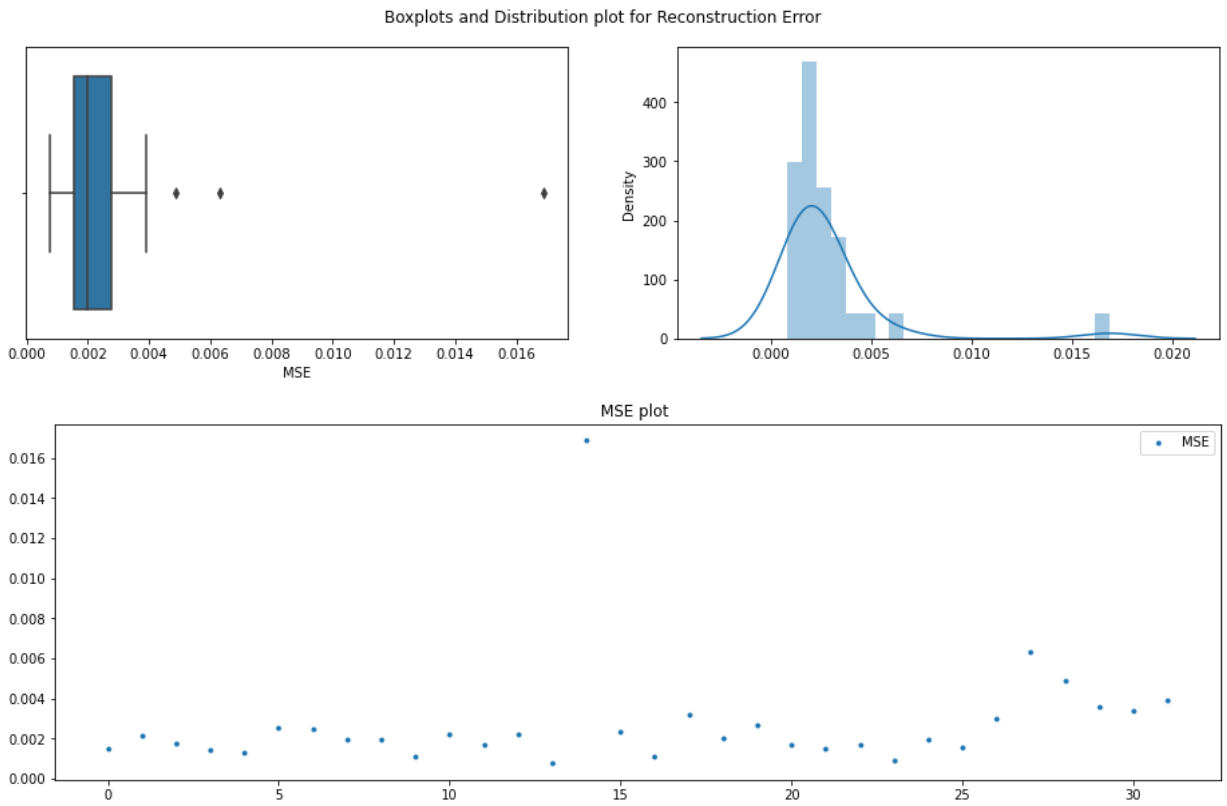


Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 5.237
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: 52
mean=0.00242875,median=0.00222 ,max=0.00758,min=0.00014,variance=2.3958e-06
```
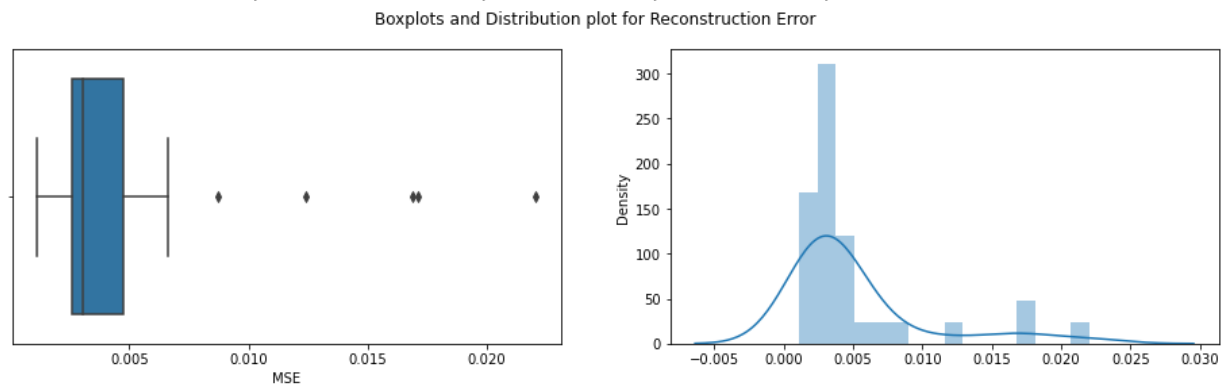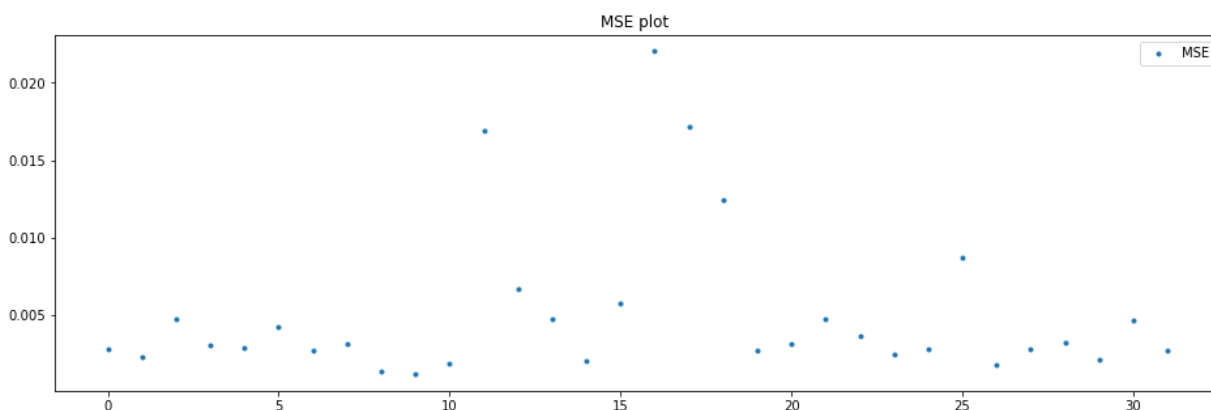
Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 2.122
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=0.0027490625,median=0.002675 ,max=0.01079,min=0.00054,variance=3.0689e-06
```
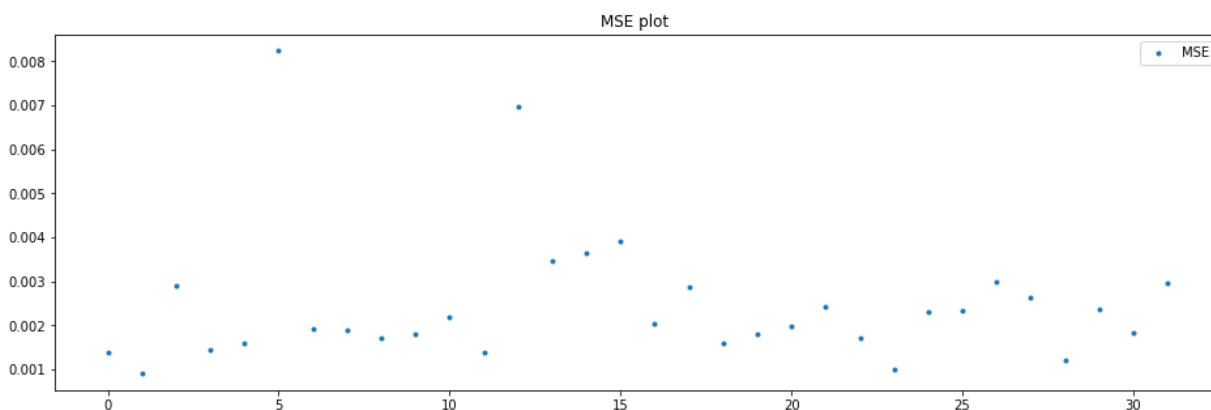
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 1.835
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
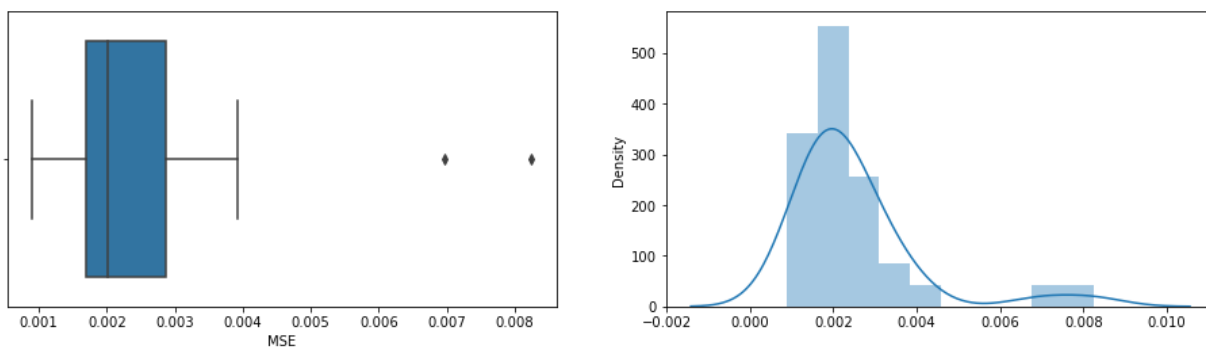5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 54
mean=0.00135875,median=0.001055 ,max=0.00565,min=0.00019,variance=1.2286e-06



Boxplots and Distribution plot for Reconstruction Error



MSE plot

Anderson_Darling Test
Statistic: 2.534
15.000: 0.523, data does not look normal (reject H0)
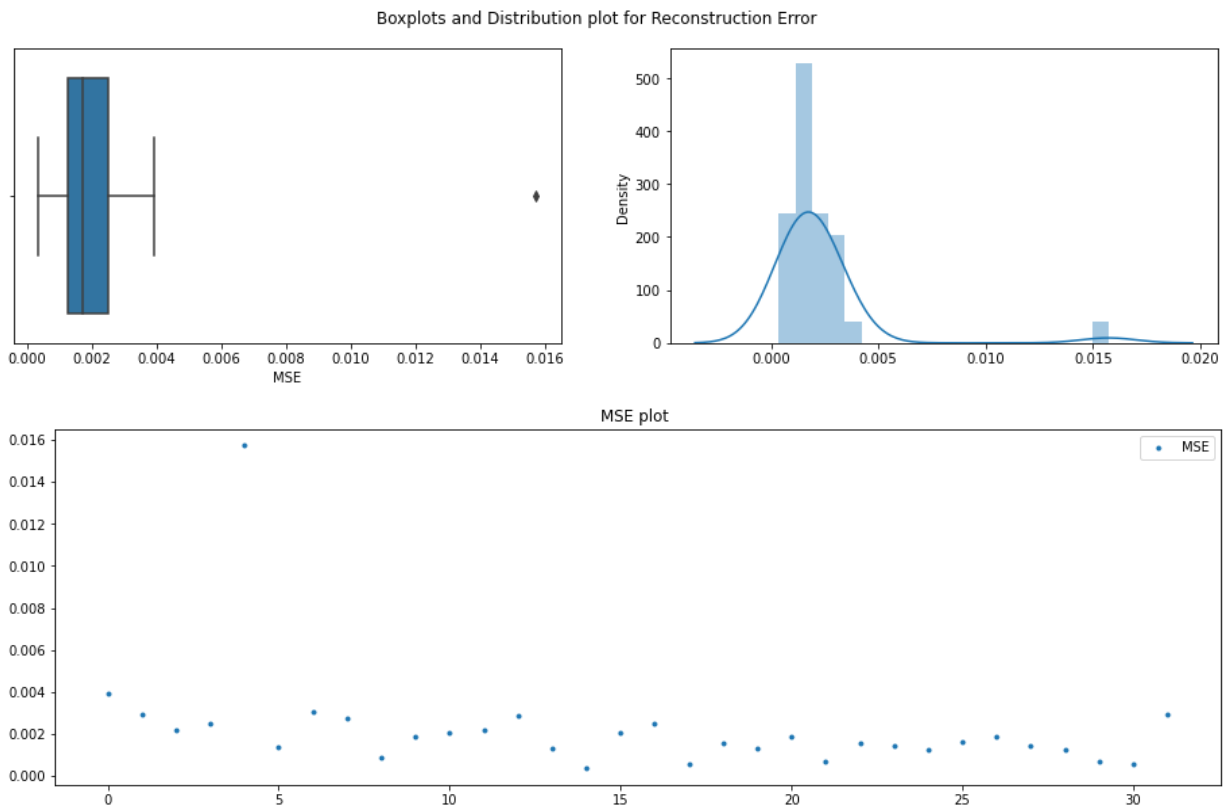10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 55
mean=0.0016375,median=0.001105 ,max=0.0095,min=0.00023,variance=3.2313e-06

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 3.848
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=0.001280625,median=0.001255 ,max=0.00242,min=0.00043,variance=2.001e-07
```
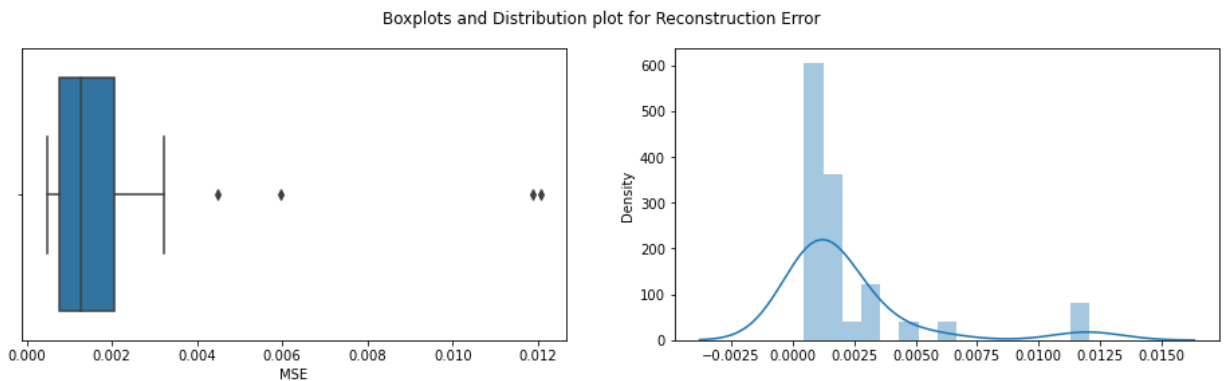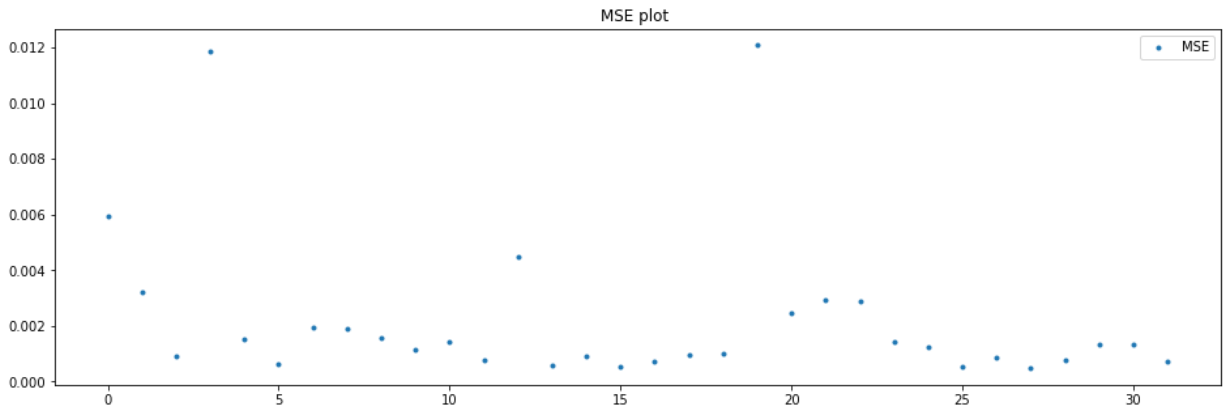
Boxplots and Distribution plot for Reconstruction Error
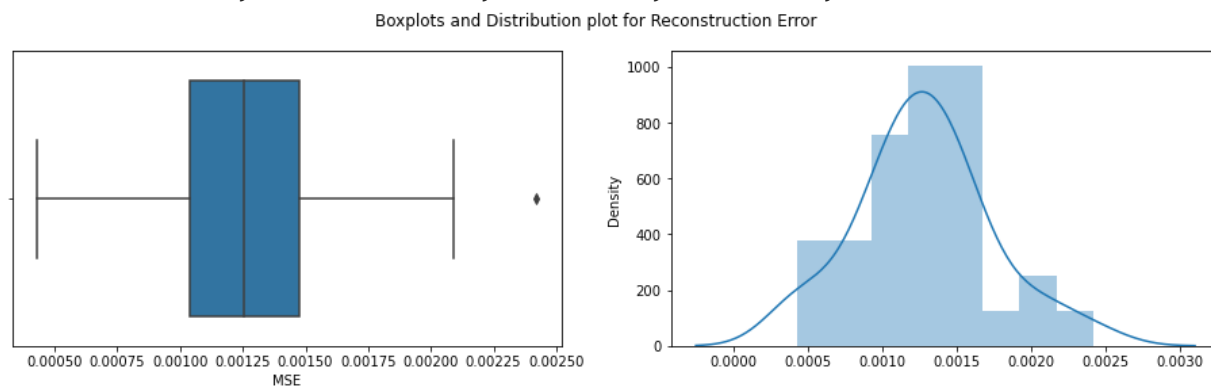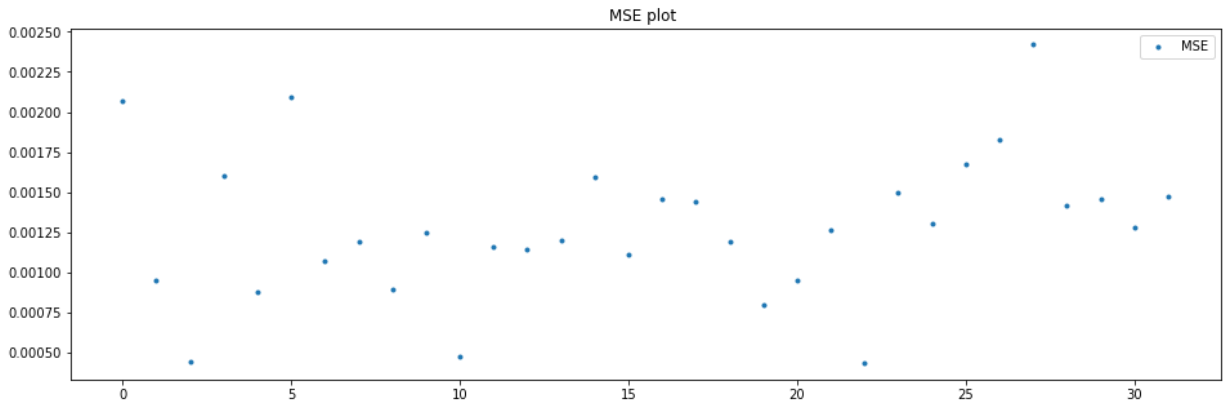
Anderson_Darling Test
Statistic: 0.369
15.000: 0.523, data looks normal (fail to reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 57
mean=0.002071875,median=0.00203 ,max=0.00396,min=0.00055,variance=7.345e-07
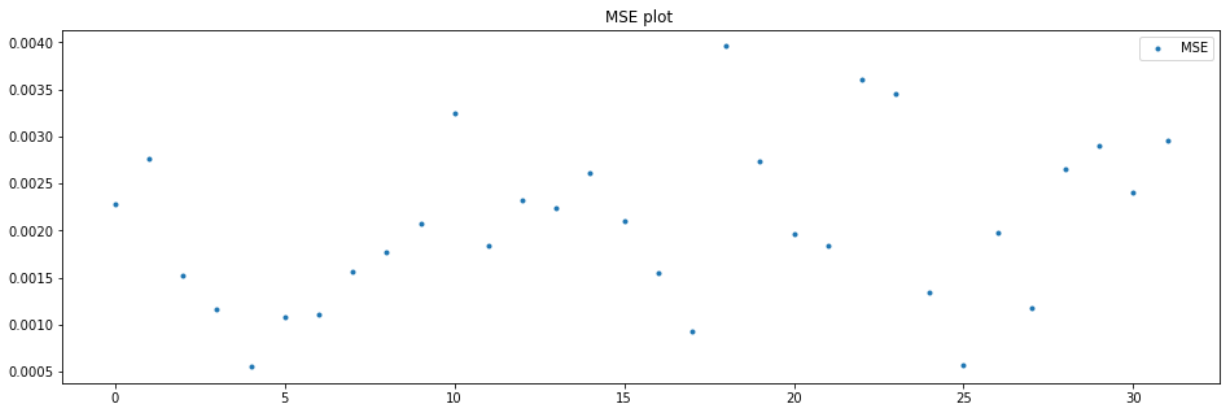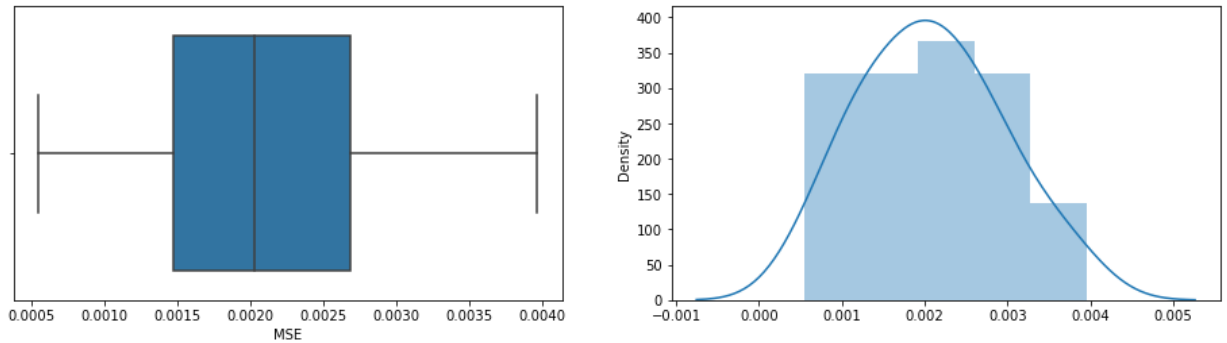




Anderson_Darling Test
Statistic: 0.140
15.000: 0.523, data looks normal (fail to reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 58
mean=0.0034790625,median=0.00244 ,max=0.01014,min=0.00046,variance=6.6166e-06

Boxplots and Distribution plot for Reconstruction Error

MSE plot
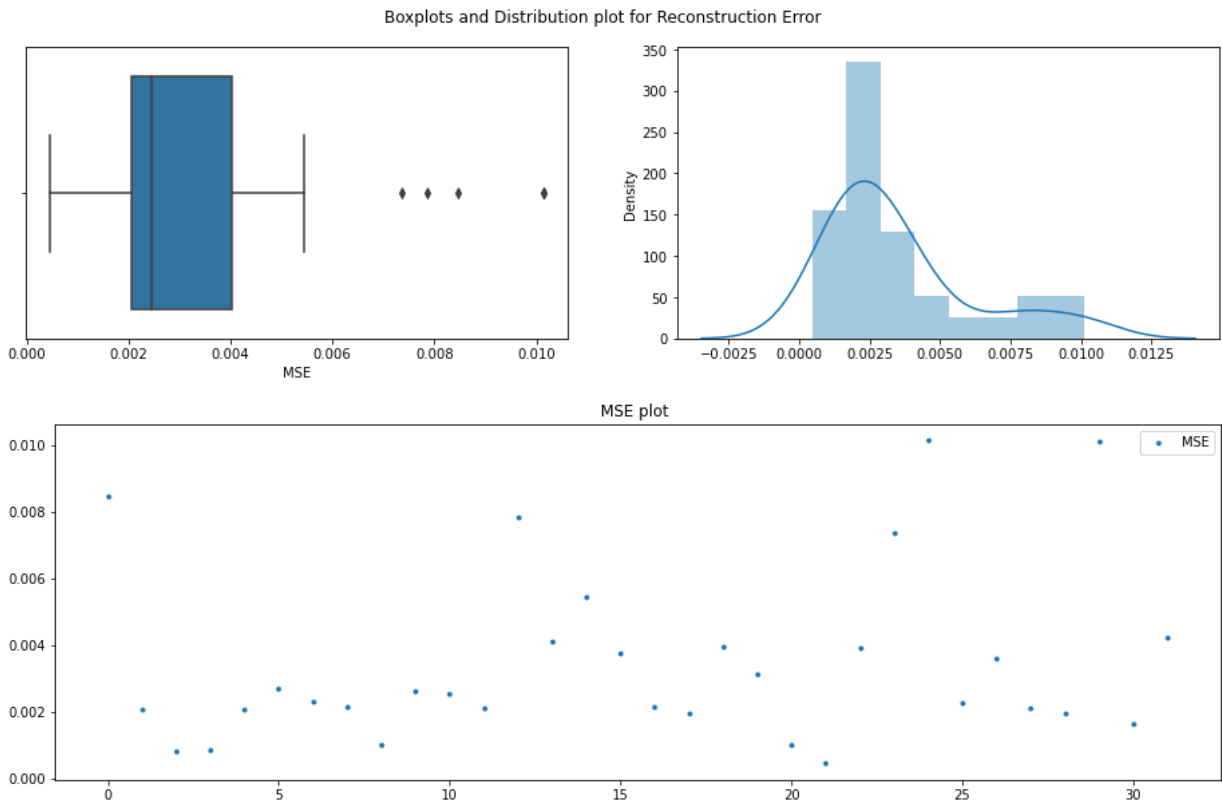
```
Anderson_Darling Test
Statistic: 2.174
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

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

Batch: 59
mean=0.0055434375,median=0.003195 ,max=0.03053,min=0.00052,variance=5.44203e-05
```
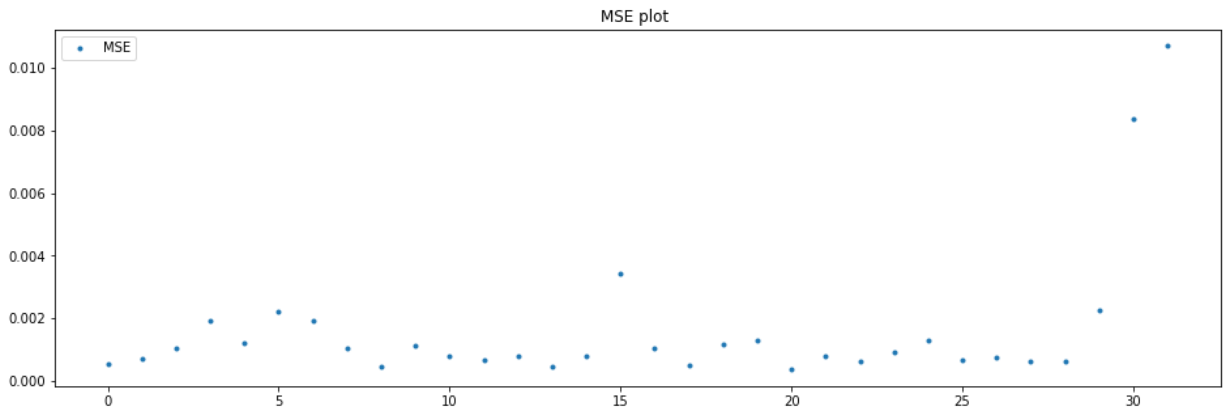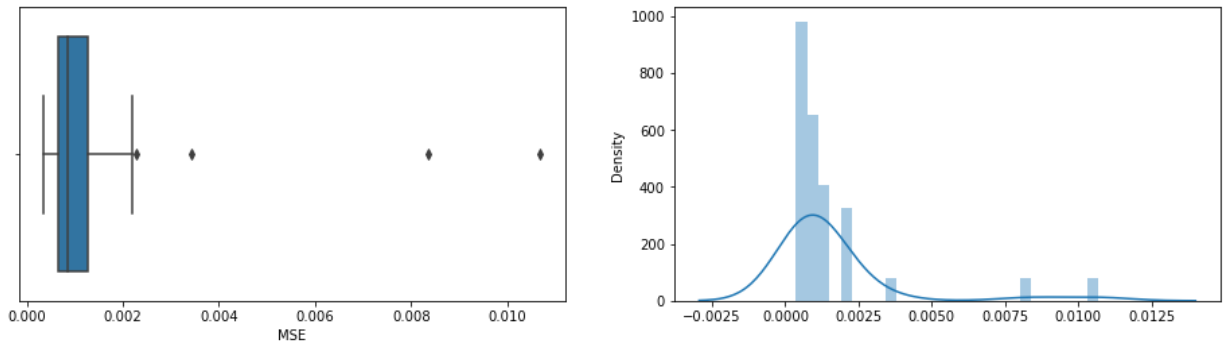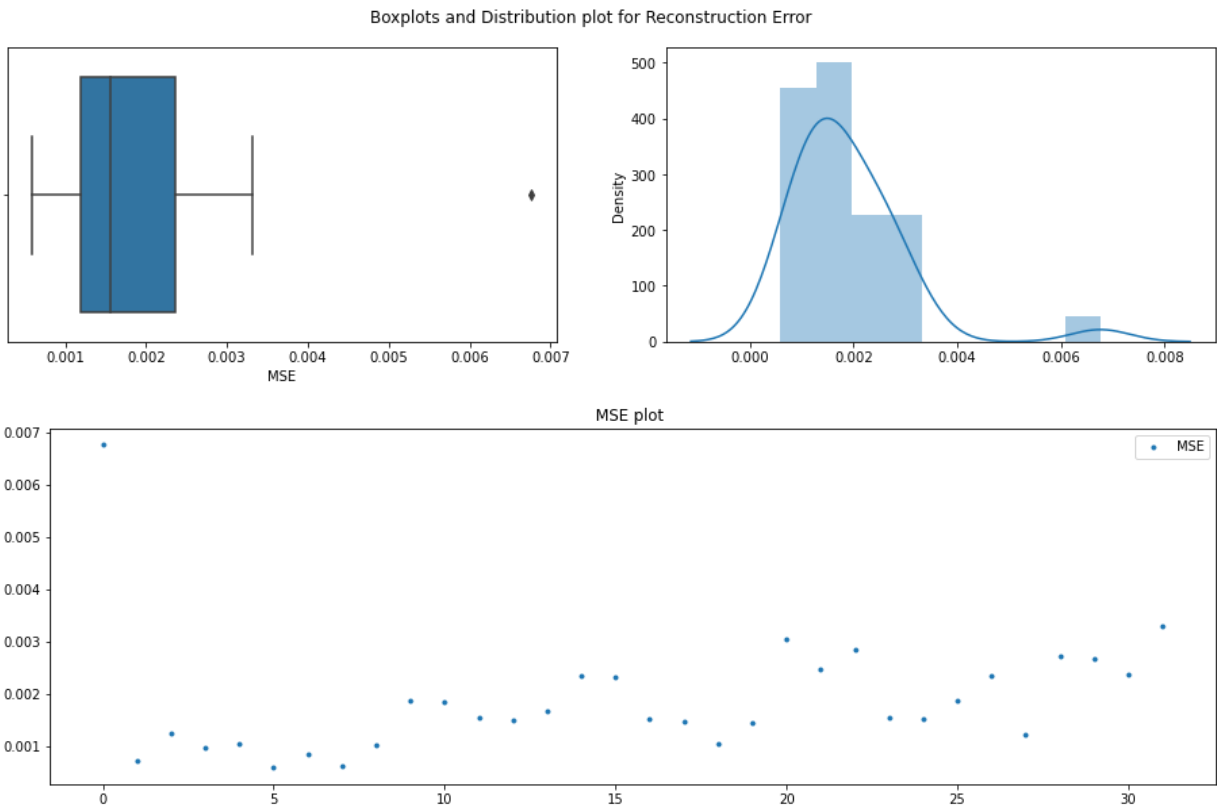
Boxplots and Distribution plot for Reconstruction Error

MSE plot
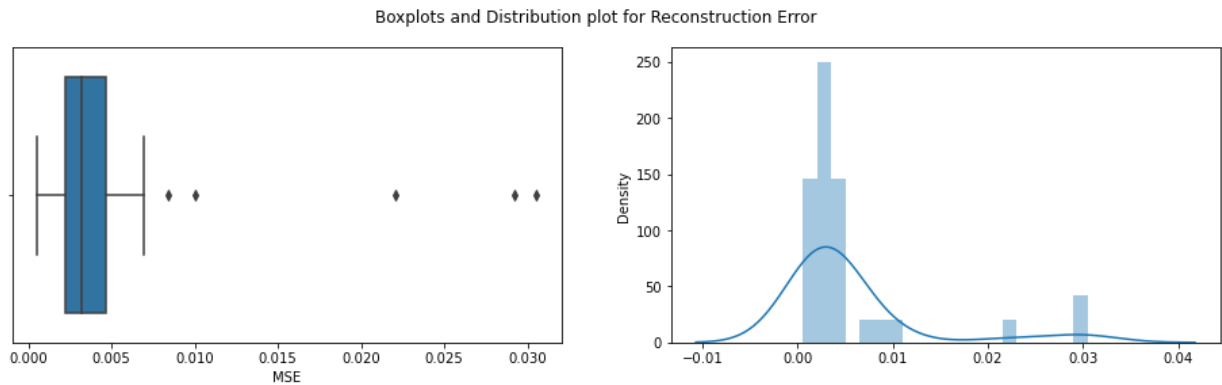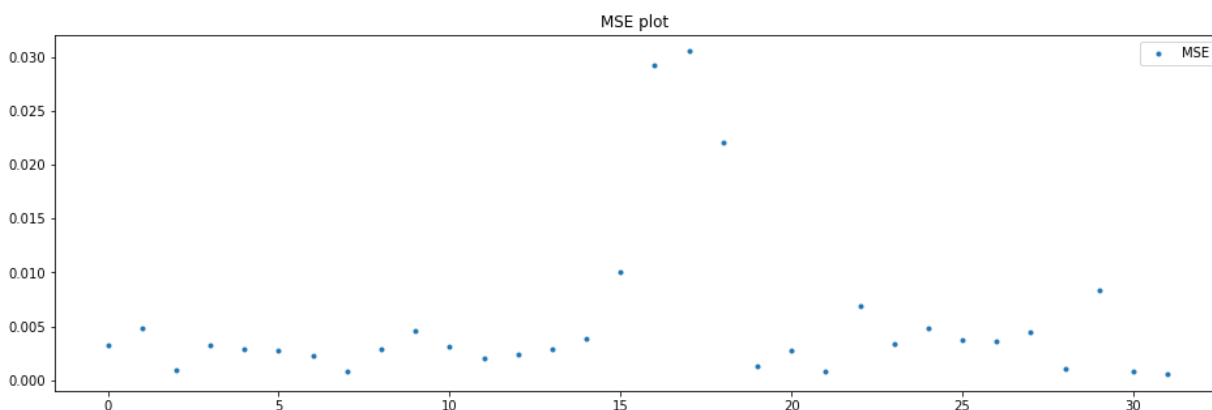
```
Anderson_Darling Test
Statistic: 5.246
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 60
mean=0.0034484375,median=0.00218 ,max=0.01786,min=0.00044,variance=1.57559e-05
```
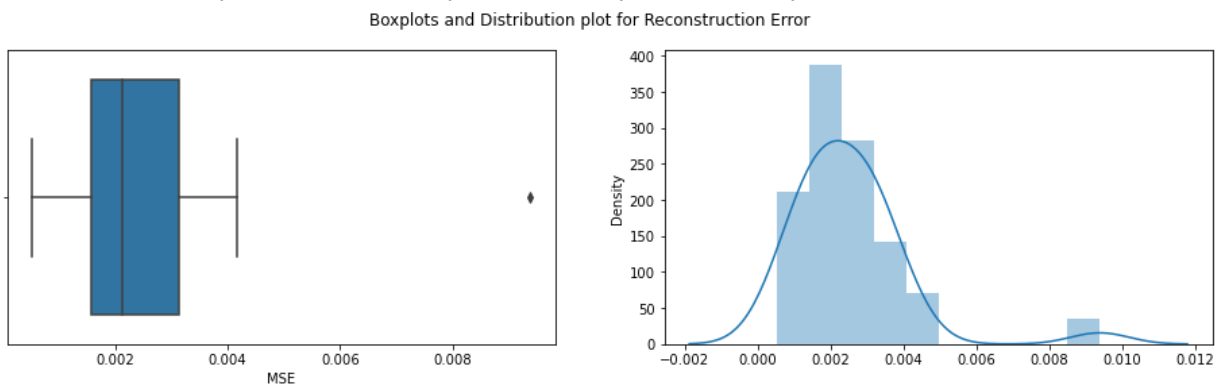


Boxplots and Distribution plot for Reconstruction Error



MSE plot
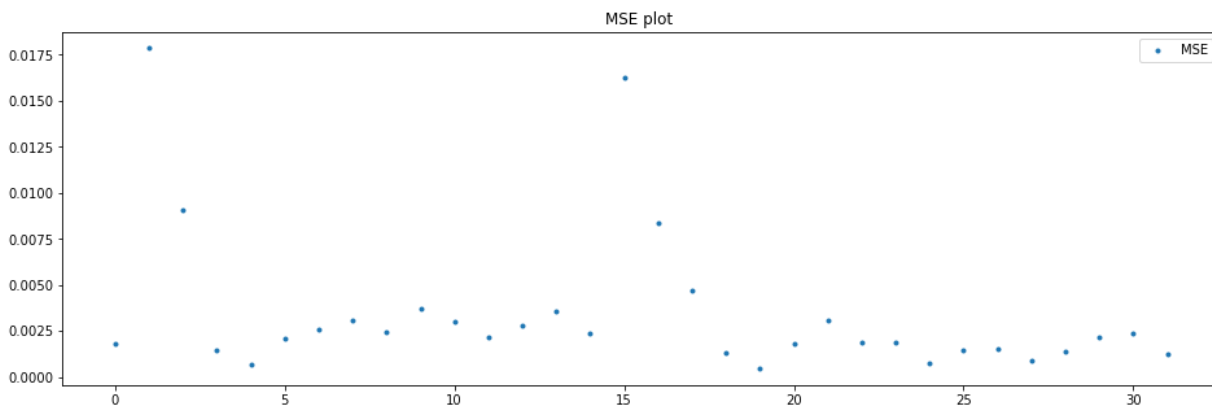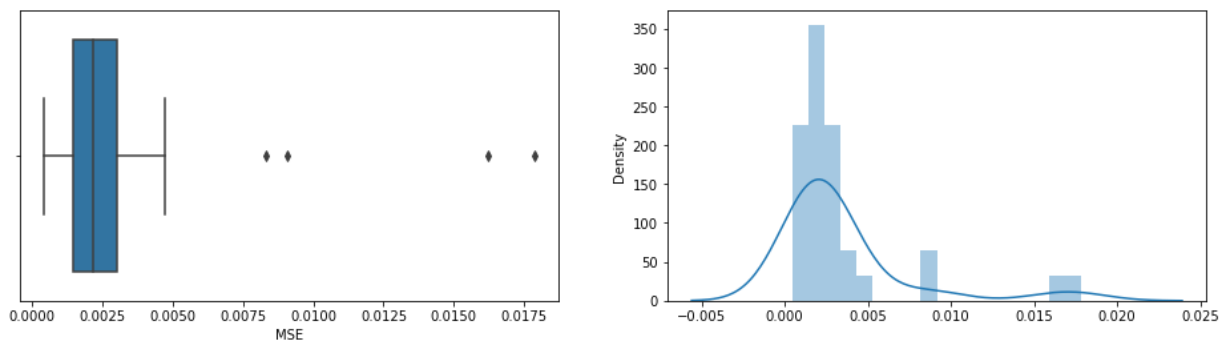
```
Anderson_Darling Test
Statistic: 4.760
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 61
mean=0.001345625,median=0.00121 ,max=0.00526,min=0.00057,variance=6.728e-07
```
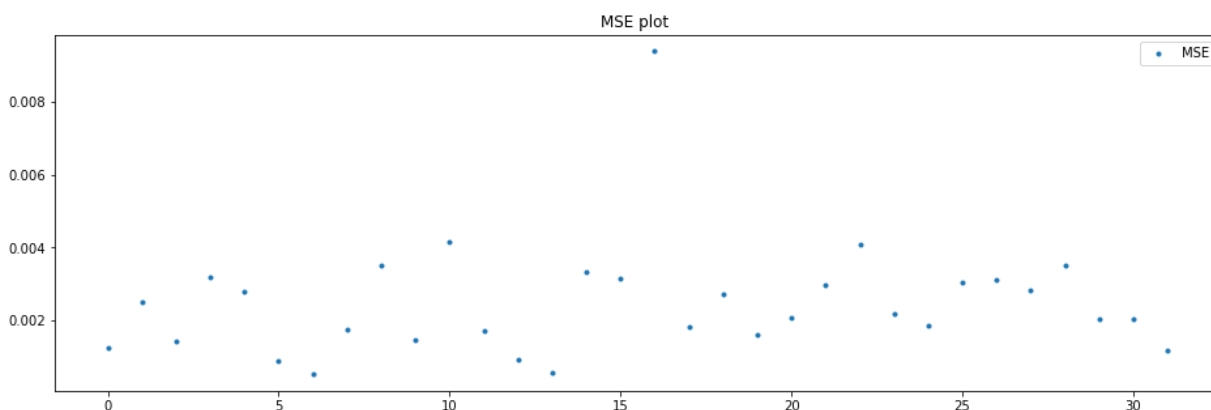
Boxplots and Distribution plot for Reconstruction Error



MSE plot
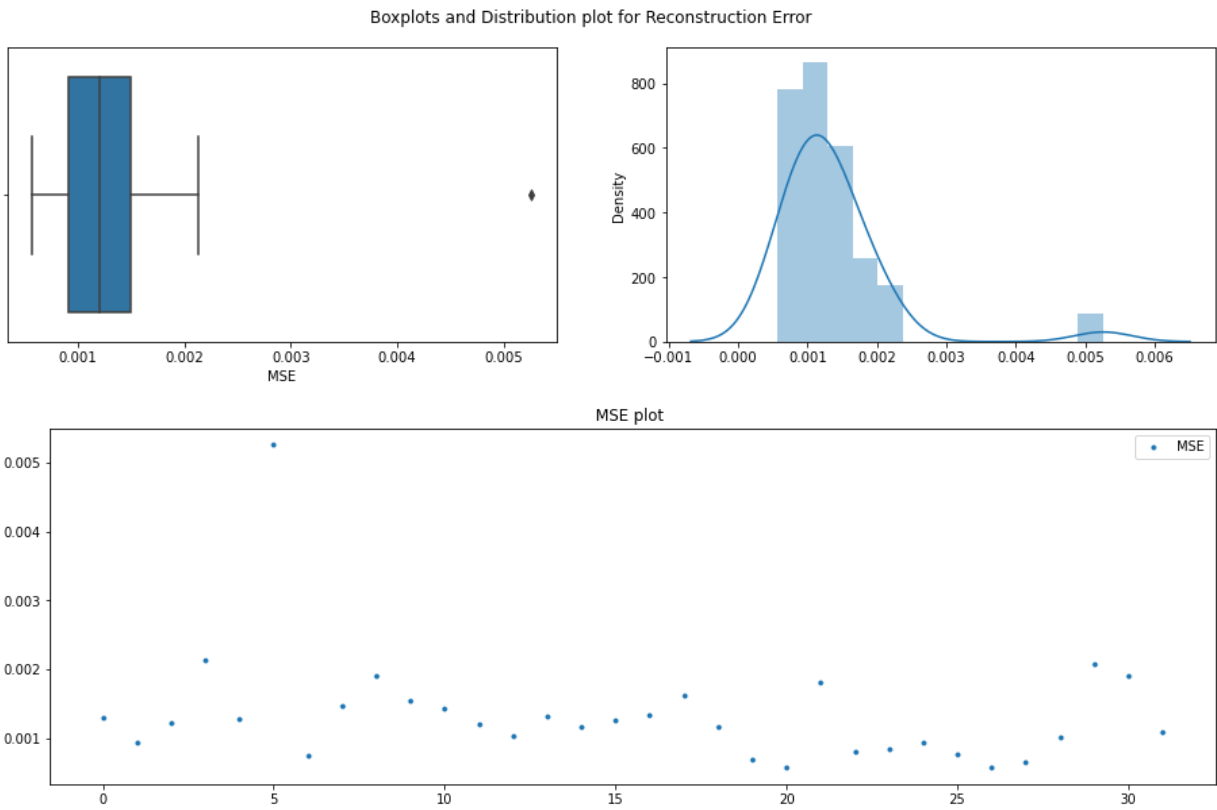


```
Anderson_Darling Test
Statistic: 2.476
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


  ********************
Batch: 62
mean=0.0015765625,median=0.001265 ,max=0.00572,min=0.00011,variance=1.0939e-06
```
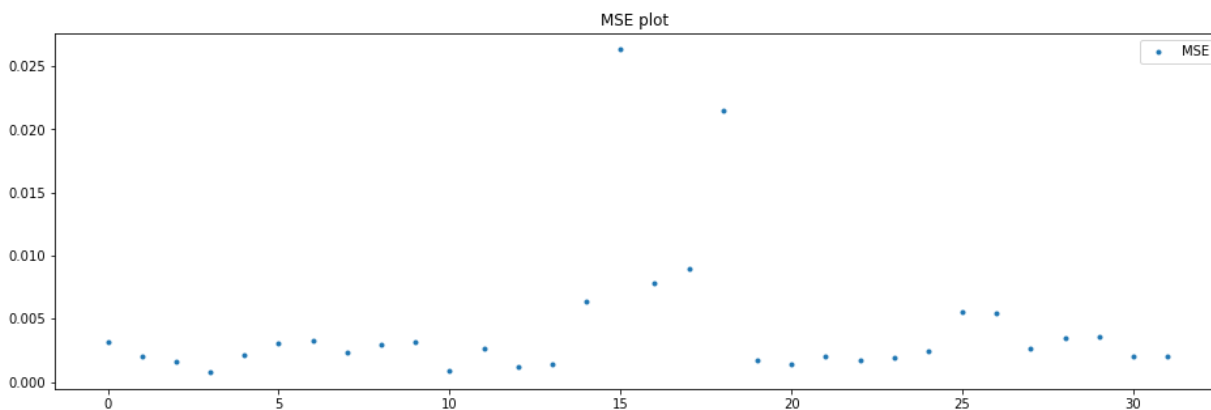
Boxplots and Distribution plot for Reconstruction Error

MSE plot
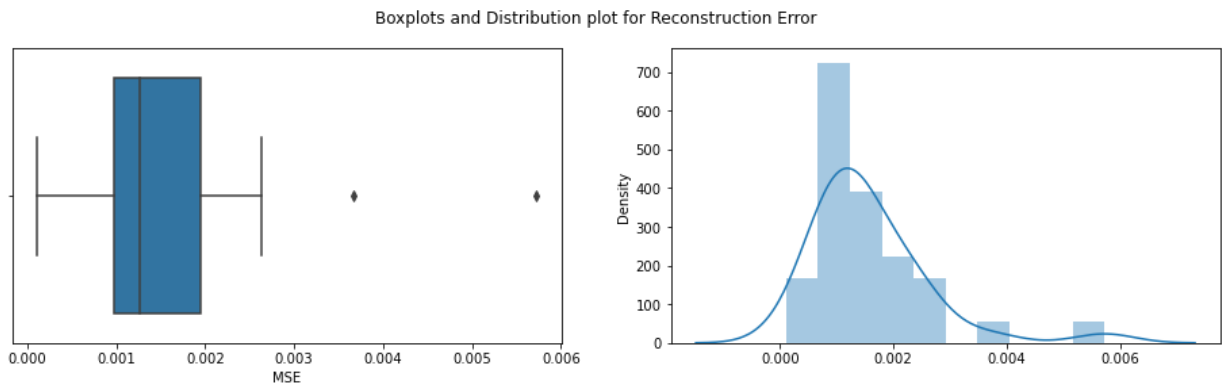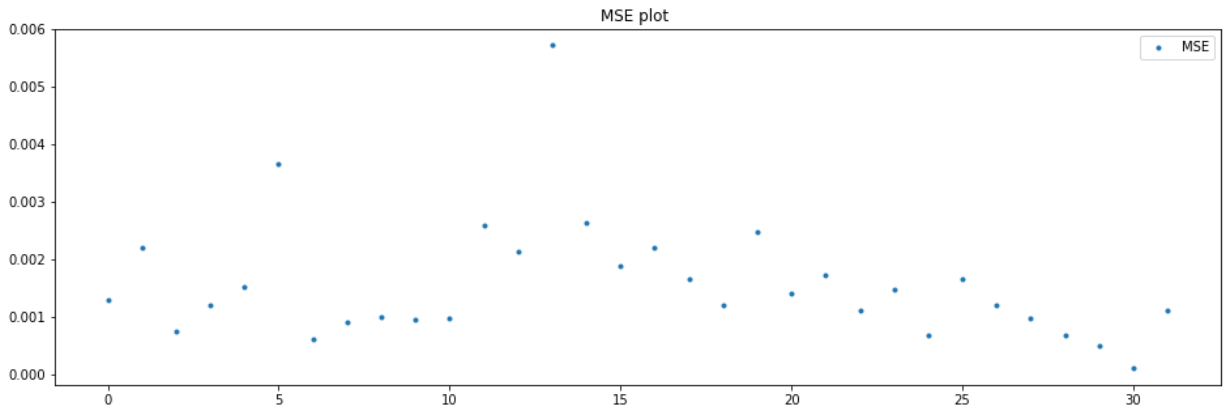
Anderson_Darling Test
Statistic: 1.471
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
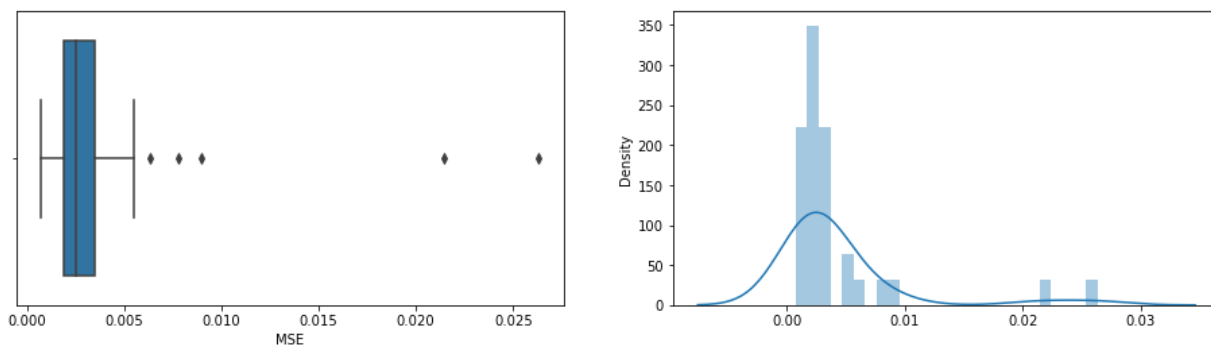5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 63
mean=0.0024921875,median=0.001845 ,max=0.01651,min=0.00088,variance=6.9861e-06



Boxplots and Distribution plot for Reconstruction Error



MSE plot
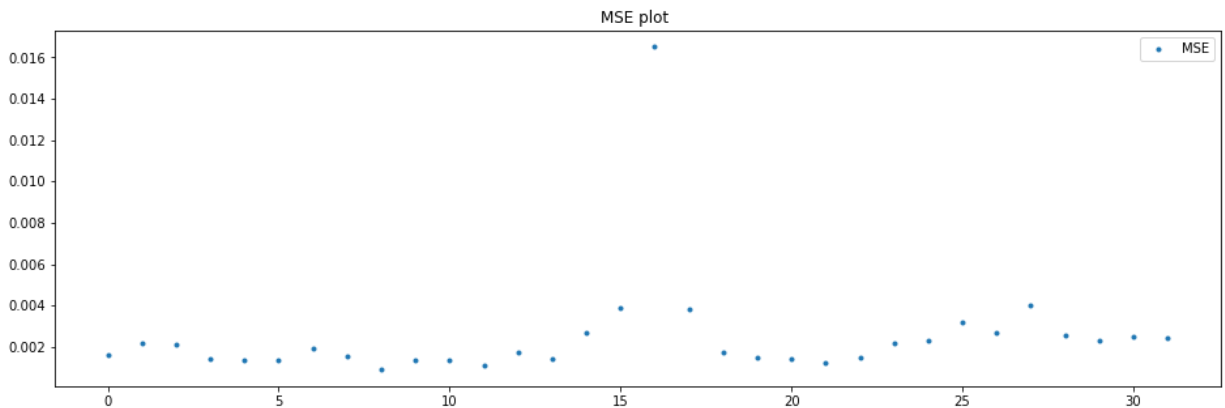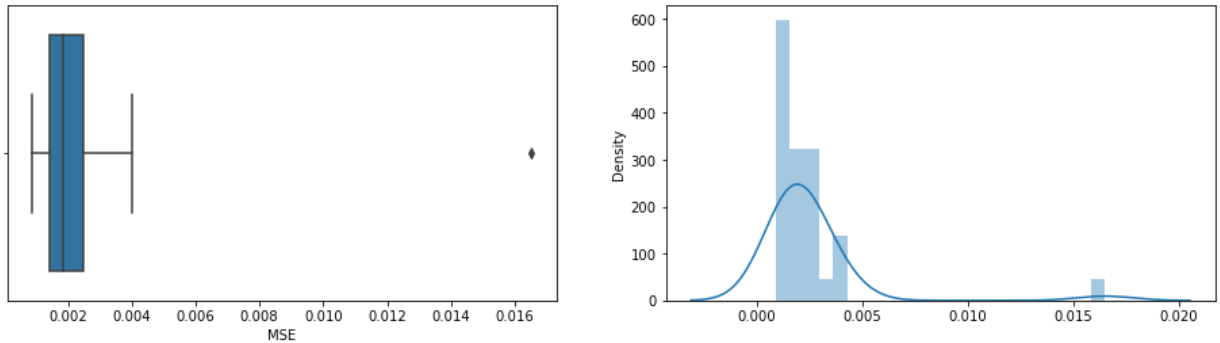
Anderson_Darling Test
Statistic: 5.653
15.000: 0.523, data does not look normal (reject H0)
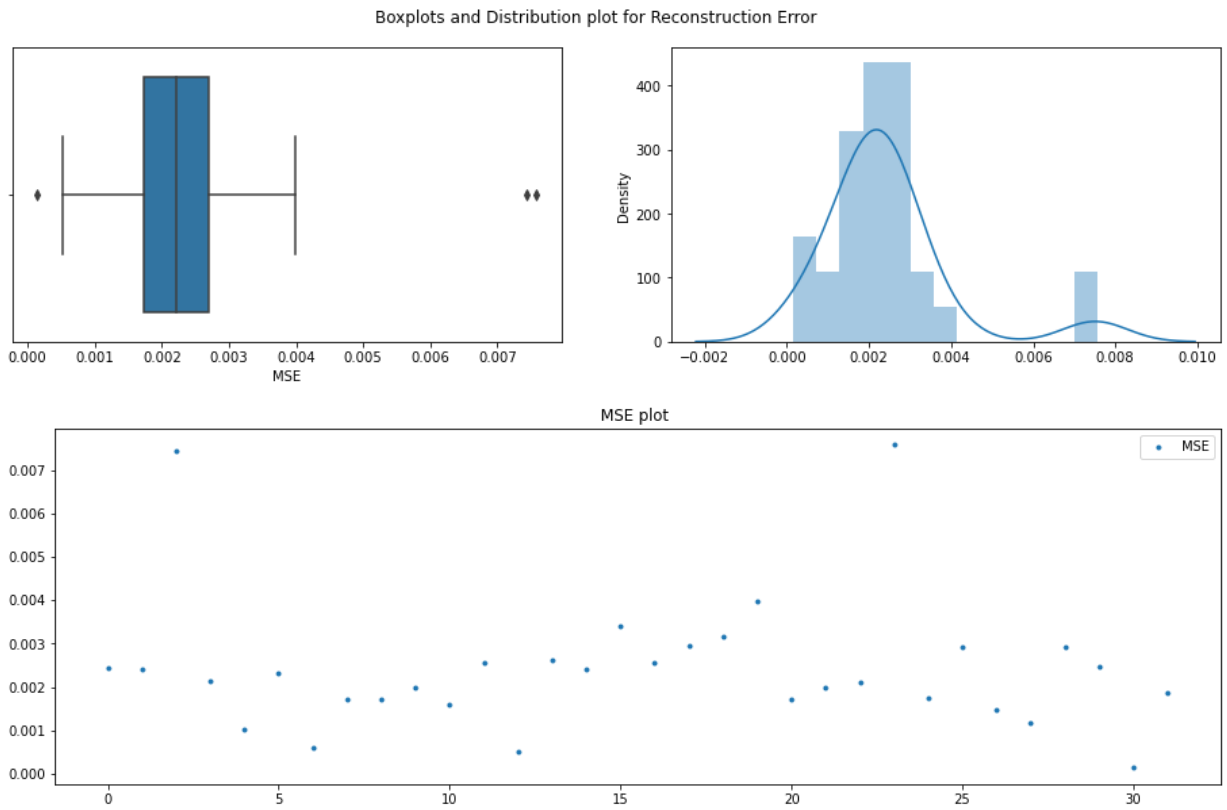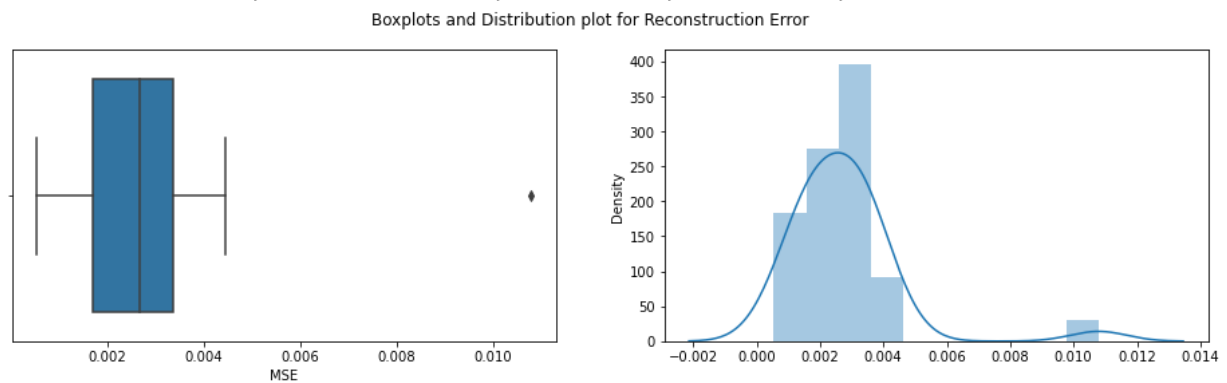10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 64
mean=0.0021159375,median=0.002125 ,max=0.00394,min=0.00054,variance=7.544e-07

Boxplots and Distribution plot for Reconstruction Error



MSE plot
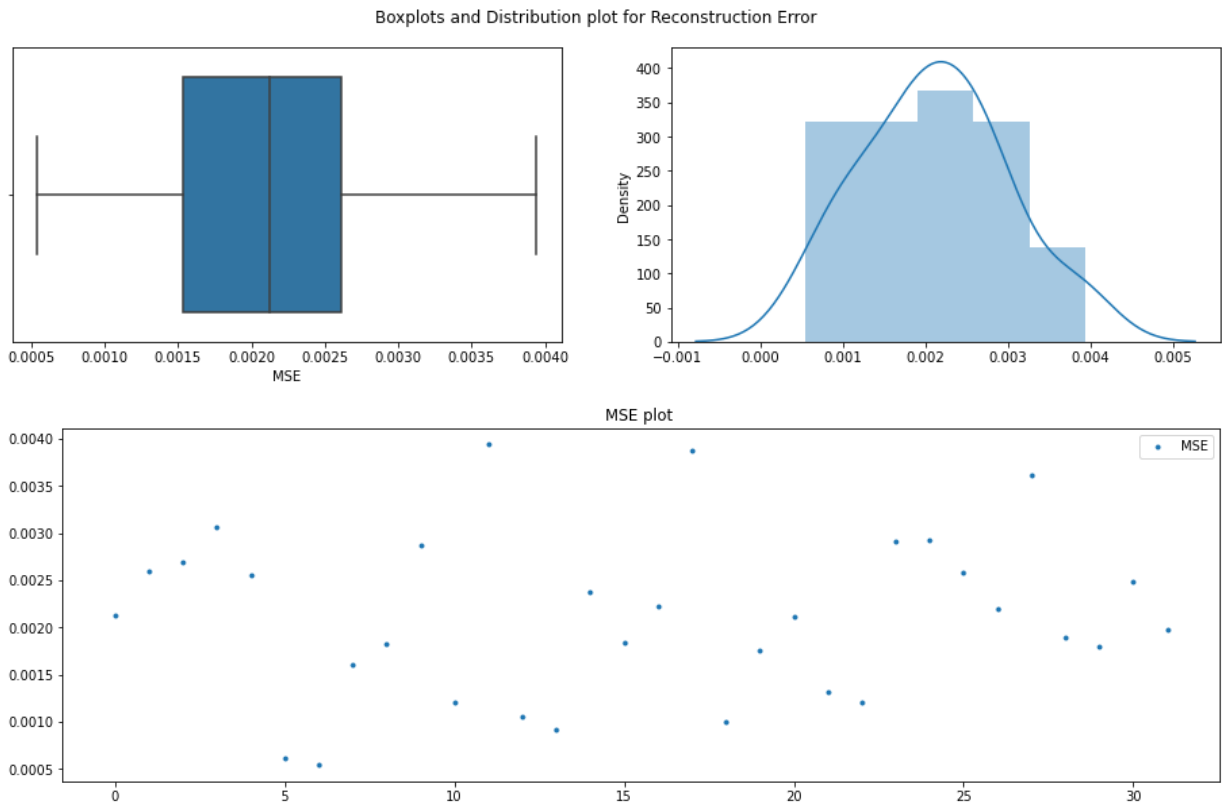


```
Anderson_Darling Test
Statistic: 0.192
15.000: 0.523, data looks normal (fail to reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 65
mean=0.0025390625,median=0.00136 ,max=0.01911,min=0.00035,variance=1.10733e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
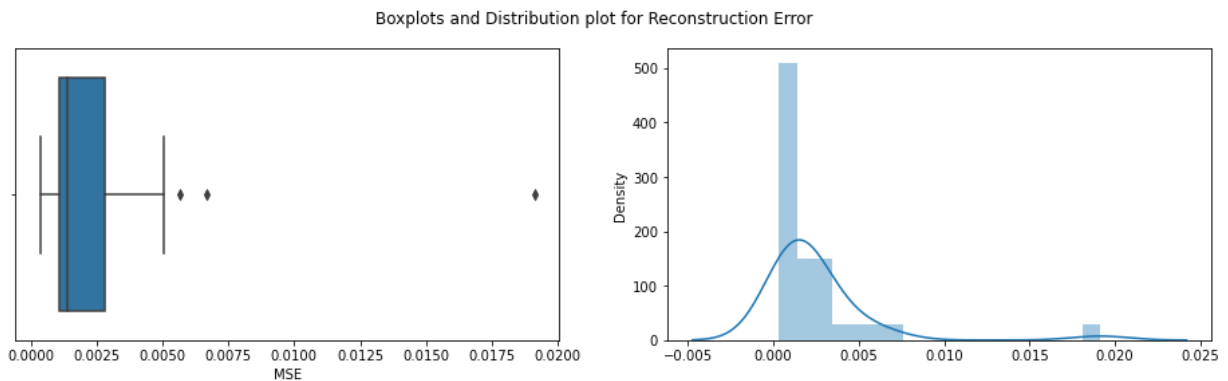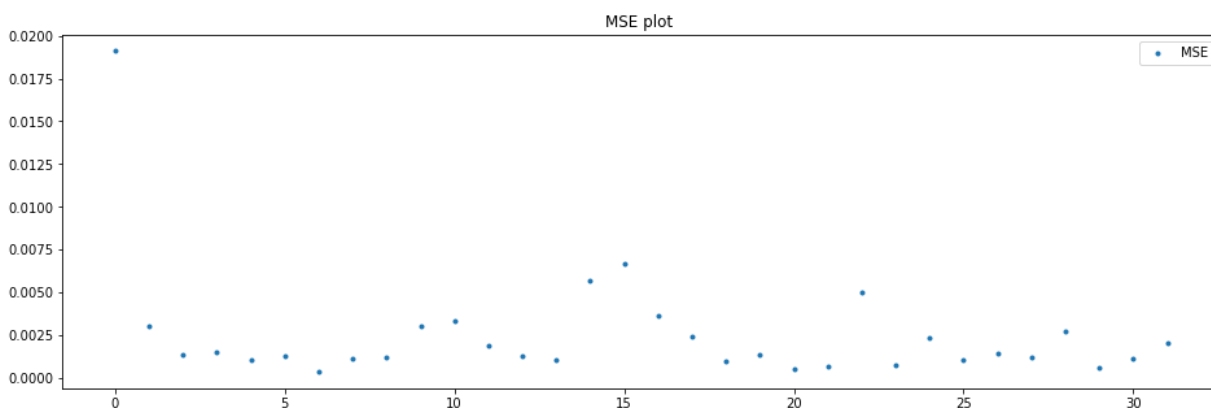
```
Anderson_Darling Test
Statistic: 4.510
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 66
mean=0.0017428125,median=0.00107 ,max=0.01105,min=0.00044,variance=3.8994e-06
```
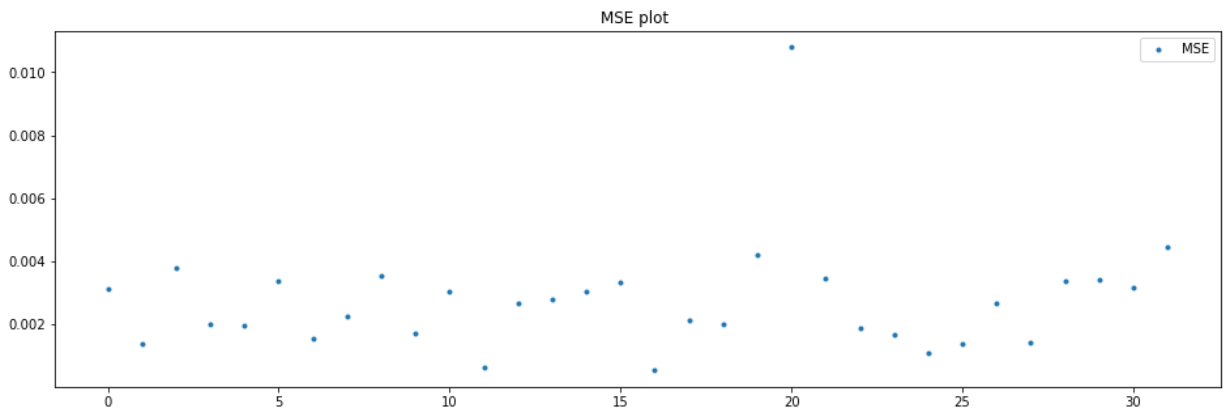
Boxplots and Distribution plot for Reconstruction Error



MSE plot
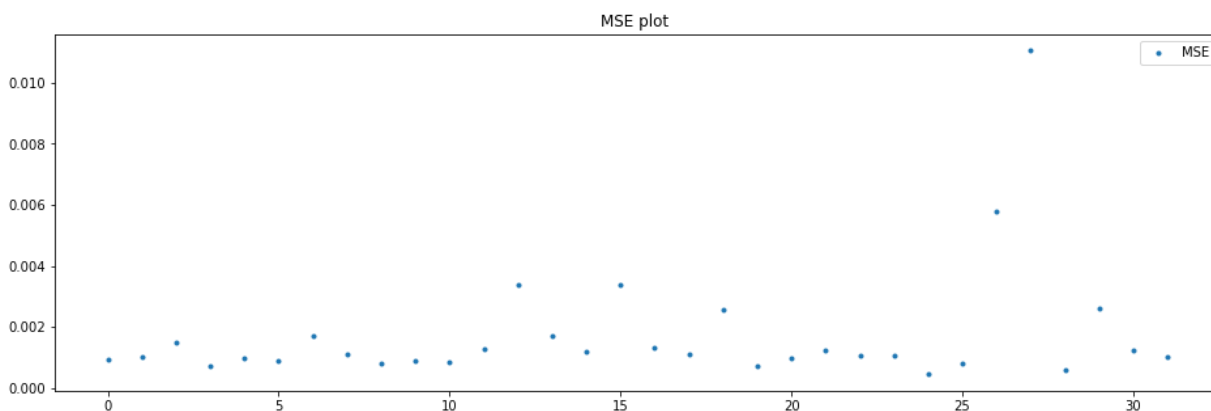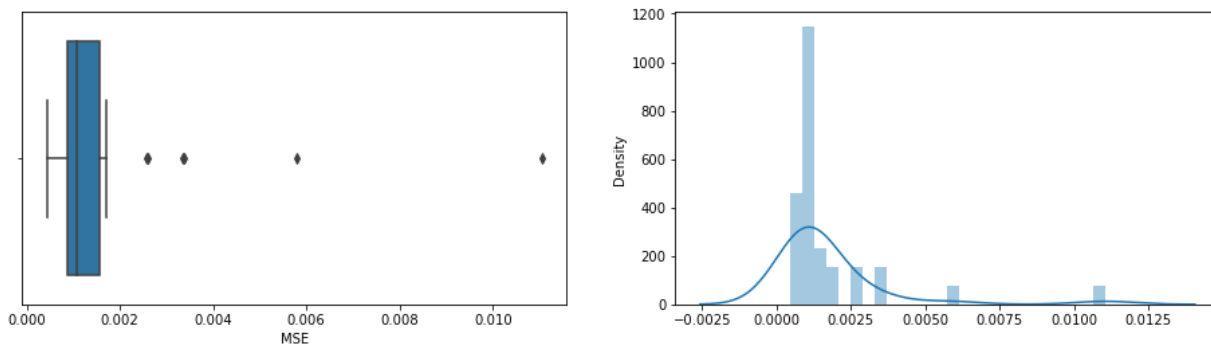


```
Anderson_Darling Test
Statistic: 5.169
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 67
mean=0.001675,median=0.001065 ,max=0.00655,min=0.00014,variance=2.4018e-06
```
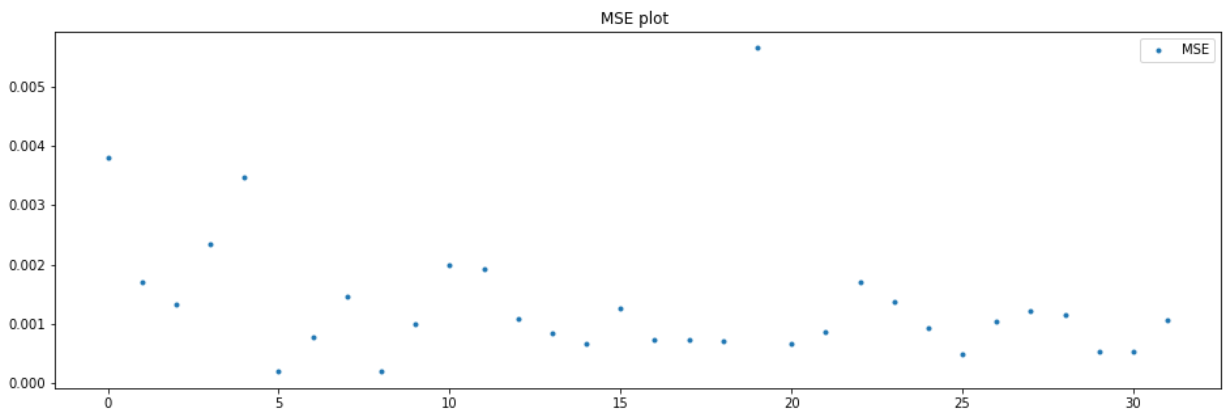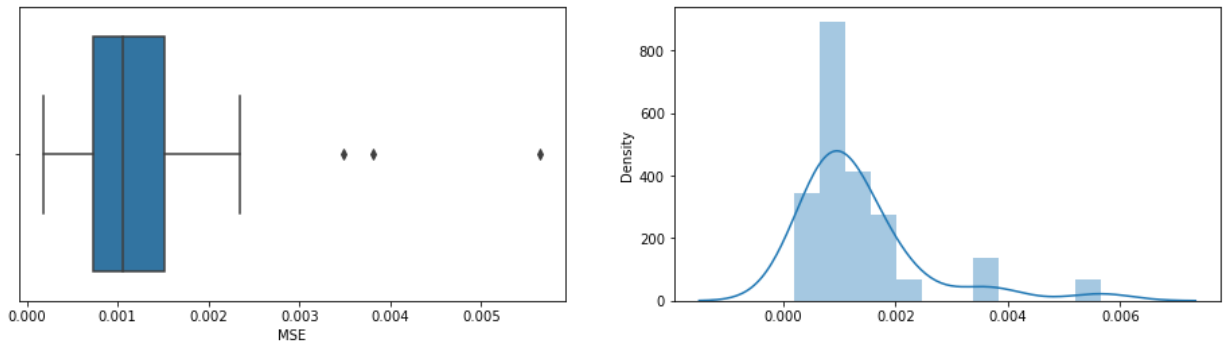
Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 2.426
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=0.0020646875,median=0.001725 ,max=0.00943,min=0.00059,variance=2.4289e-06
```
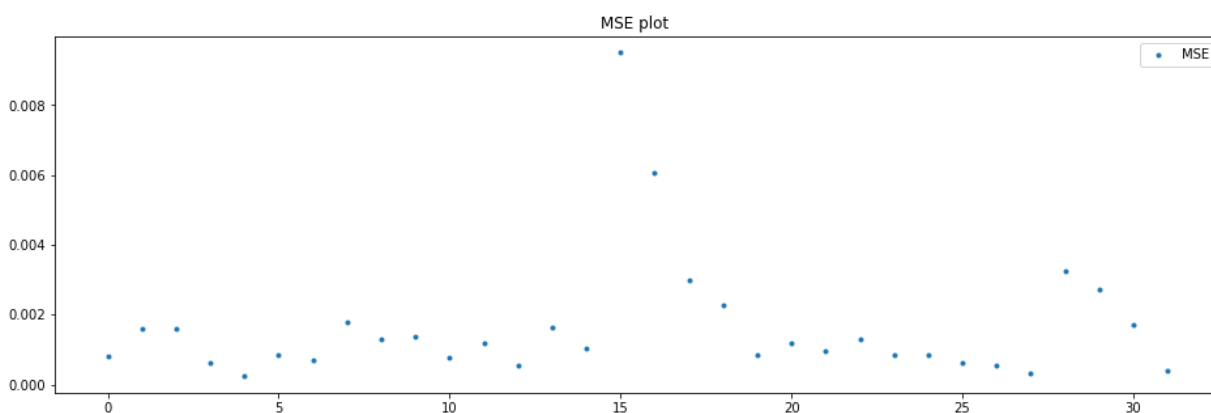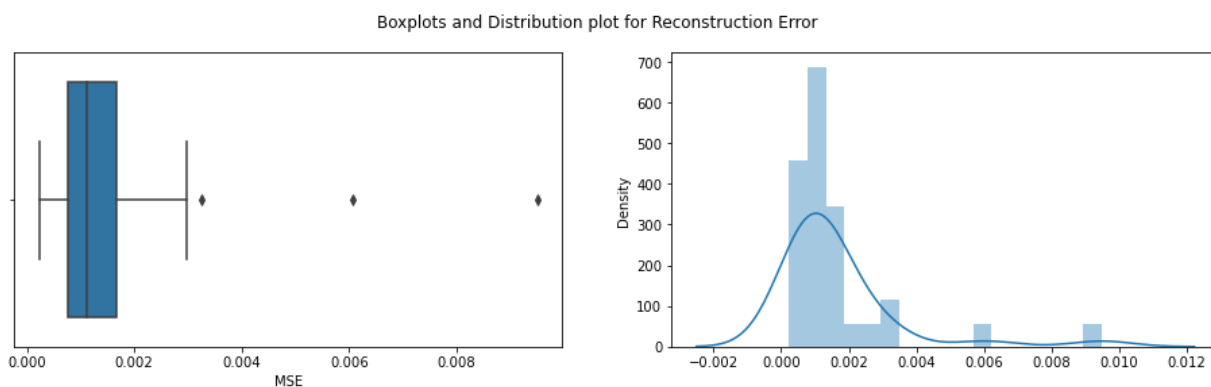
Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 2.384
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=0.0031353125,median=0.002325 ,max=0.01801,min=0.00054,variance=1.0349e-05



Boxplots and Distribution plot for Reconstruction Error



MSE plot
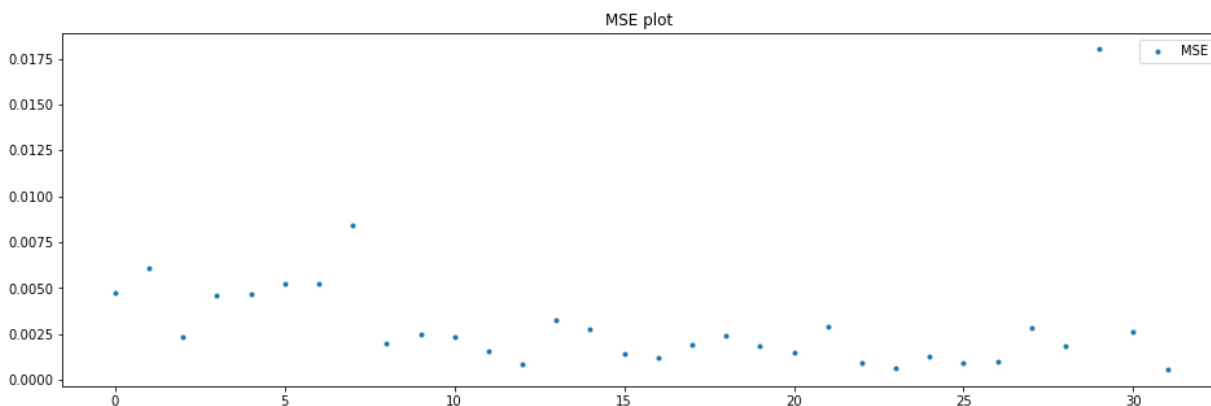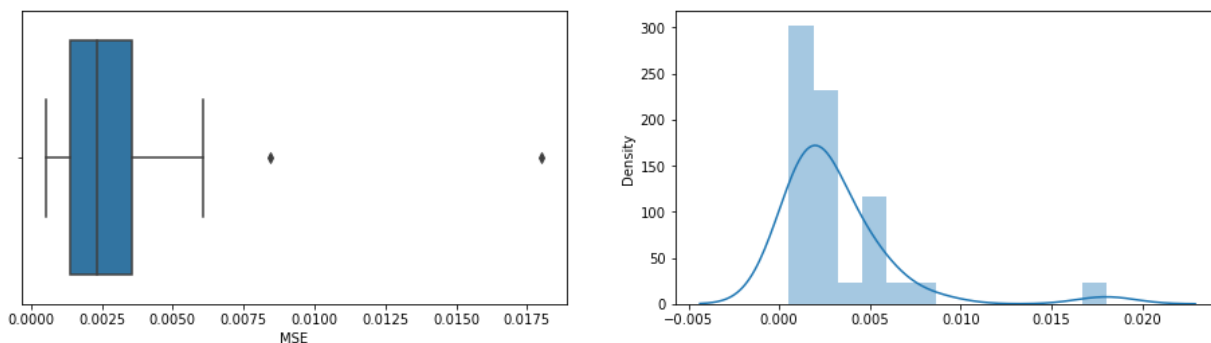
Anderson_Darling Test
Statistic: 3.037
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 70
mean=0.0020728125,median=0.00146 ,max=0.00754,min=0.0004,variance=3.3625e-06

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 2.366
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: 71
mean=0.0018375,median=0.00116 ,max=0.01275,min=0.00021,variance=5.4057e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

Anderson_Darling Test
Statistic: 4.137
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: 72
mean=0.006376875,median=0.00201 ,max=0.03898,min=0.00023,variance=8.33124e-05



Boxplots and Distribution plot for Reconstruction Error



MSE plot

Anderson_Darling Test
Statistic: 3.628
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=0.004996,median=0.0013 ,max=0.01966,min=0.00057,variance=5.40228e-05

Boxplots and Distribution plot for Reconstruction Error



MSE plot
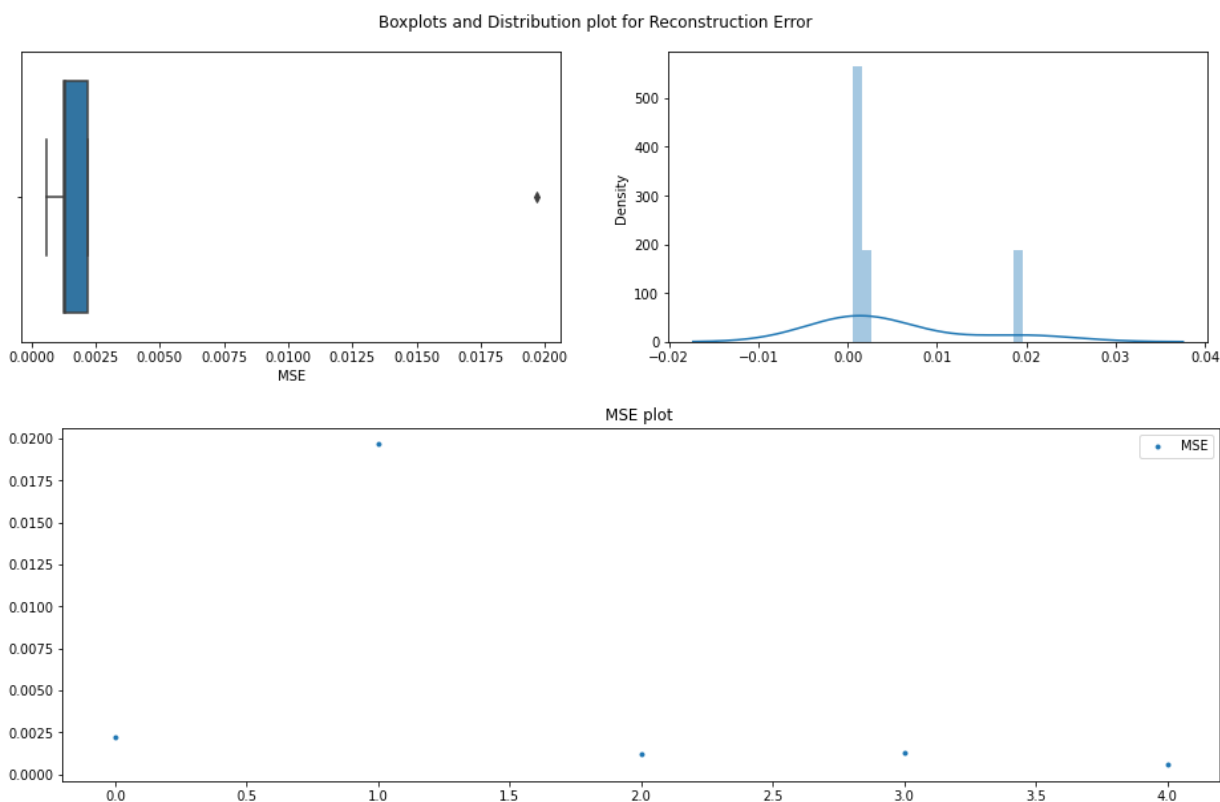


```
Anderson_Darling Test
Statistic: 1.019
15.000: 0.720, data does not look normal (reject H0)
10.000: 0.820, data does not look normal (reject H0)
5.000: 0.984, data does not look normal (reject H0)
2.500: 1.148, data looks normal (fail to reject H0)
1.000: 1.365, data looks normal (fail to reject 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]: 0.009

## Batch Threshold Computation

In [35]:
```python
## computes loss threshold uisng IQR as well as ZScore from batch average recon. err
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]: 0.0063

## 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]:
```python
plot_results(exceed_list_neg_en_neg)
```

mean=1.1351351351,median=1.0 ,max=9,min=0,variance=3.4952520088

Boxplots and Distribution plot for Reconstruction Error
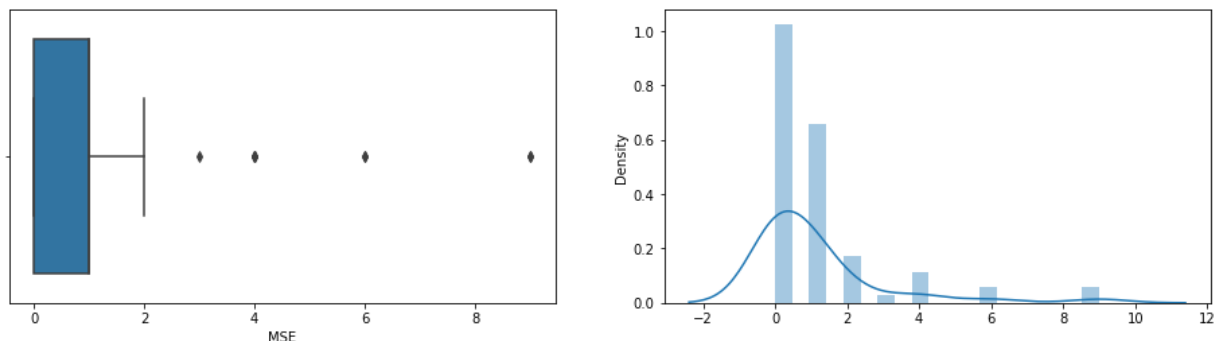


MSE plot
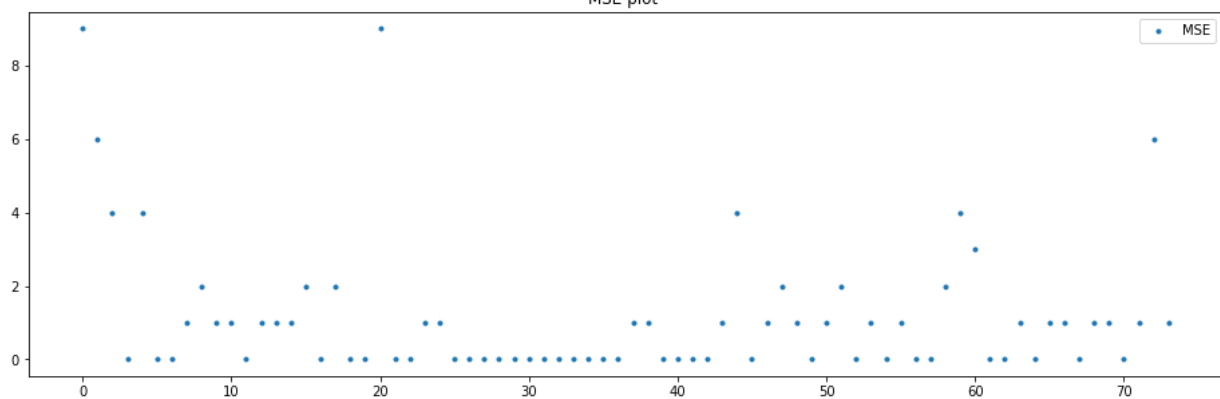


## Count Threshold is ataken as median value

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

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

Out[43]: 1.0

# 5. B) Positive Class Data

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

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

Out[45]:

| | attribute1 | attribute2 | attribute3 | attribute4 | attribute5 | attribute6 | attribute7 | attribute8 |
|---|---|---|---|---|---|---|---|---|

| | 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 |
| **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]:
```
plot_results(predictions_pos)
```

mean=0.0063364206,median=0.005 ,max=0.038,min=0.000122,variance=2.55451e-05



Boxplots and Distribution plot for Reconstruction Error
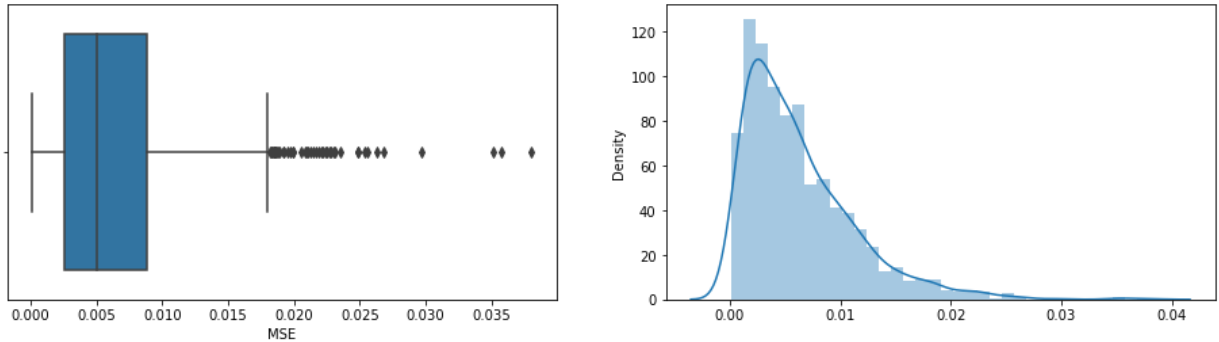


MSE plot
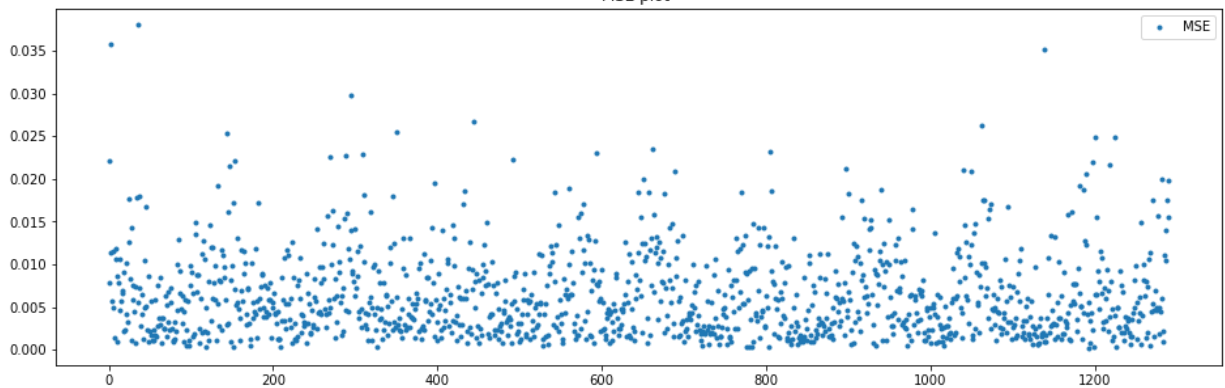
In [47]:
```
batches_pos=make_batches(test_pos_class)
```

In [48]:

```
batch_avg_mse_pos,batch_mse_values_pos=check_all_batch_normality(batches_pos,encoder_
```

```
********************
Batch: 0
mean=0.00870625,median=0.00767 ,max=0.0357,min=0.00091,variance=4.55617e-05
```



Boxplots and Distribution plot for Reconstruction Error
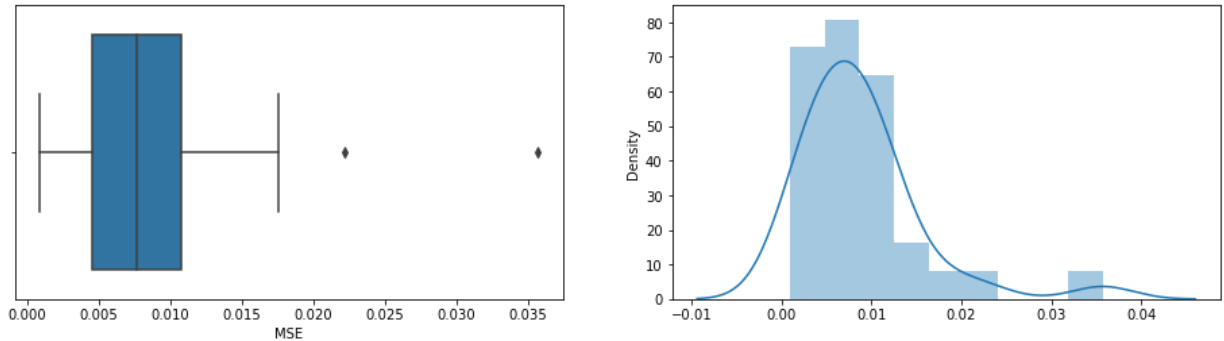


MSE plot

```
Anderson_Darling Test
Statistic: 1.411
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=0.006486875,median=0.00452 ,max=0.038,min=0.00081,variance=5.35874e-05
```



Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 2.913
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: 2
mean=0.0042178125,median=0.003475 ,max=0.01296,min=0.00052,variance=8.3562e-06
```
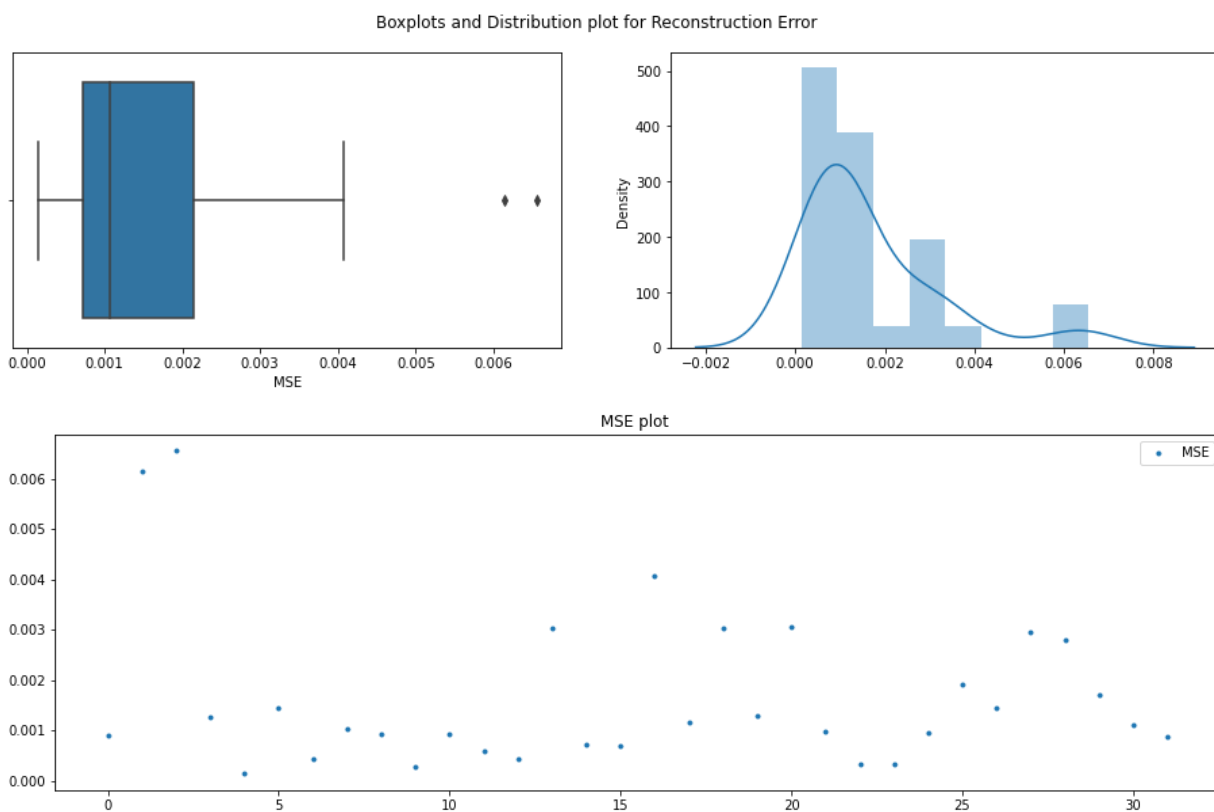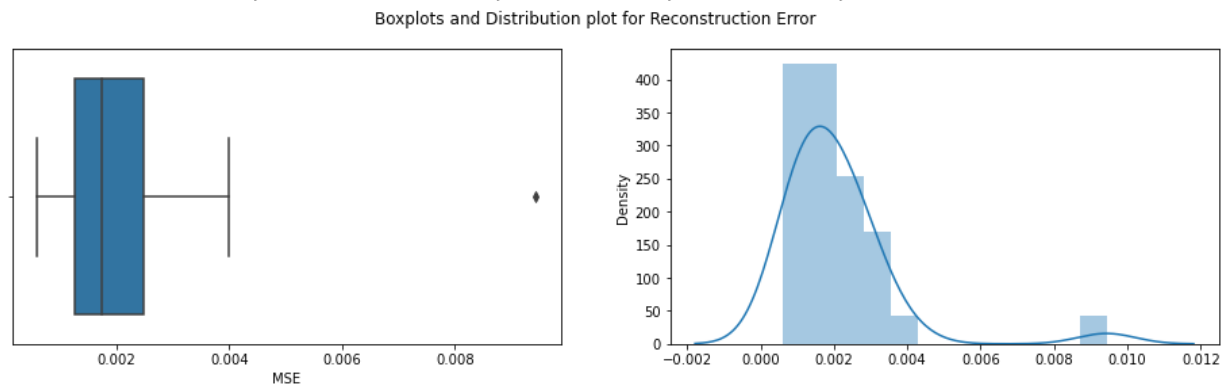


Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 0.724
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: 3
mean=0.00652875,median=0.0063 ,max=0.01486,min=0.00027,variance=2.04896e-05
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 0.679
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: 4
mean=0.0088884375,median=0.0079 ,max=0.02536,min=0.0004,variance=4.11542e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 0.984
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: 5
mean=0.0063265625,median=0.00568 ,max=0.01715,min=0.00052,variance=1.33893e-05
```
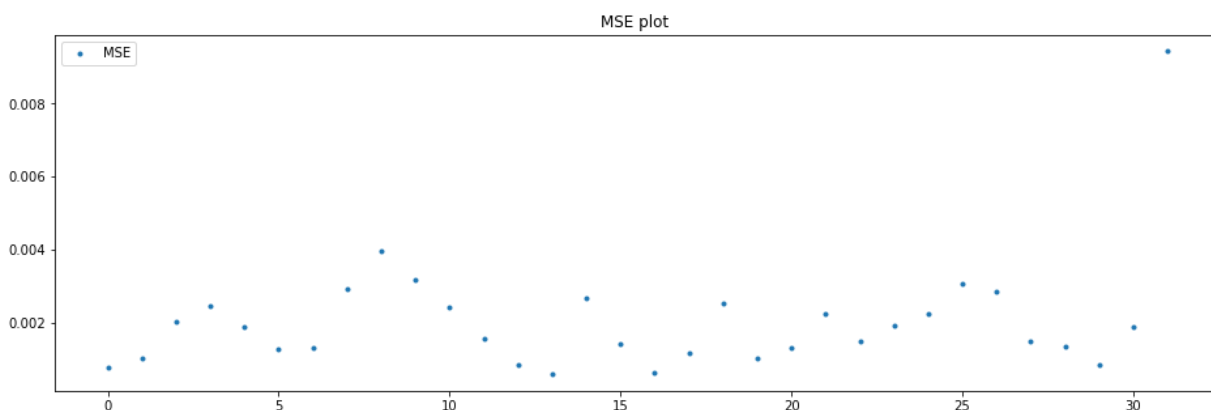


Boxplots and Distribution plot for Reconstruction Error



MSE plot

```
Anderson_Darling Test
Statistic: 0.380
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: 6
mean=0.0052159375,median=0.004725 ,max=0.01257,min=0.00035,variance=9.5708e-06
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 0.648
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: 7
mean=0.00462875,median=0.003615 ,max=0.0141,min=0.00081,variance=9.7437e-06
```
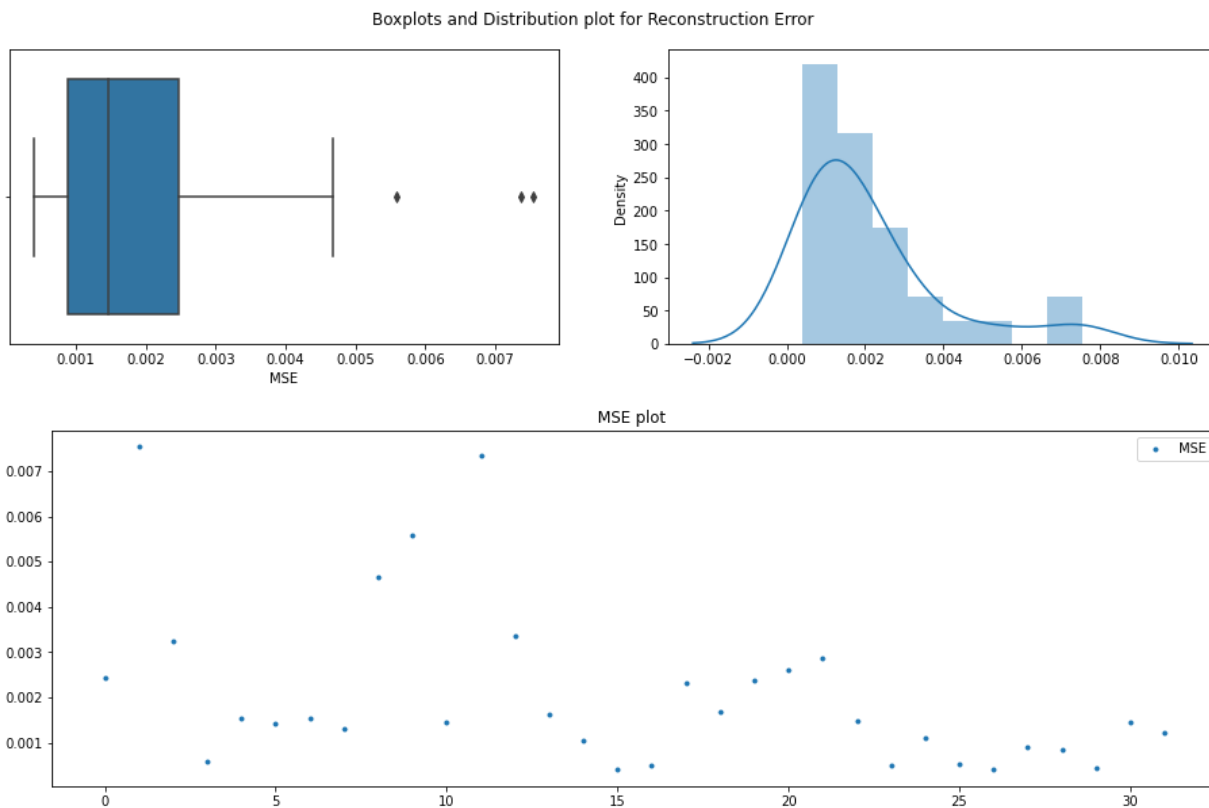
Boxplots and Distribution plot for Reconstruction Error

Anderson_Darling Test
Statistic: 0.880
15.000: 0.523, data does not look normal (reject H0)
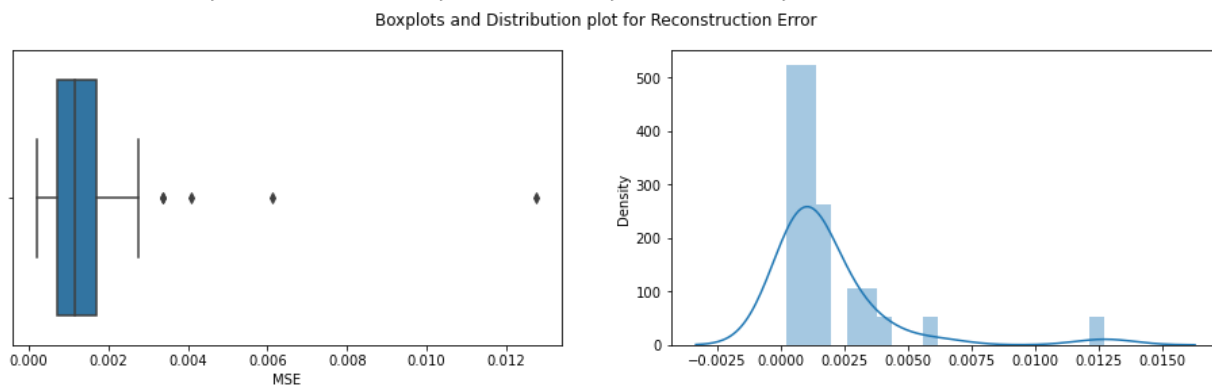10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
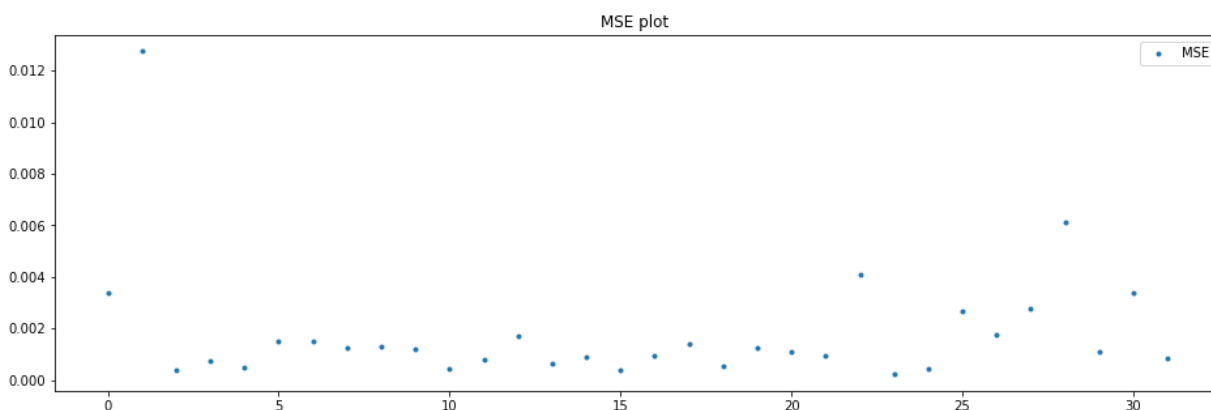2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

   ********************
Batch: 8
mean=0.0080521875,median=0.006765 ,max=0.0225,min=0.00136,variance=2.35244e-05

Boxplots and Distribution plot for Reconstruction Error





Anderson_Darling Test
Statistic: 0.695
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: 9
mean=0.009689375,median=0.00828 ,max=0.02972,min=0.00111,variance=4.43559e-05

Boxplots and Distribution plot for Reconstruction Error



MSE plot



```
Anderson_Darling Test
Statistic: 1.003
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=0.0063221875,median=0.00496 ,max=0.02555,min=0.00042,variance=2.67682e-05
```
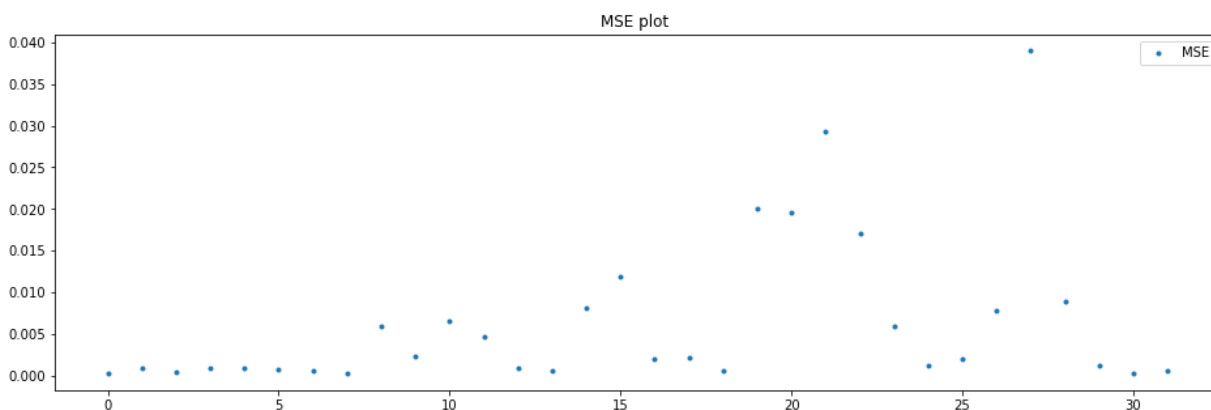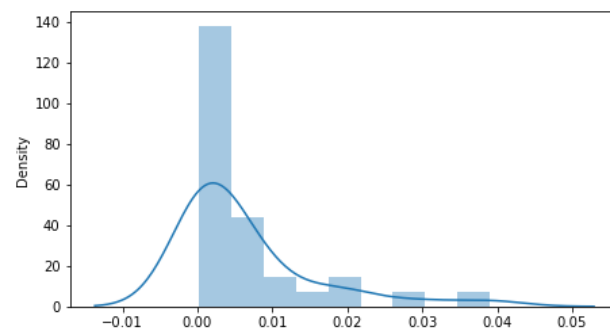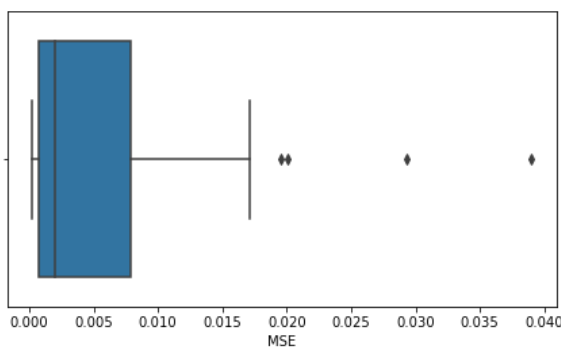
Boxplots and Distribution plot for Reconstruction Error

MSE plot

```
Anderson_Darling Test
Statistic: 1.512
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=0.0051084375,median=0.00381 ,max=0.01311,min=0.00131,variance=1.1365e-05
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot
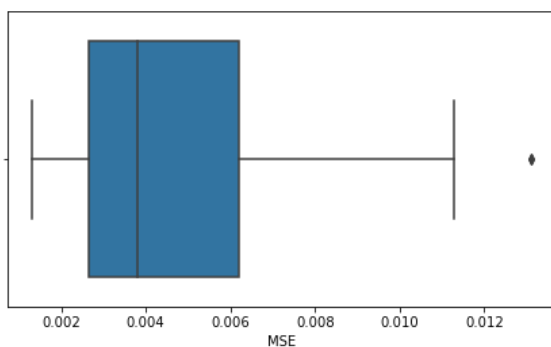


```
Anderson_Darling Test
Statistic: 1.625
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


  *******************
Batch: 12
mean=0.0063165625,median=0.005475 ,max=0.01948,min=0.00113,variance=1.68252e-05
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot
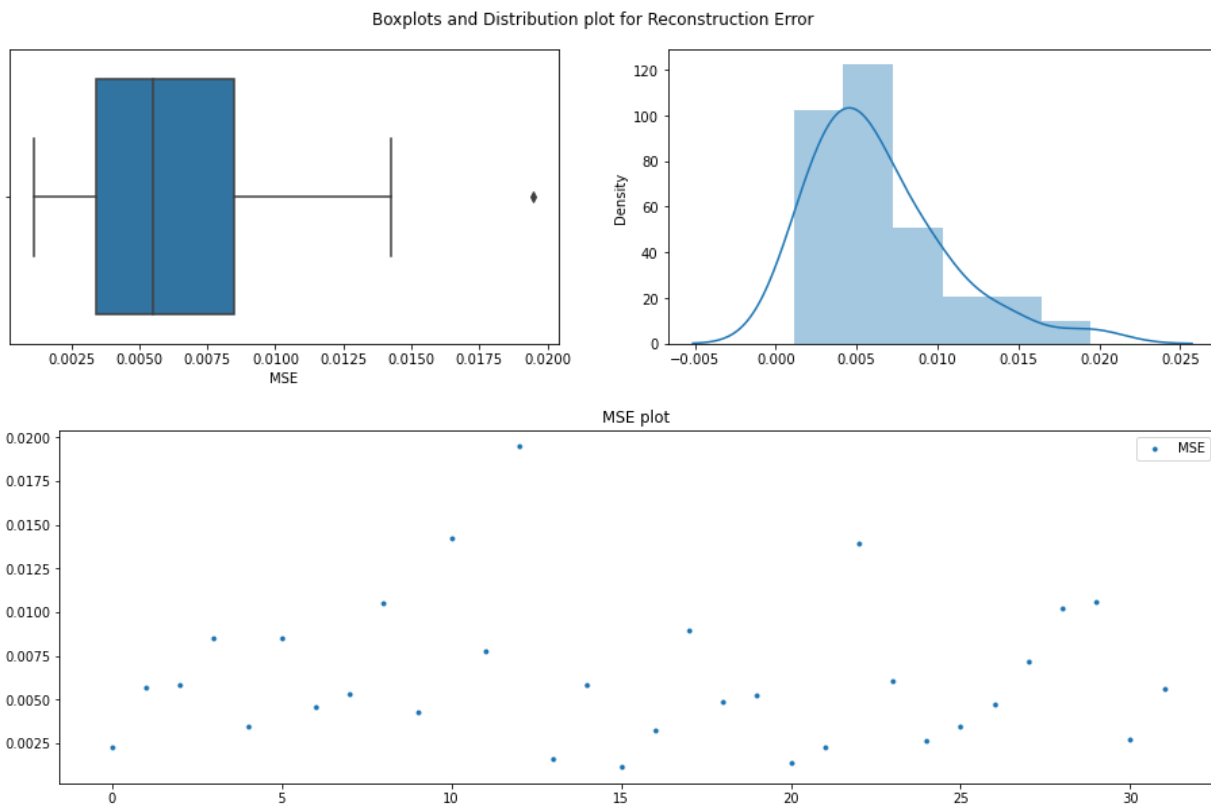


```
Anderson_Darling Test
Statistic: 0.954
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 13
mean=0.0073309375,median=0.00613 ,max=0.02678,min=0.00088,variance=3.27066e-05
```

Boxplots and Distribution plot for Reconstruction Error
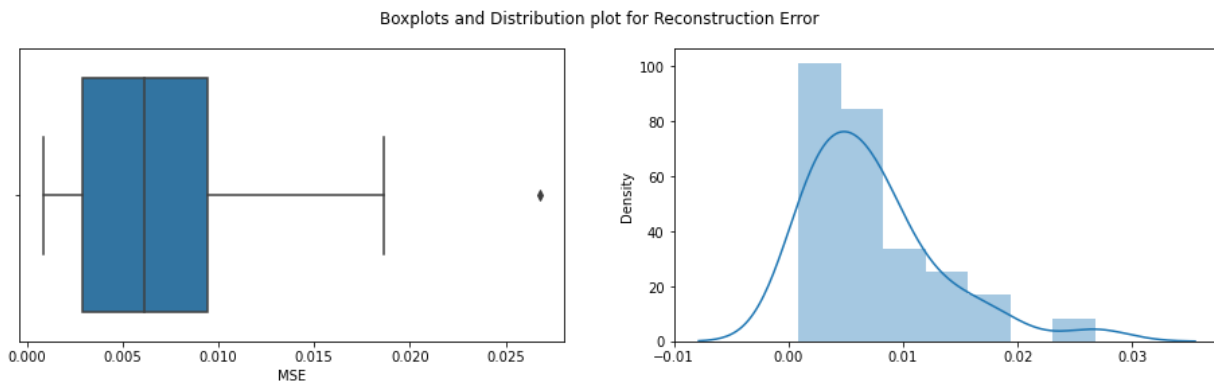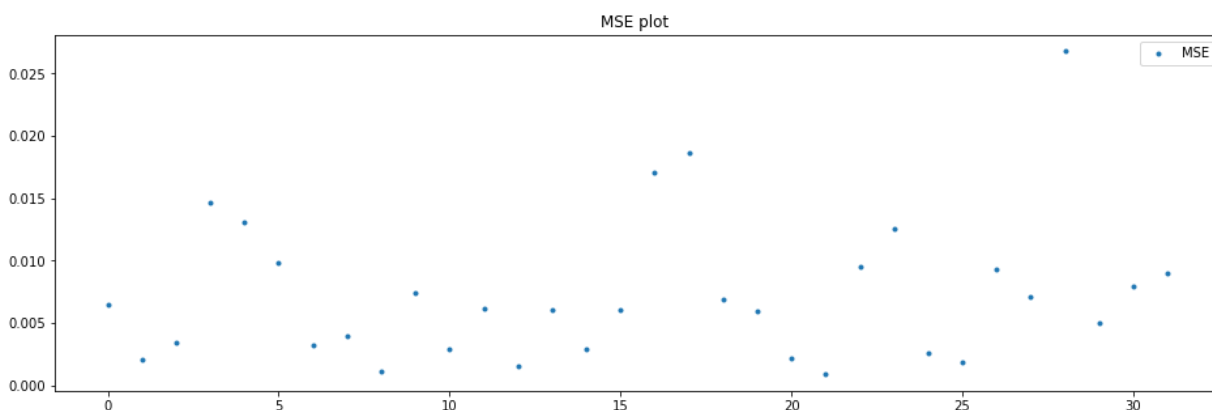
```
Anderson_Darling Test
Statistic: 1.221
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 14
mean=0.00509625,median=0.003995 ,max=0.01492,min=0.00075,variance=1.34046e-05
```
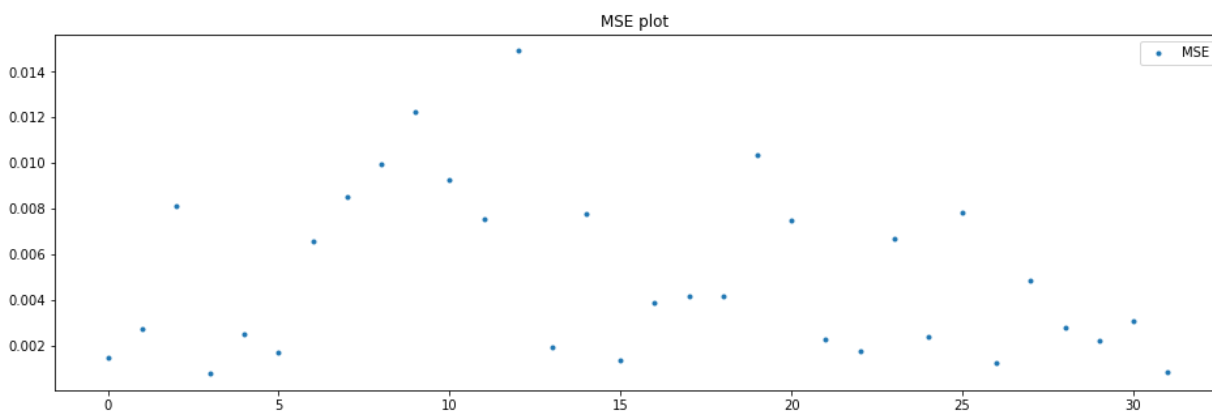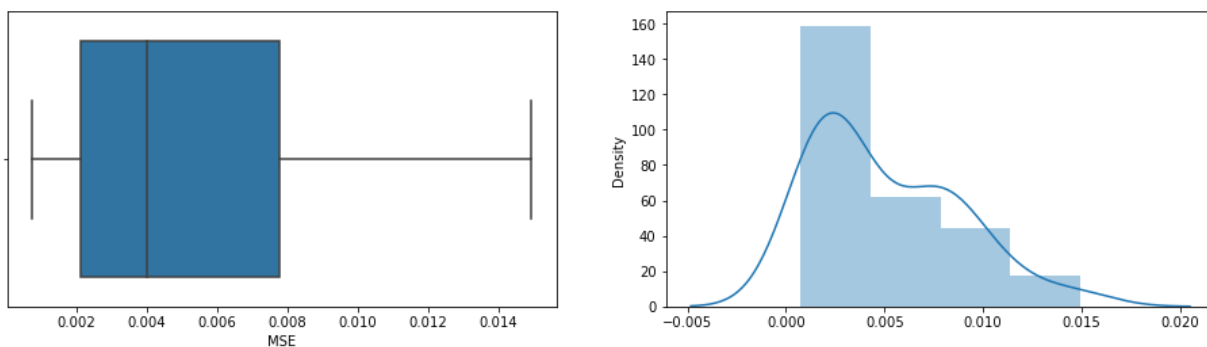




```
Anderson_Darling Test
Statistic: 1.125
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 15
mean=0.0048721875,median=0.0042 ,max=0.02234,min=0.00081,variance=1.50305e-05
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot
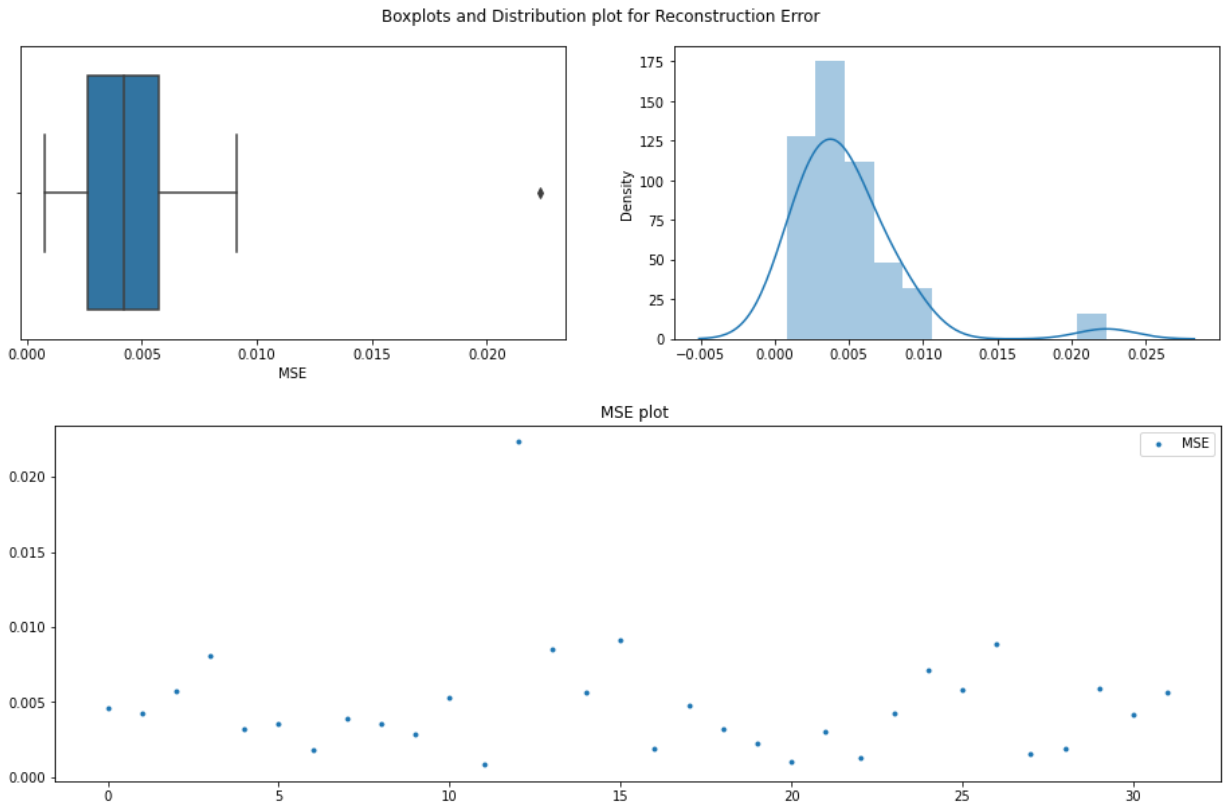


```
Anderson_Darling Test
Statistic: 1.849
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 16
mean=0.0058778125,median=0.00534 ,max=0.01847,min=0.00048,variance=1.7231e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
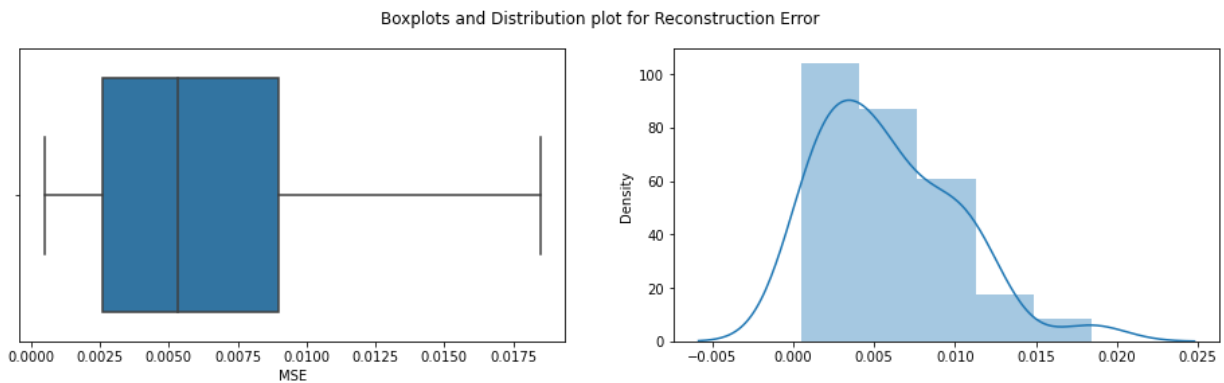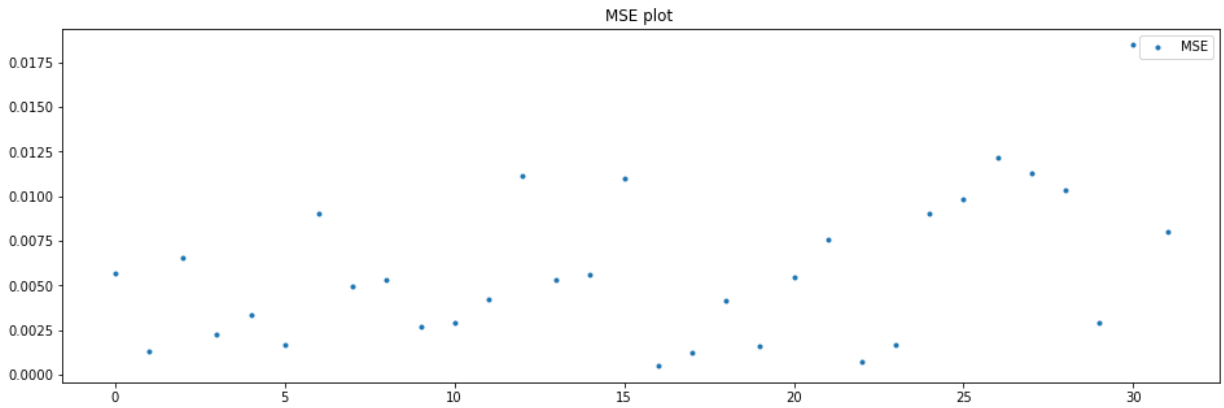
Anderson_Darling Test
Statistic: 0.682
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


   ********************
Batch: 17
mean=0.0066075,median=0.005965 ,max=0.01886,min=0.00079,variance=2.35789e-05



Boxplots and Distribution plot for Reconstruction Error



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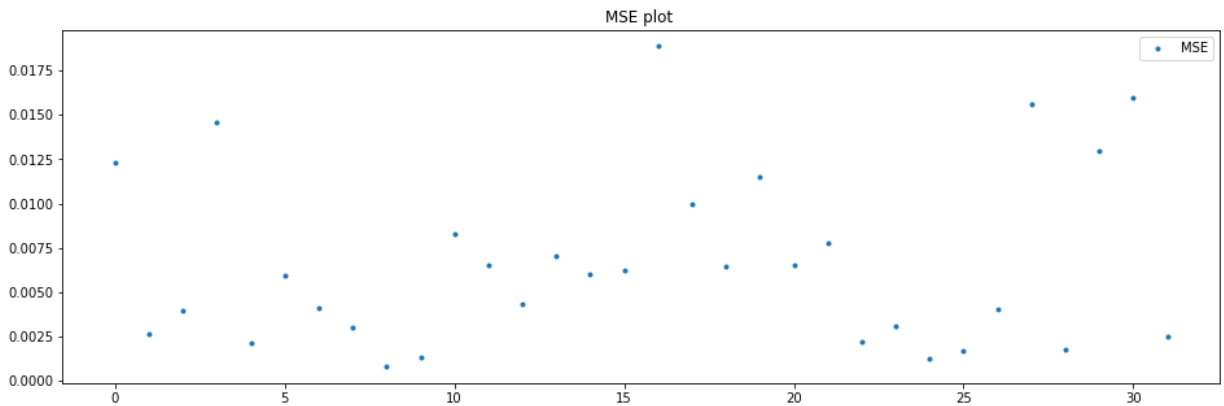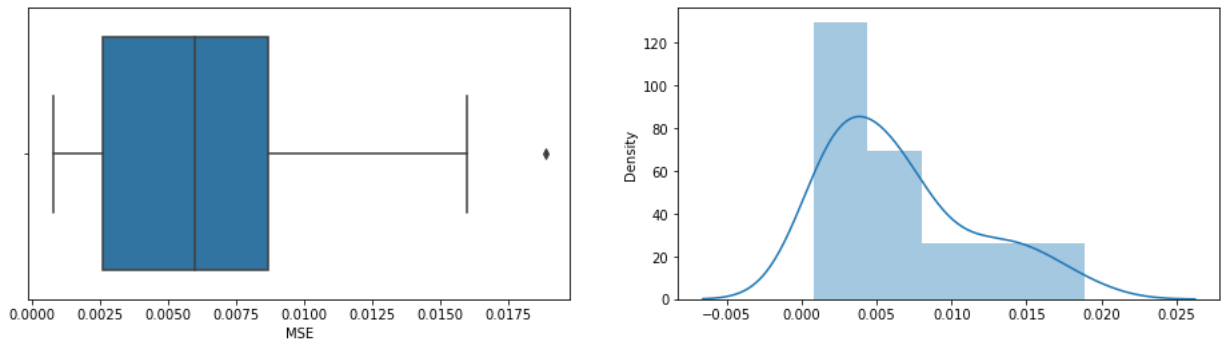
Anderson_Darling Test
Statistic: 1.173
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


   ********************
Batch: 18
mean=0.0070696875,median=0.00652 ,max=0.02305,min=0.00075,variance=2.58749e-05

Boxplots and Distribution plot for Reconstruction Error



MSE plot
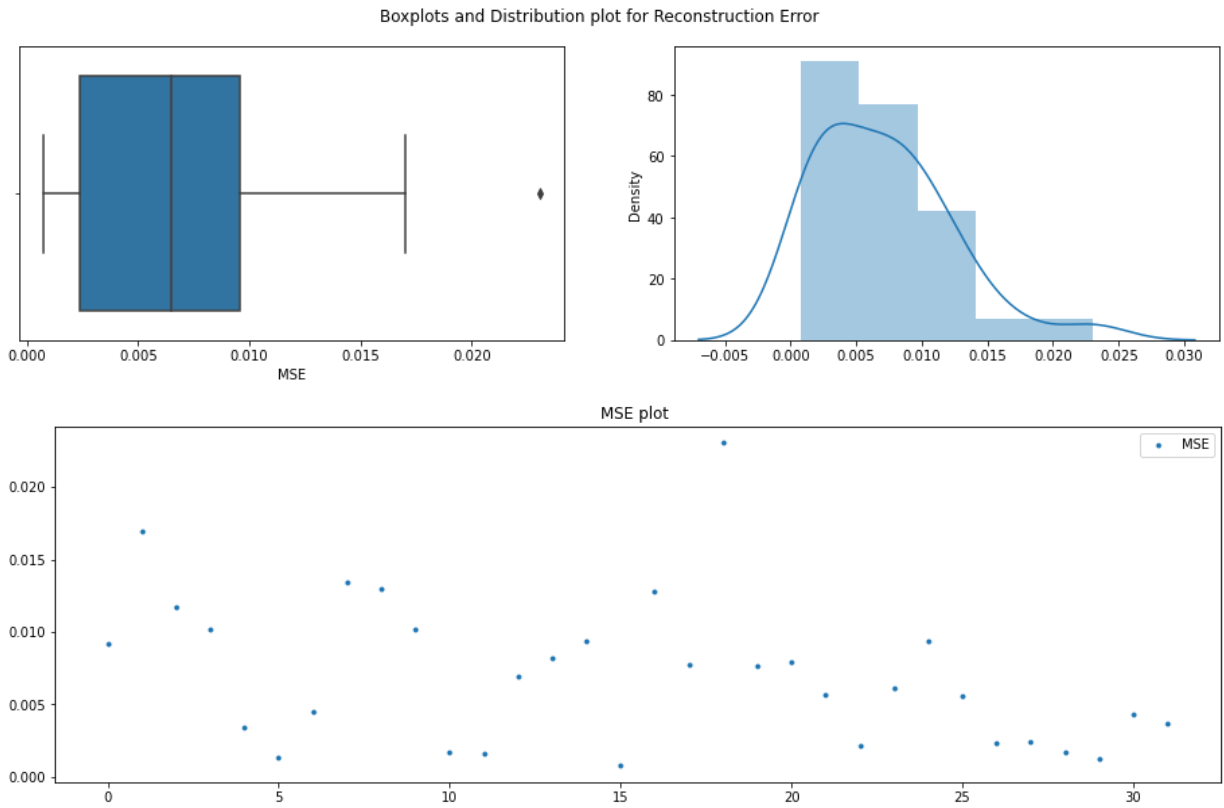


```
Anderson_Darling Test
Statistic: 0.647
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 19
mean=0.0046459375,median=0.00444 ,max=0.01266,min=0.00085,variance=9.1035e-06
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
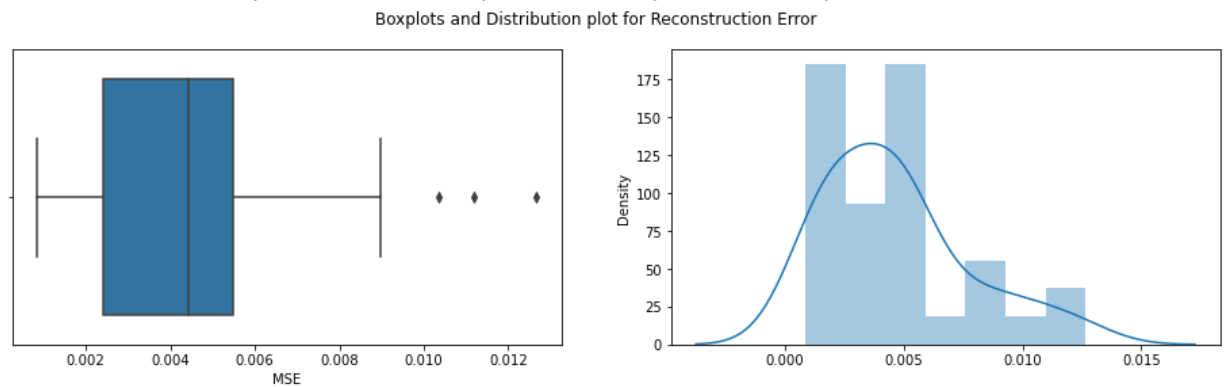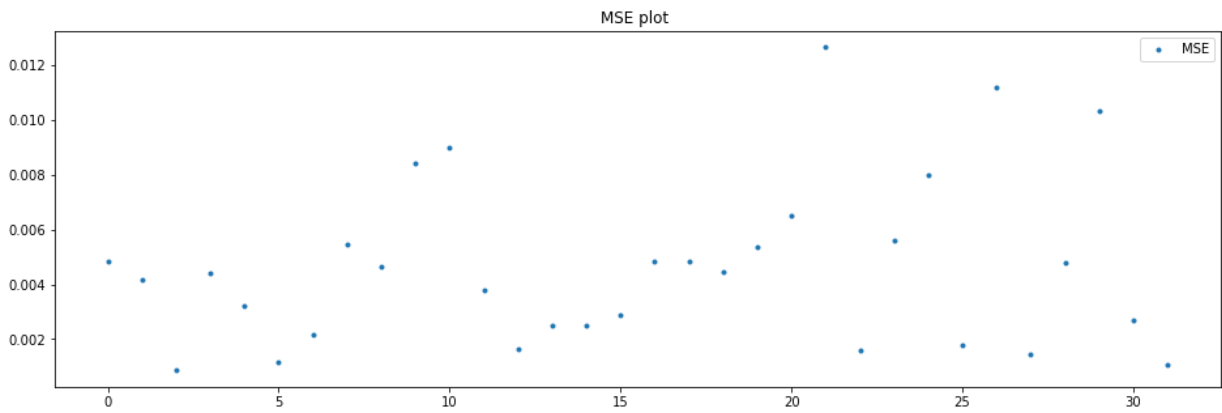
```
Anderson_Darling Test
Statistic: 0.964
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 20
mean=0.0102709375,median=0.01083 ,max=0.02352,min=0.00076,variance=2.98937e-05
```



Boxplots and Distribution plot for Reconstruction Error



MSE plot
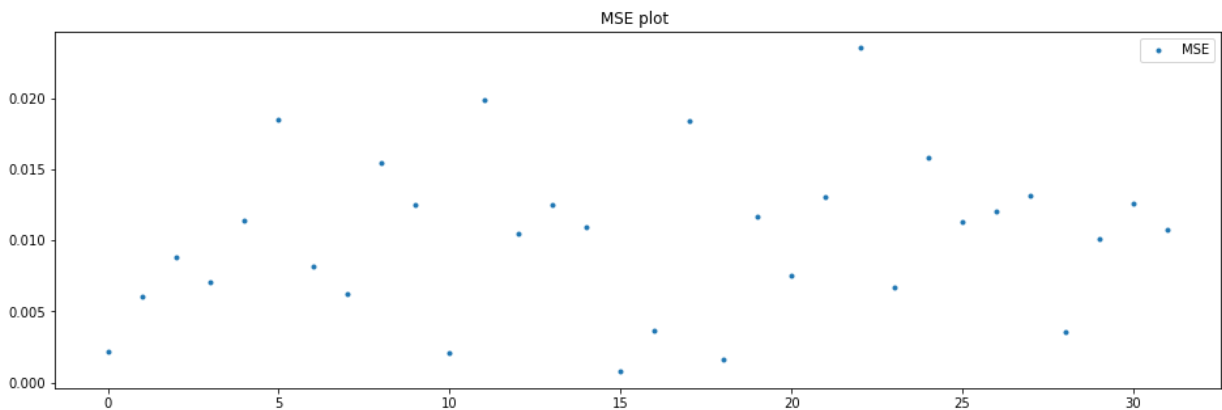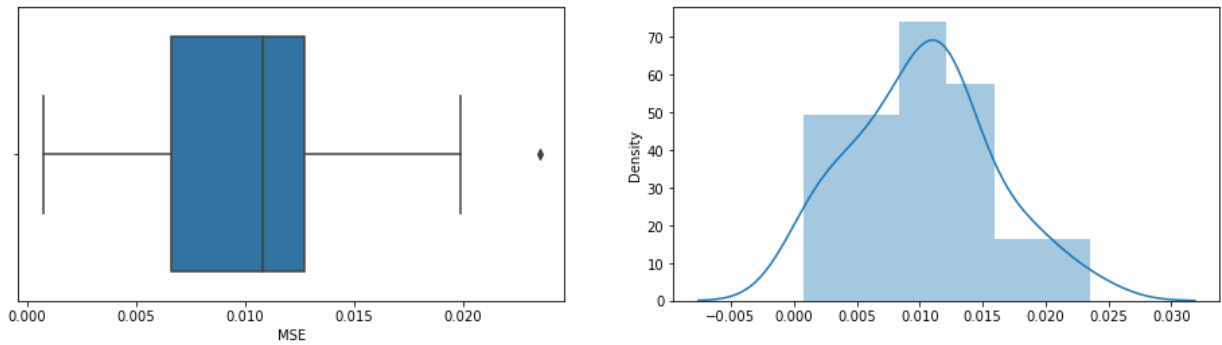
```
Anderson_Darling Test
Statistic: 0.307
15.000: 0.523, data looks normal (fail to reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 21
mean=0.007336875,median=0.00665 ,max=0.02091,min=0.00103,variance=2.55135e-05
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot
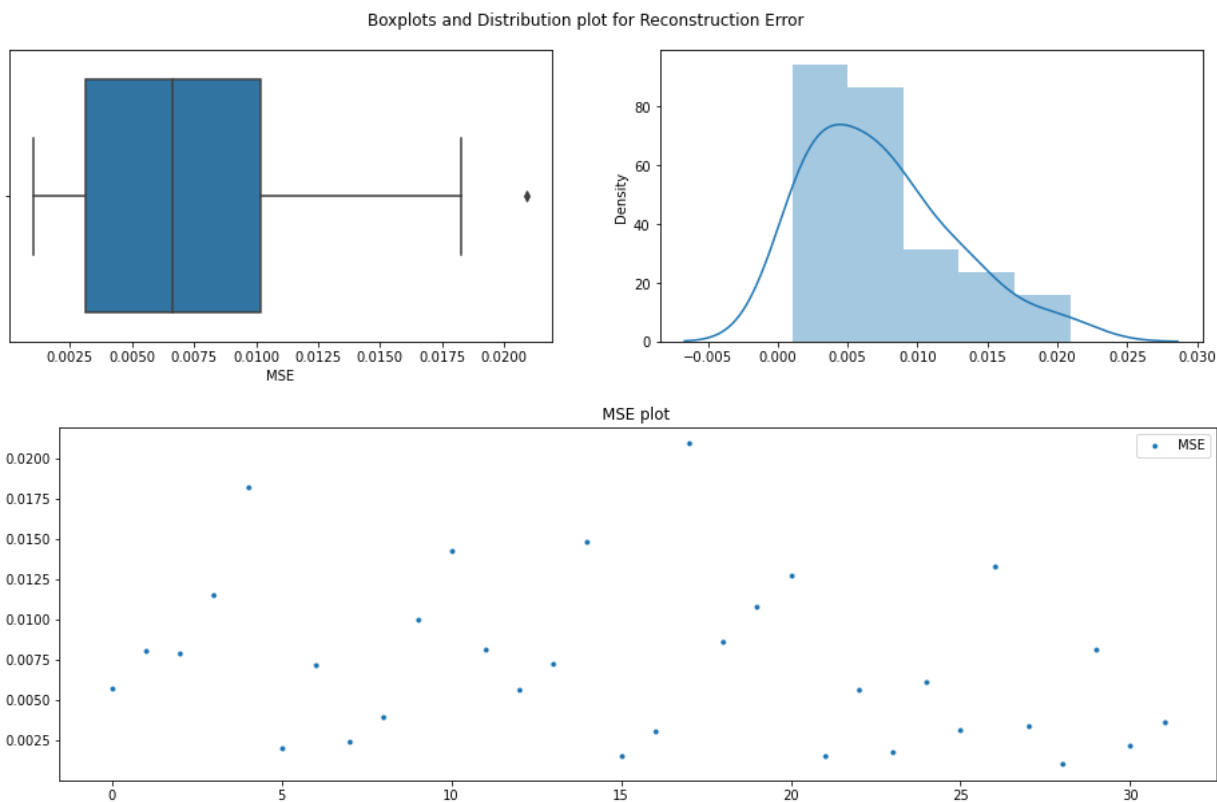


```
Anderson_Darling Test
Statistic: 0.737
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

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

Batch: 22
mean=0.0037621875,median=0.002765 ,max=0.01005,min=0.00048,variance=5.9855e-06
```
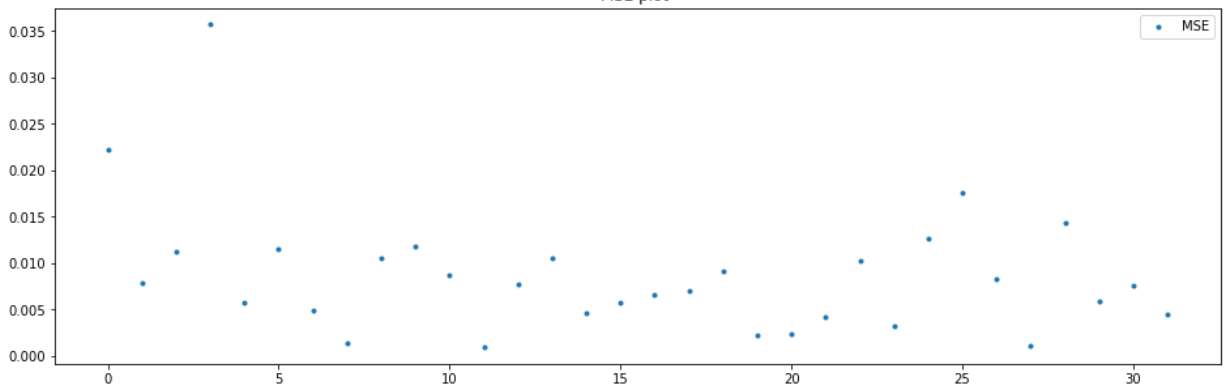
Boxplots and Distribution plot for Reconstruction Error

MSE plot
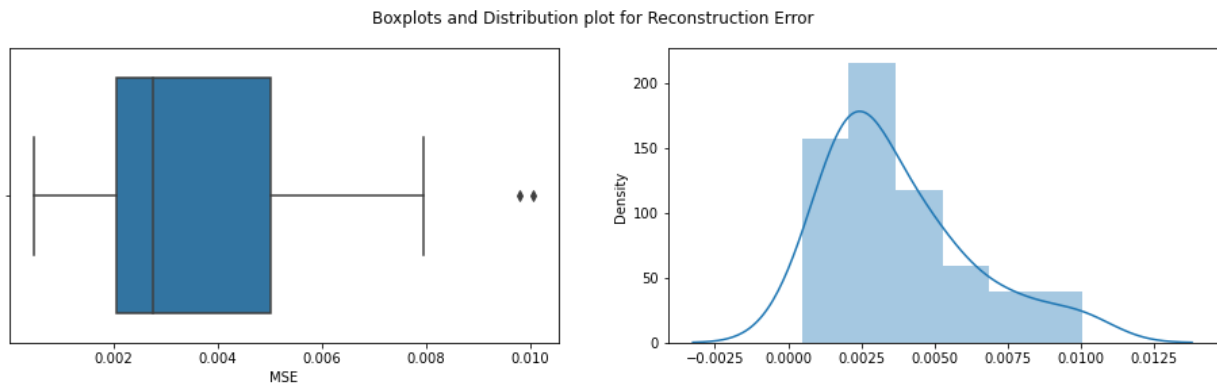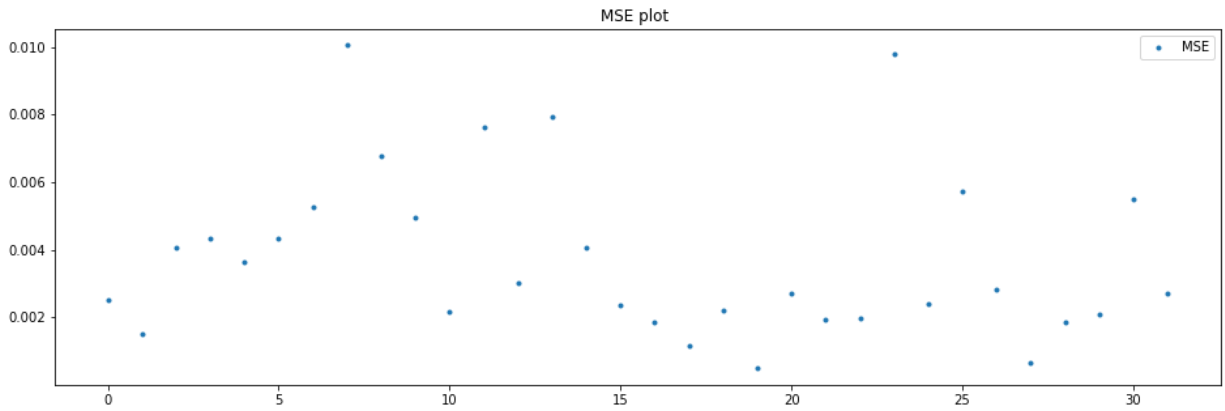
```
Anderson_Darling Test
Statistic: 1.237
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 23
mean=0.004763125,median=0.004065 ,max=0.013,min=0.00068,variance=1.1388e-05
```



Boxplots and Distribution plot for Reconstruction Error



MSE plot
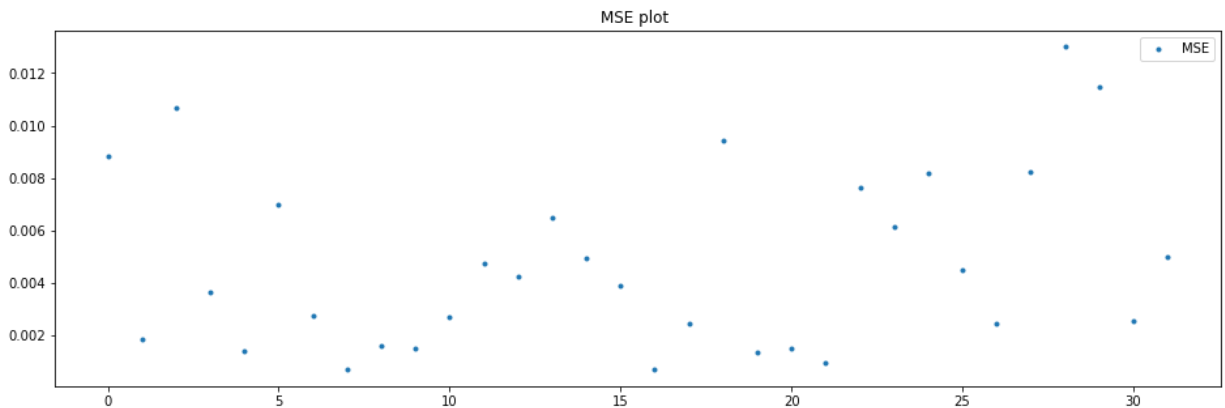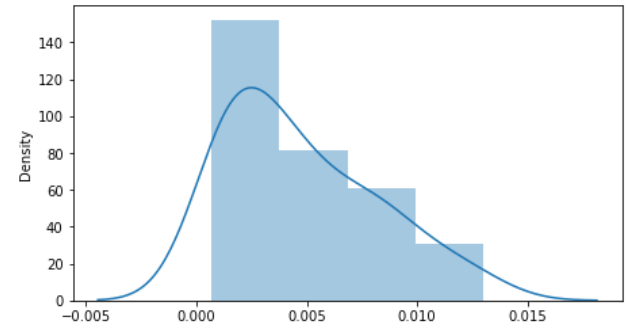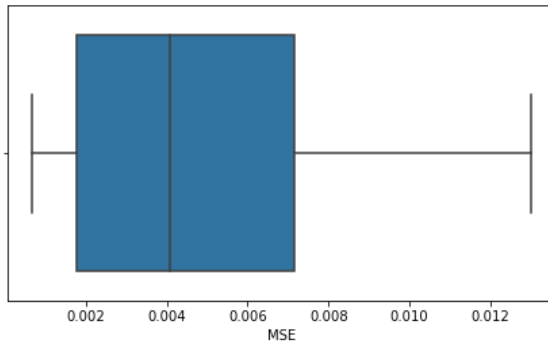
```
Anderson_Darling Test
Statistic: 0.892
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 ********************
Batch: 24
mean=0.0070515625,median=0.00563 ,max=0.01851,min=0.00032,variance=2.34248e-05
```
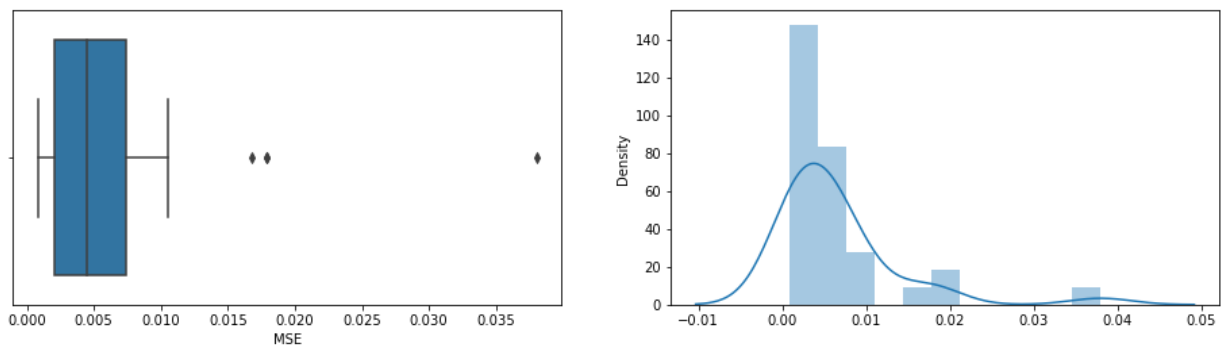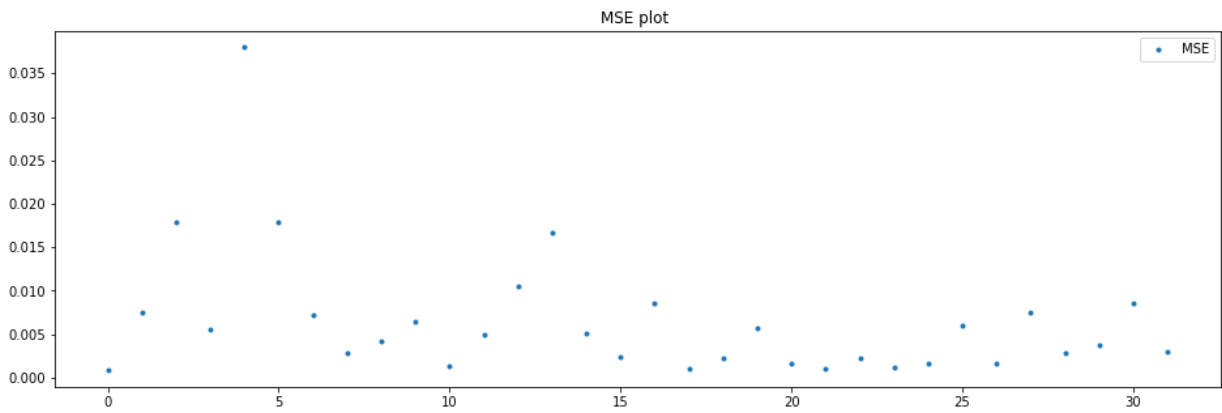
Boxplots and Distribution plot for Reconstruction Error



MSE plot
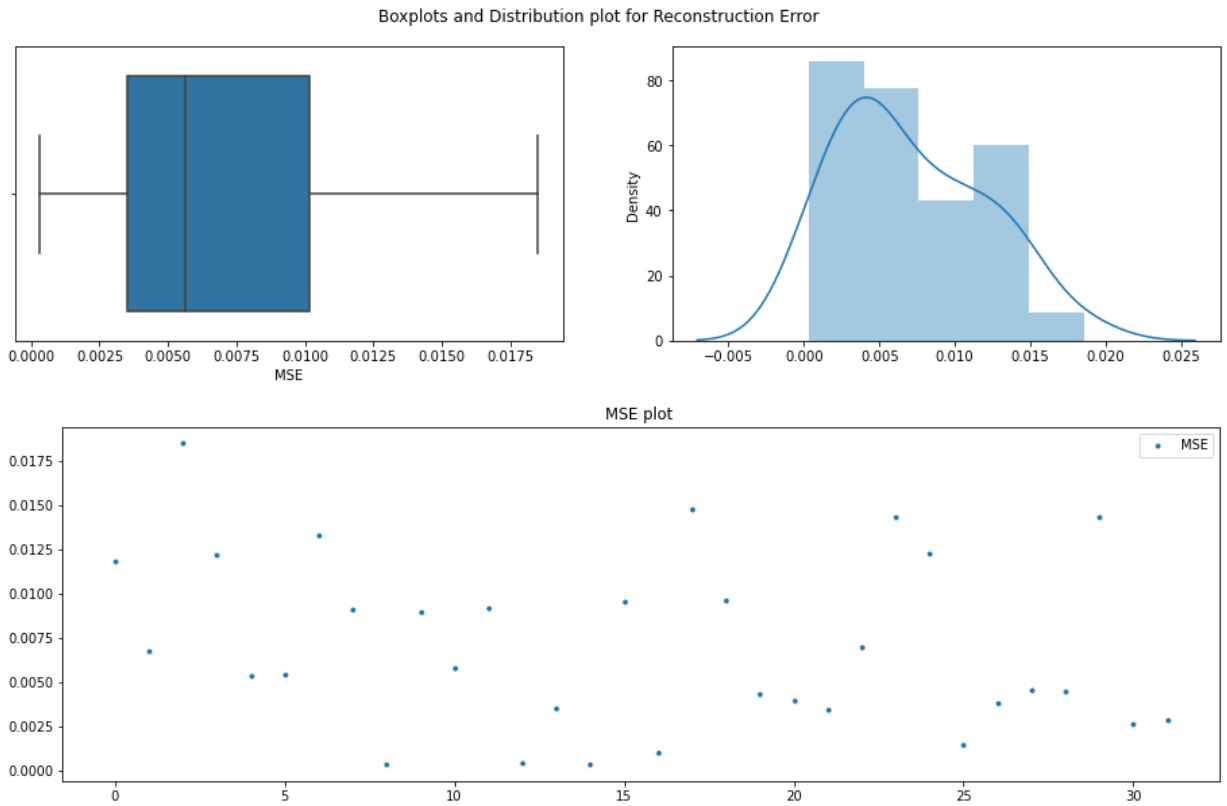


```
Anderson_Darling Test
Statistic: 0.610
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 *******************
Batch: 25
mean=0.0065153125,median=0.005985 ,max=0.02315,min=0.00031,variance=2.72532e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
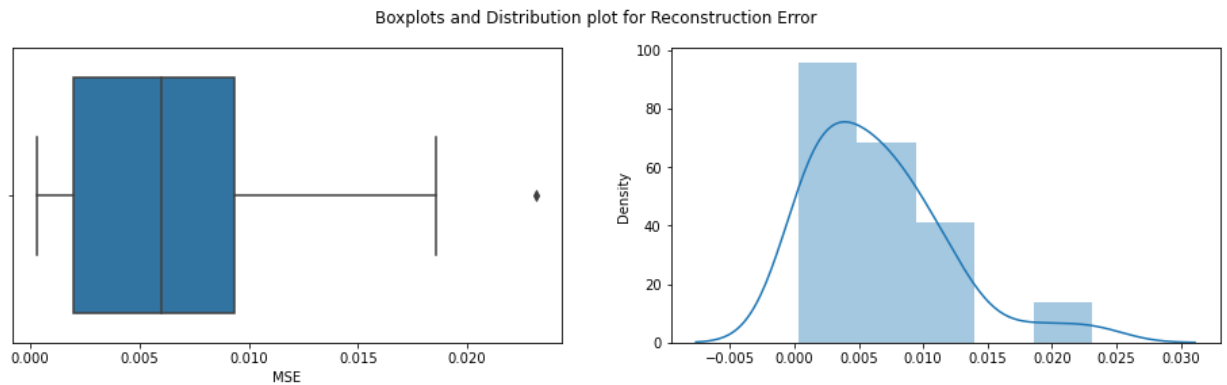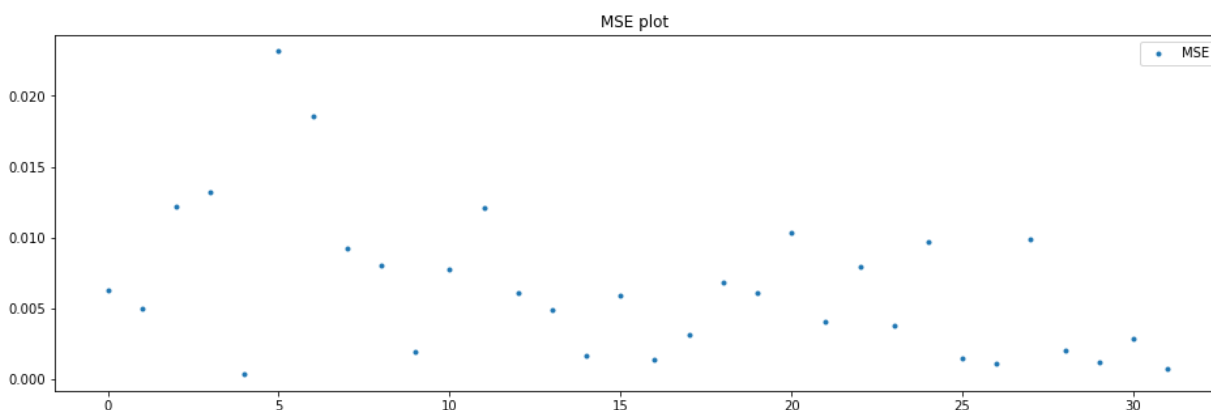
```
Anderson_Darling Test
Statistic: 0.866
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

 ********************
Batch: 26
mean=0.003675,median=0.00224 ,max=0.01305,min=0.00069,variance=1.06948e-05
```
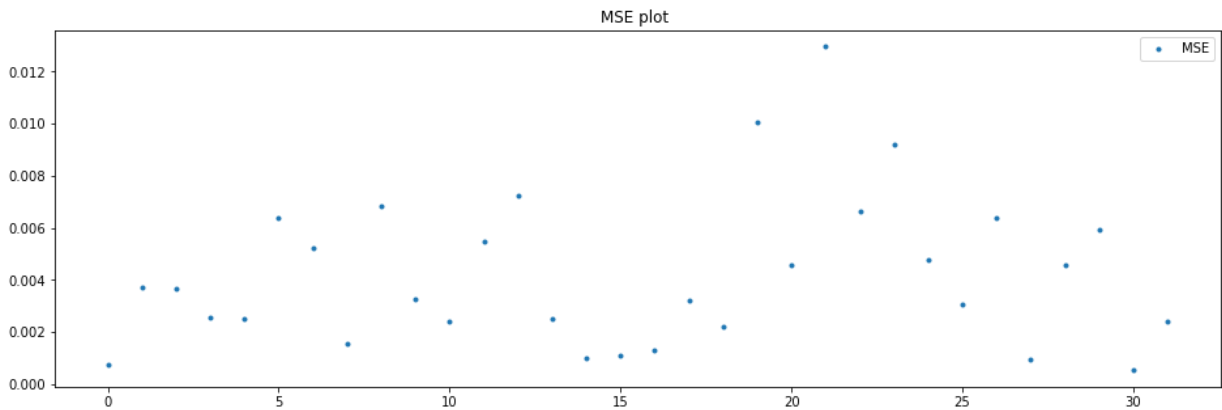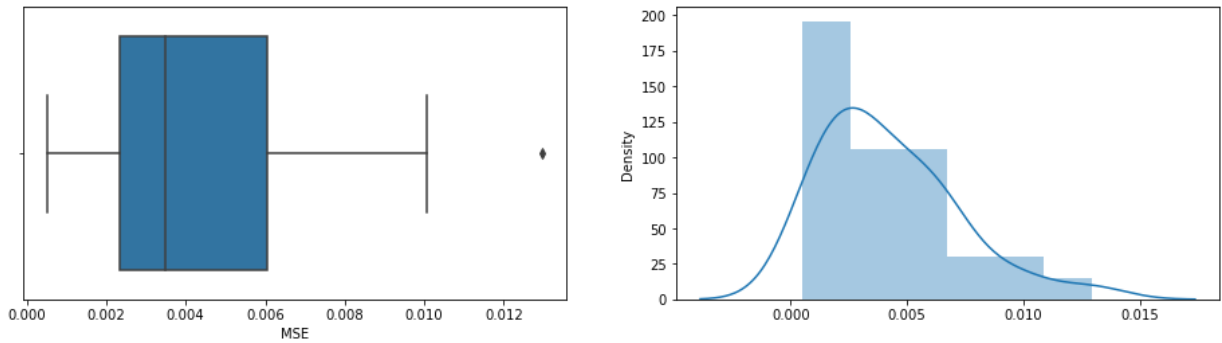


Boxplots and Distribution plot for Reconstruction Error



MSE plot
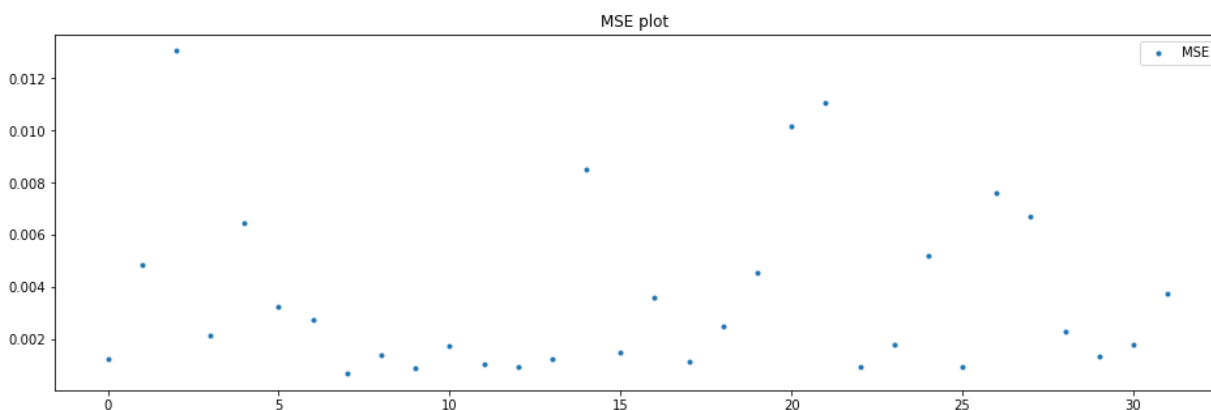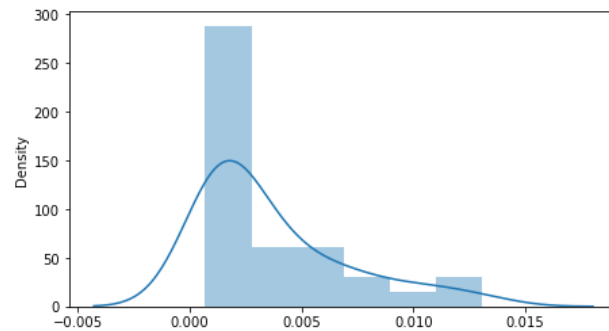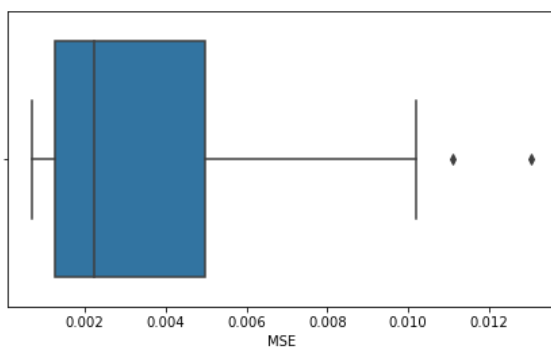
```
Anderson_Darling Test
Statistic: 2.245
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 ********************
Batch: 27
mean=0.005186875,median=0.00408 ,max=0.01552,min=0.0013,variance=1.10297e-05
```
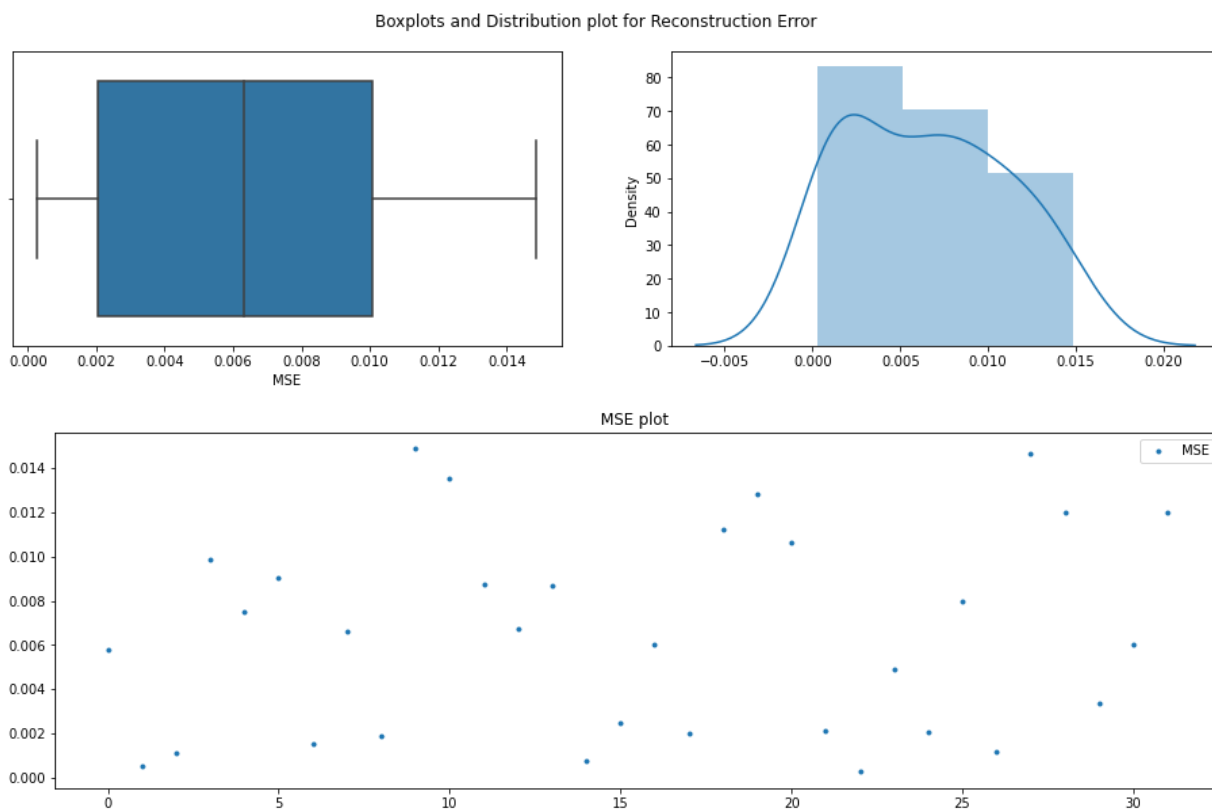
Boxplots and Distribution plot for Reconstruction Error



MSE plot
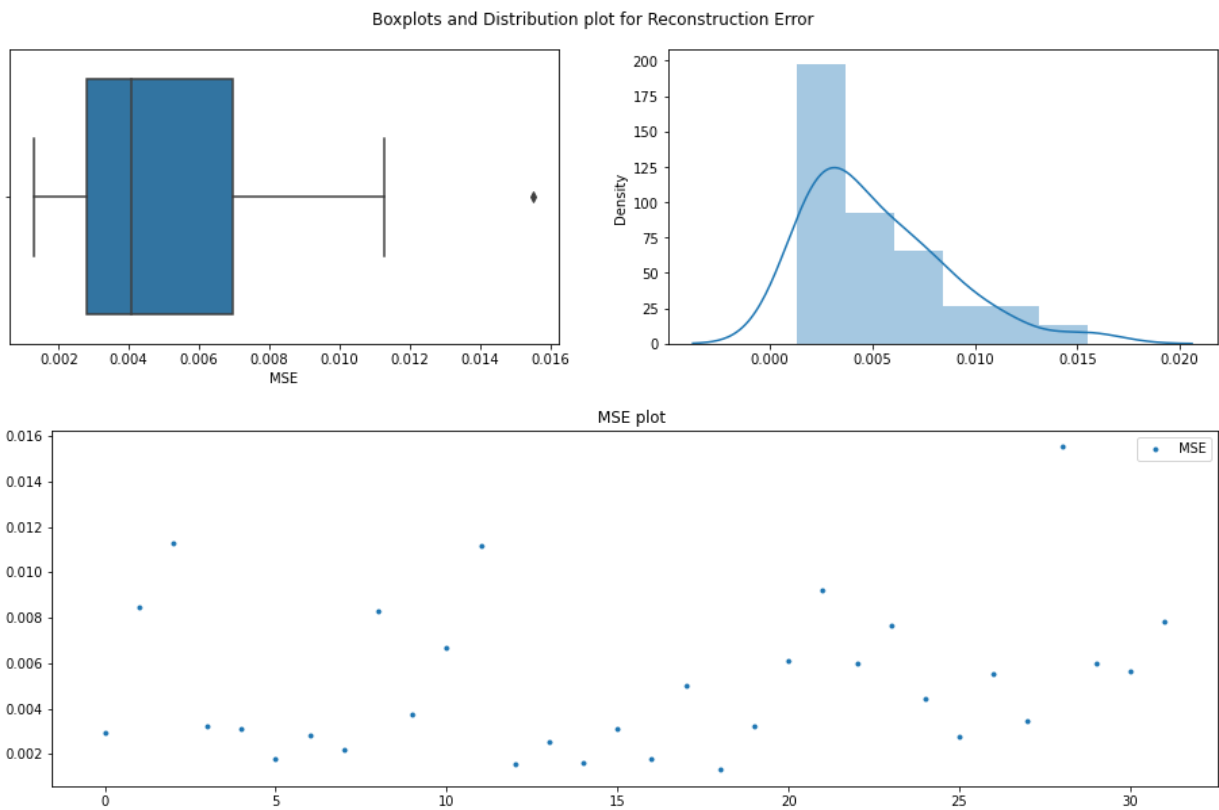


```
Anderson_Darling Test
Statistic: 1.046
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


  *******************
Batch: 28
mean=0.0082975,median=0.007065 ,max=0.02121,min=0.00059,variance=2.84699e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
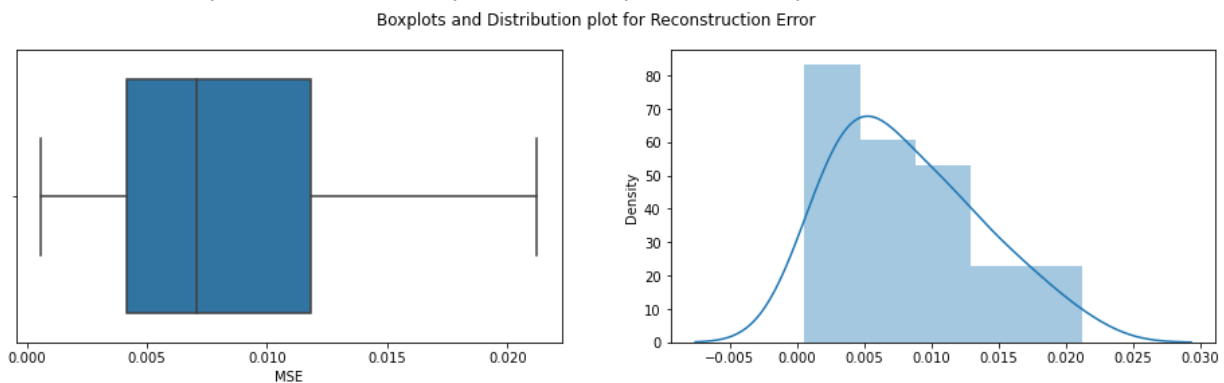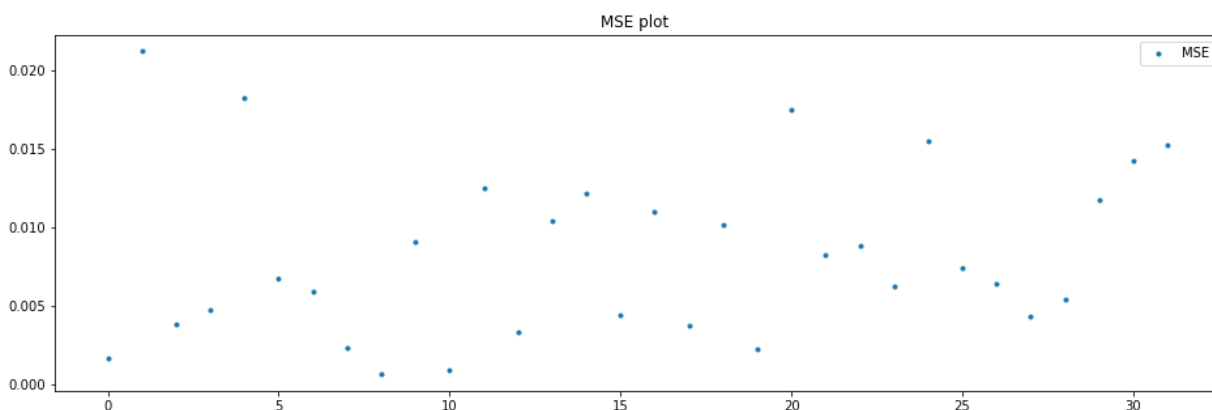
Anderson_Darling Test
Statistic: 0.459
15.000: 0.523, data looks normal (fail to reject H0)
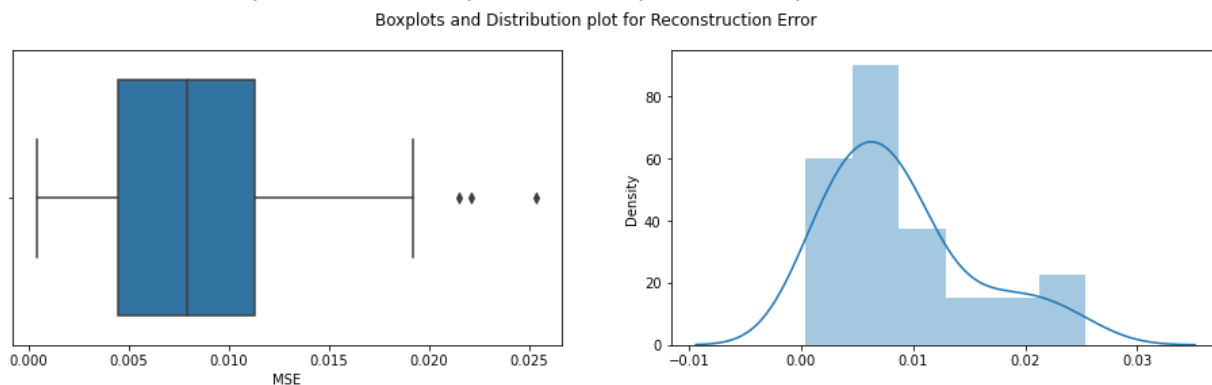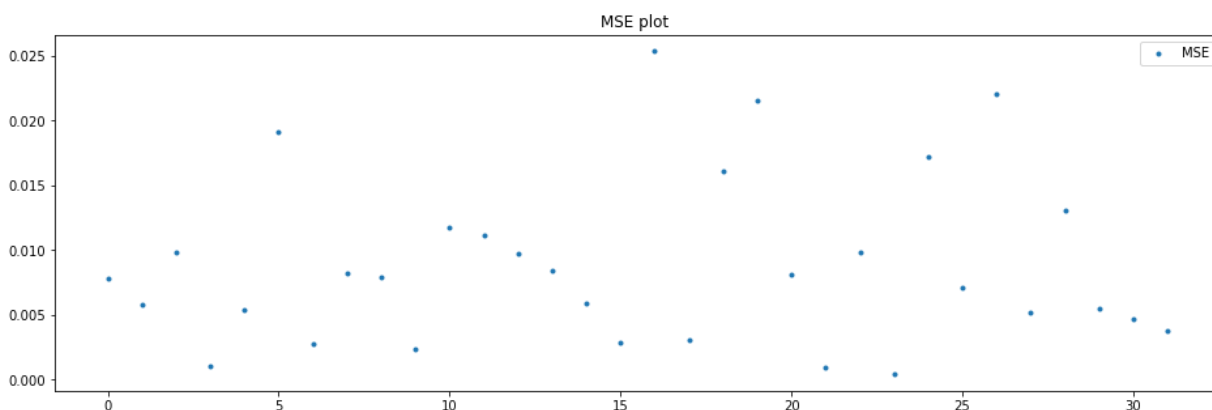10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

 *******************
Batch: 29
mean=0.0074415625,median=0.00756 ,max=0.01876,min=0.00057,variance=2.06445e-05



Boxplots and Distribution plot for Reconstruction Error



MSE plot
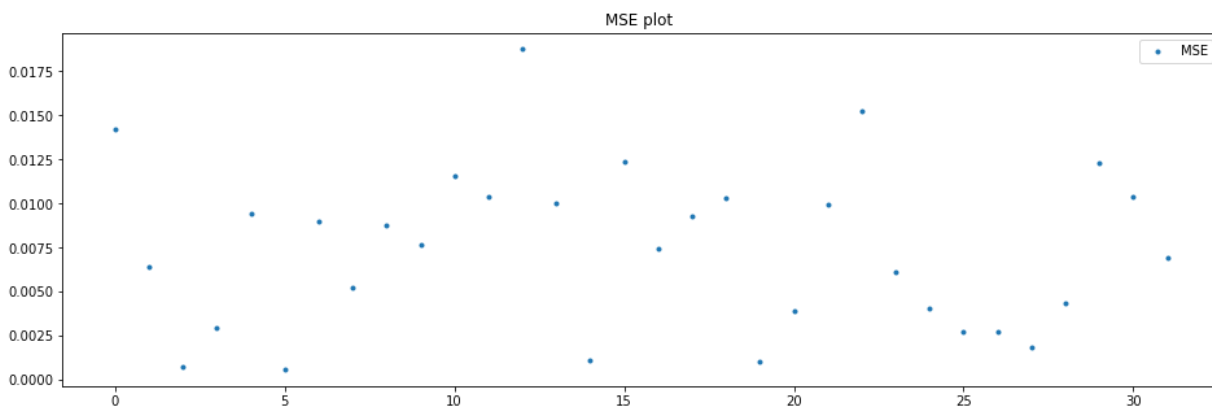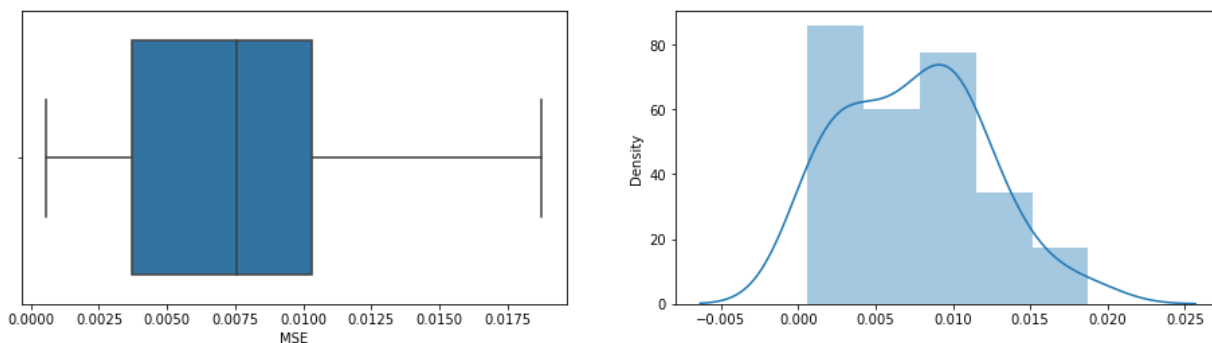
Anderson_Darling Test
Statistic: 0.330
15.000: 0.523, data looks normal (fail to reject H0)
10.000: 0.596, data looks normal (fail to reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

 *******************
Batch: 30
mean=0.0059071875,median=0.006065 ,max=0.01638,min=0.00043,variance=1.39938e-05

Boxplots and Distribution plot for Reconstruction Error



MSE plot
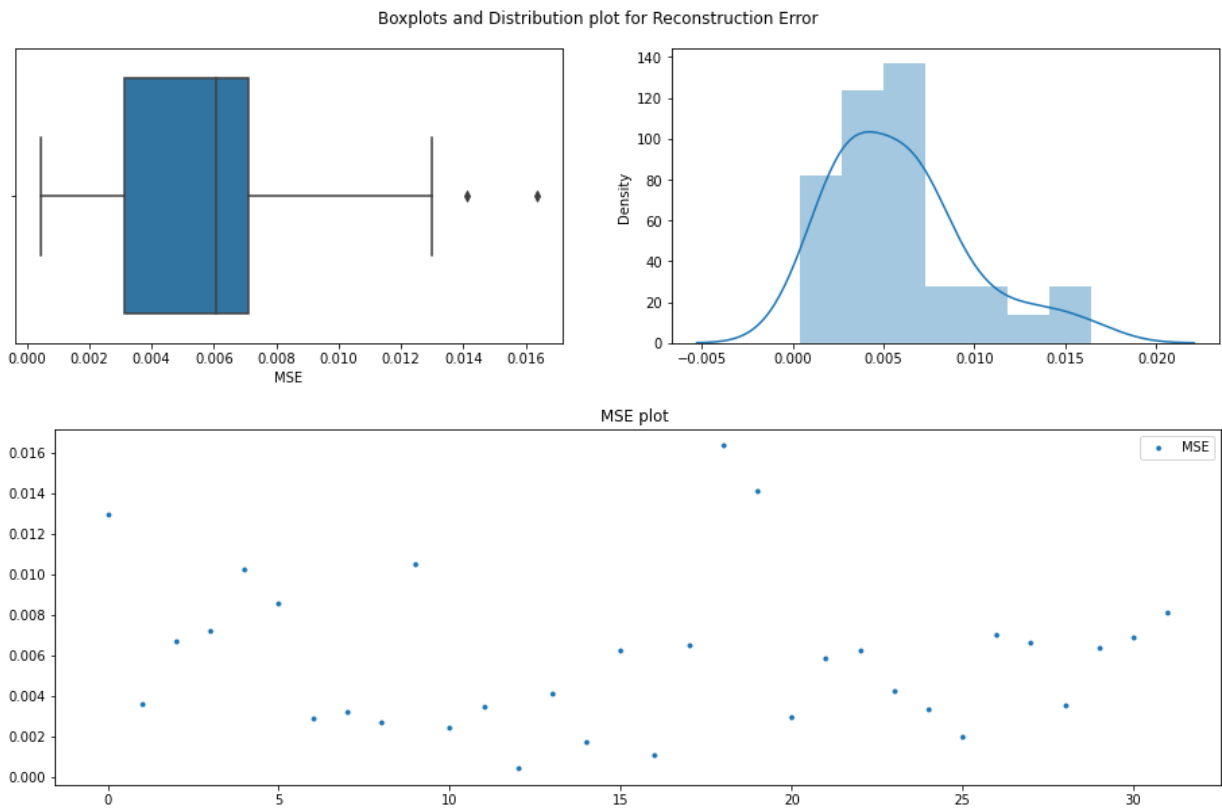


```
Anderson_Darling Test
Statistic: 0.881
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data looks normal (fail to reject H0)

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

Batch: 31
mean=0.0032921875,median=0.002715 ,max=0.01363,min=0.00057,variance=6.279e-06
```
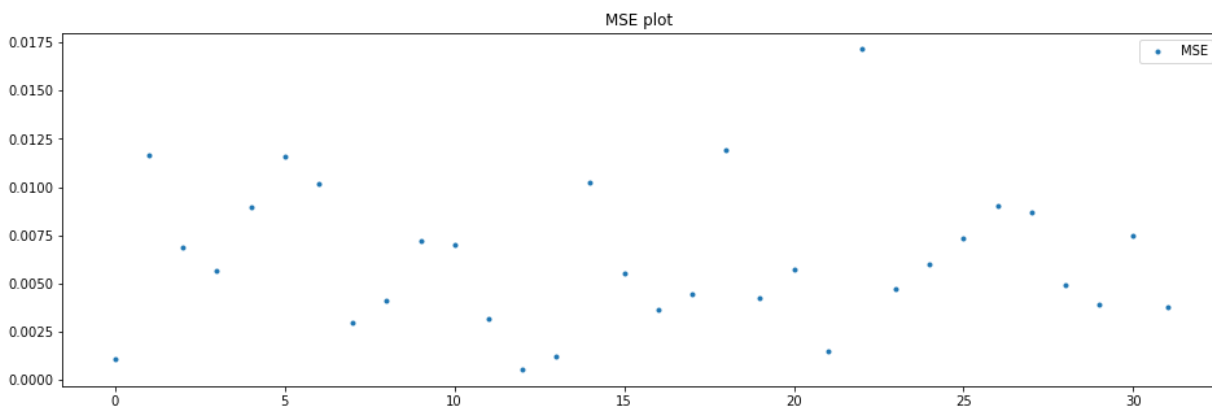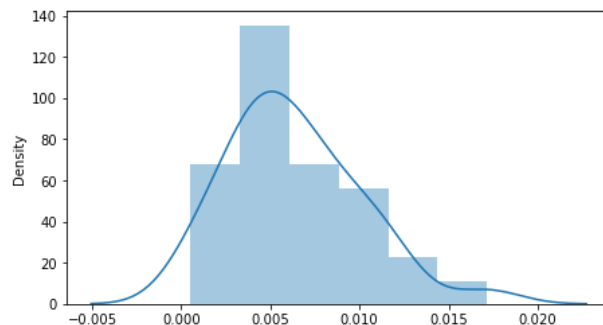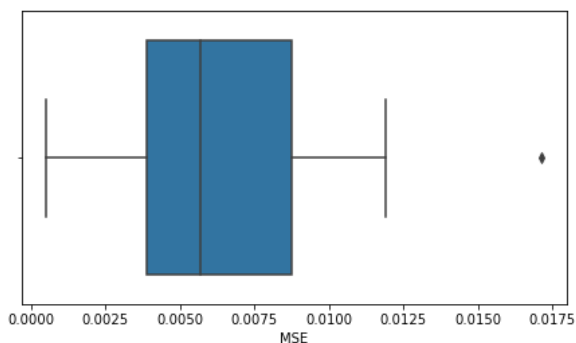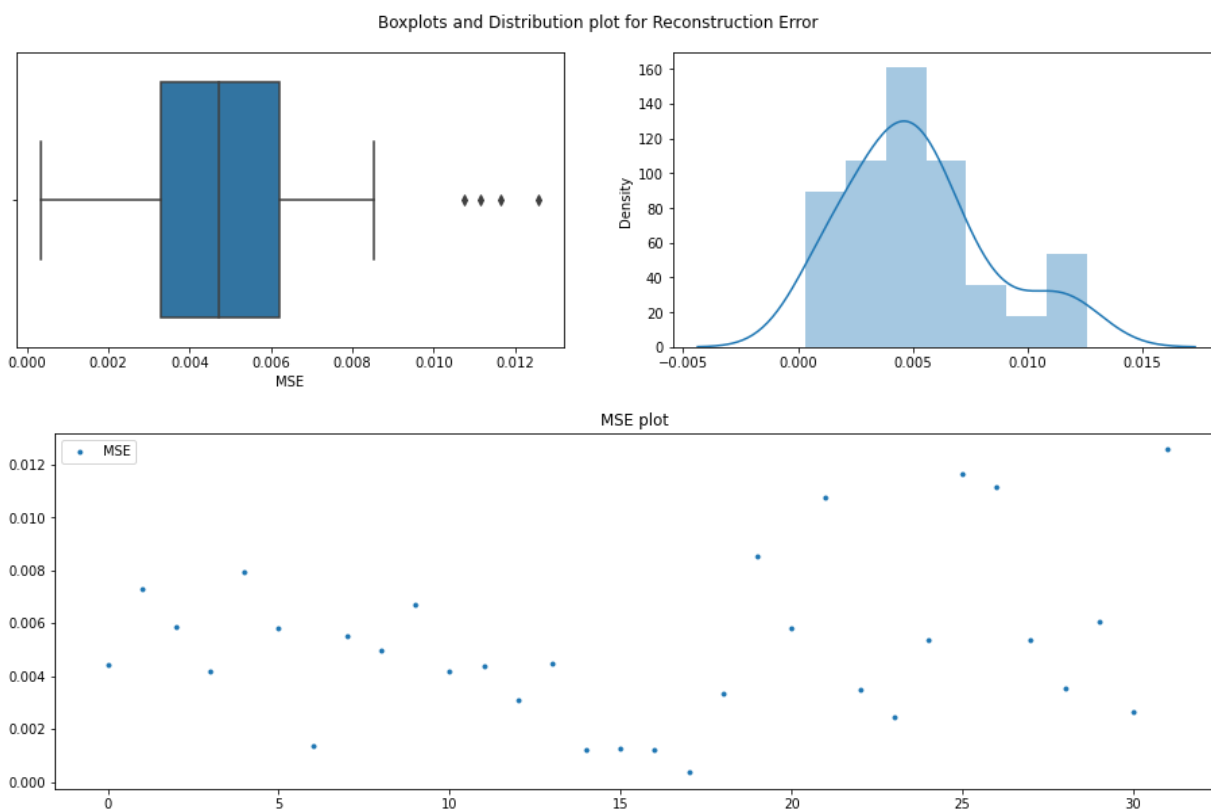
Boxplots and Distribution plot for Reconstruction Error

MSE plot
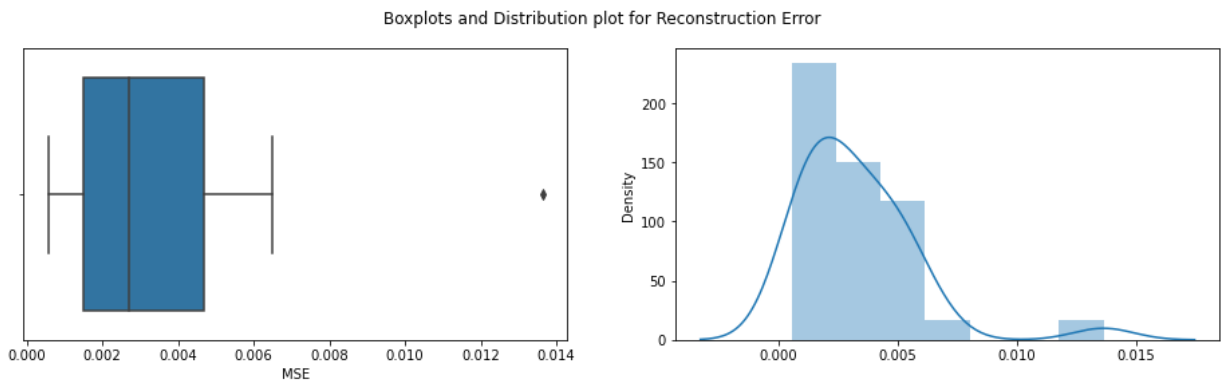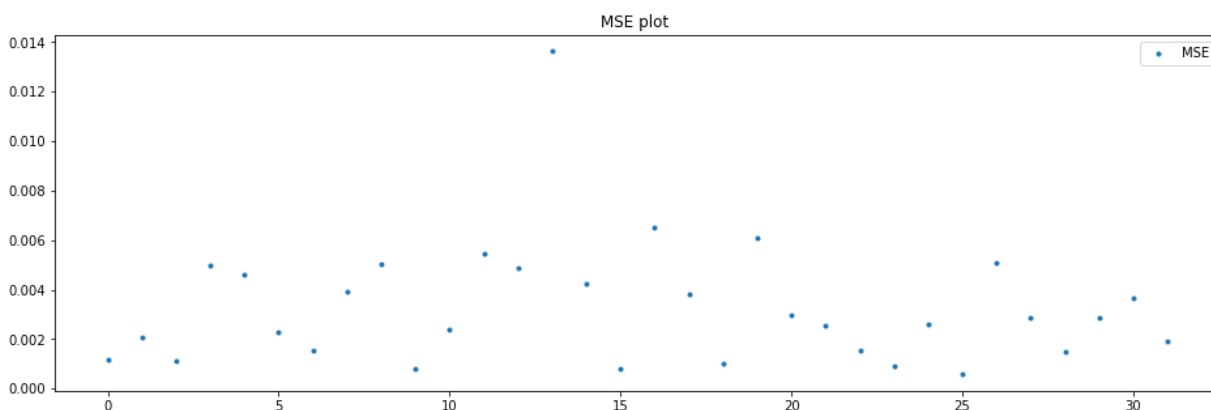
```
Anderson_Darling Test
Statistic: 1.224
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 32
mean=0.00792625,median=0.00636 ,max=0.02107,min=0.00131,variance=2.91751e-05
```

Boxplots and Distribution plot for Reconstruction Error



MSE plot
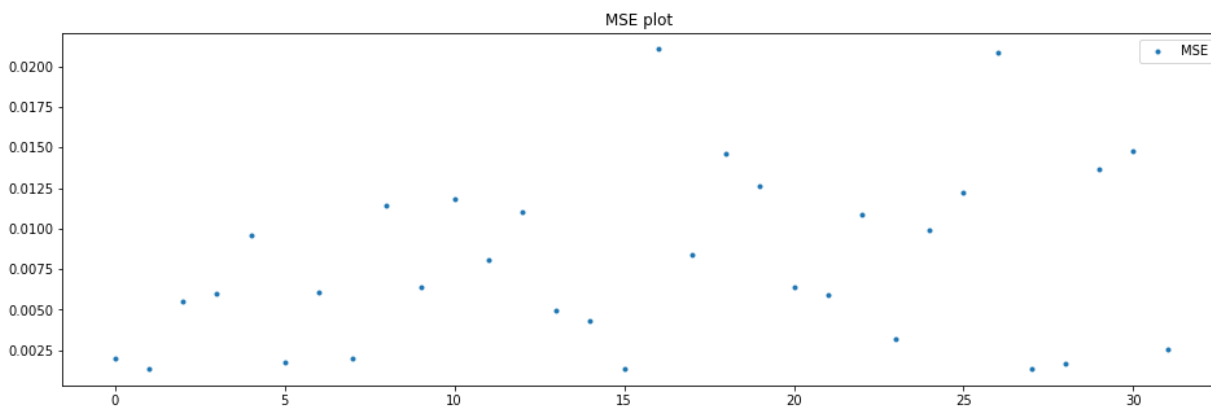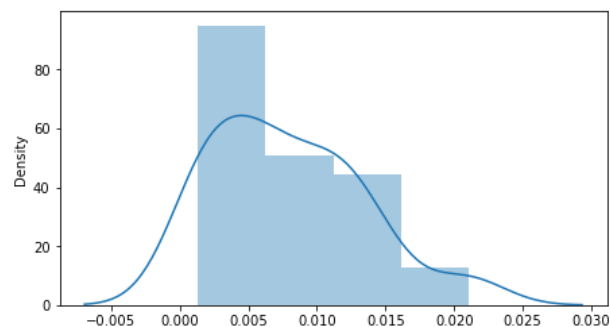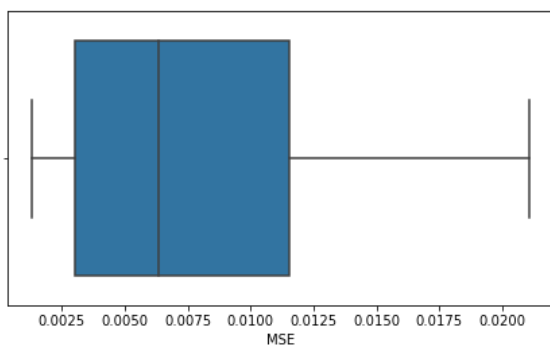


```
Anderson_Darling Test
Statistic: 0.646
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data looks normal (fail to reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


 *******************
Batch: 33
mean=0.0080628125,median=0.00642 ,max=0.02626,min=0.00111,variance=3.24582e-05
```
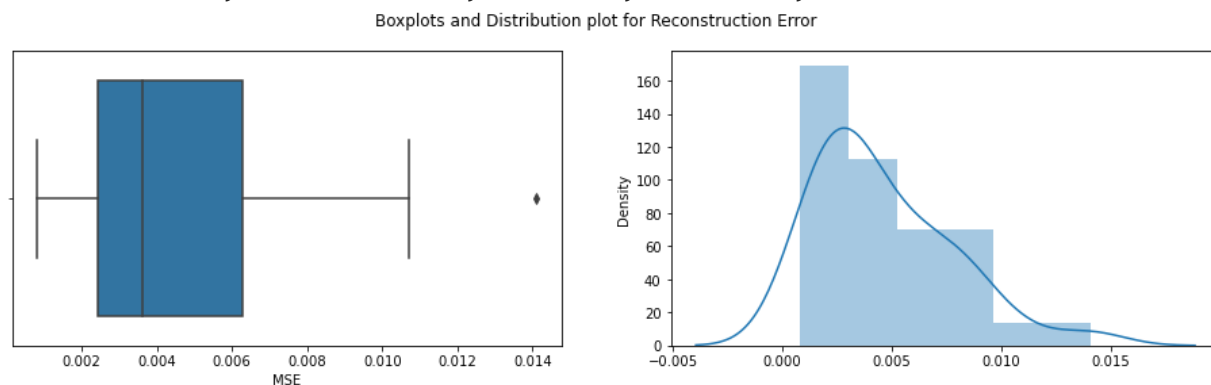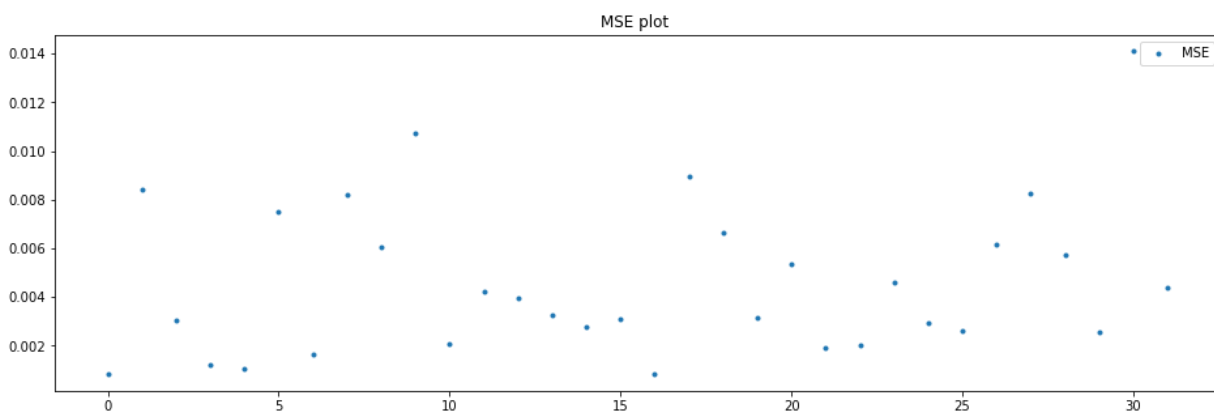
Boxplots and Distribution plot for Reconstruction Error



MSE plot
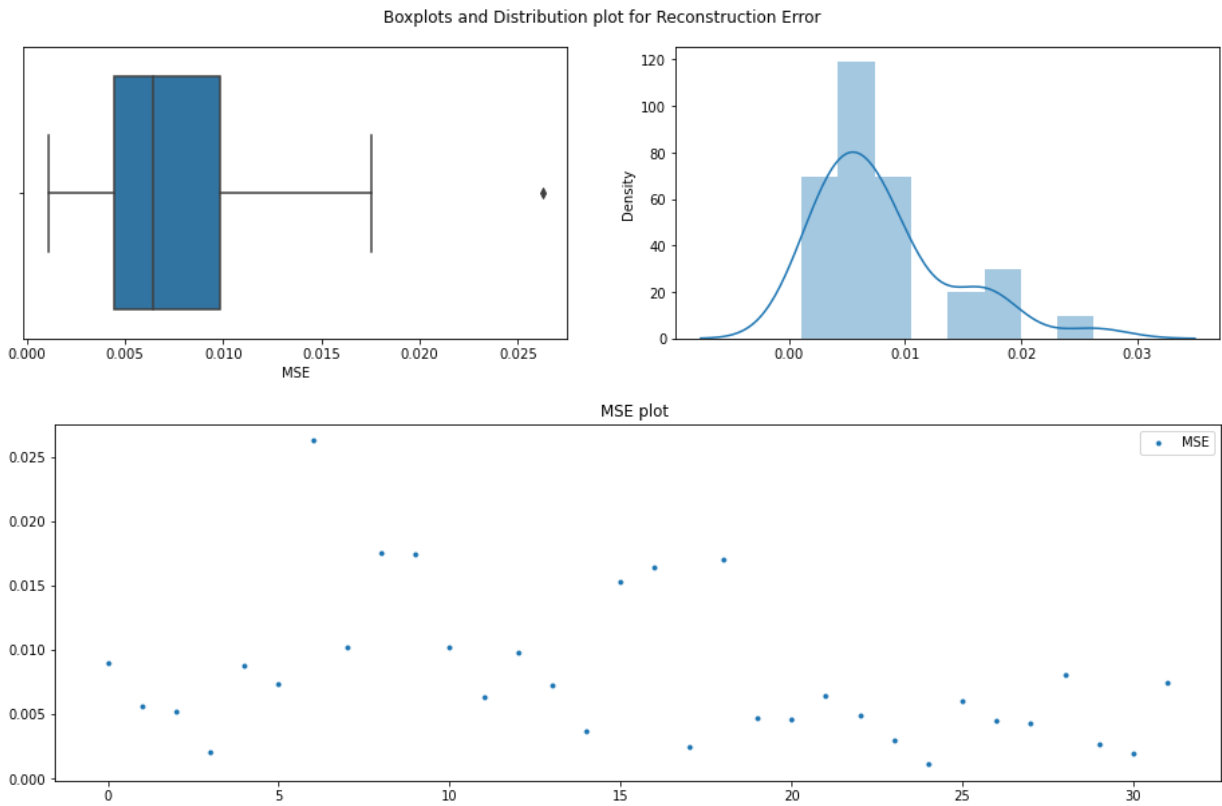


```
Anderson_Darling Test
Statistic: 1.461
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


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

Batch: 34
mean=0.00494625,median=0.0036 ,max=0.01671,min=0.00122,variance=1.26986e-05
```
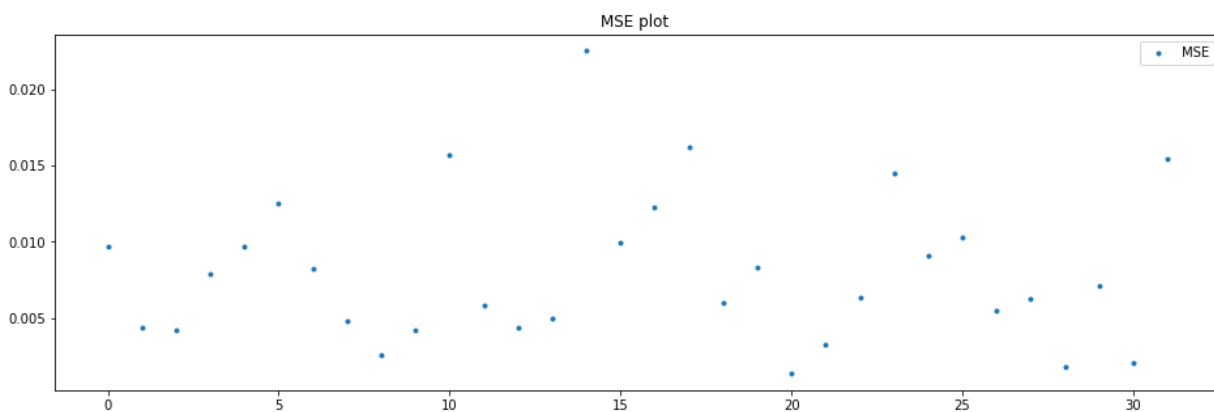
Boxplots and Distribution plot for Reconstruction Error

MSE plot
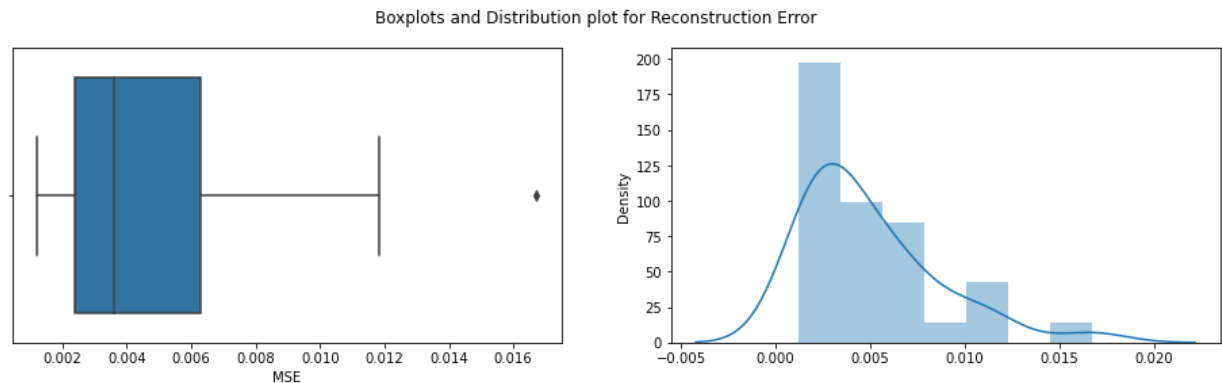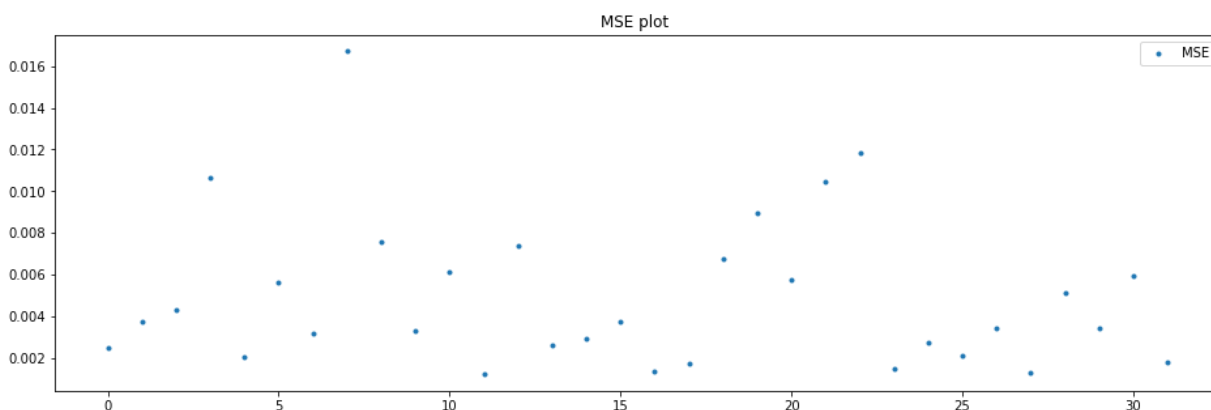
```
Anderson_Darling Test
Statistic: 1.394
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 35
mean=0.0042390625,median=0.002275 ,max=0.0351,min=0.00065,variance=3.96388e-05
```
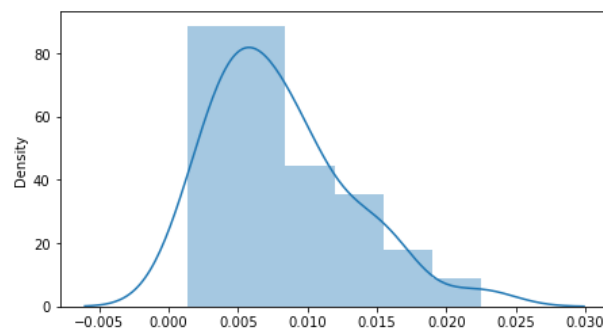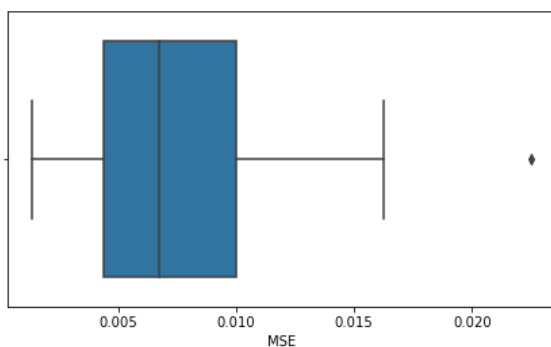
Boxplots and Distribution plot for Reconstruction Error



MSE plot
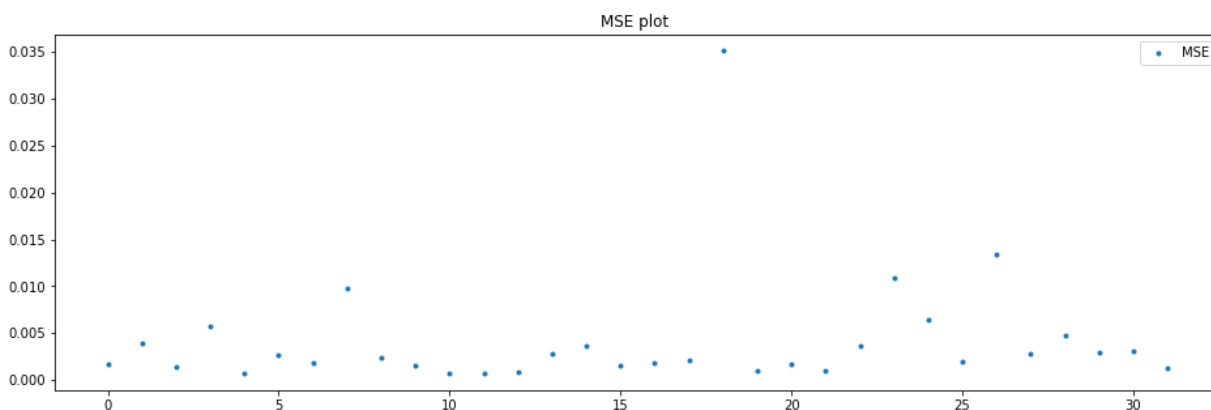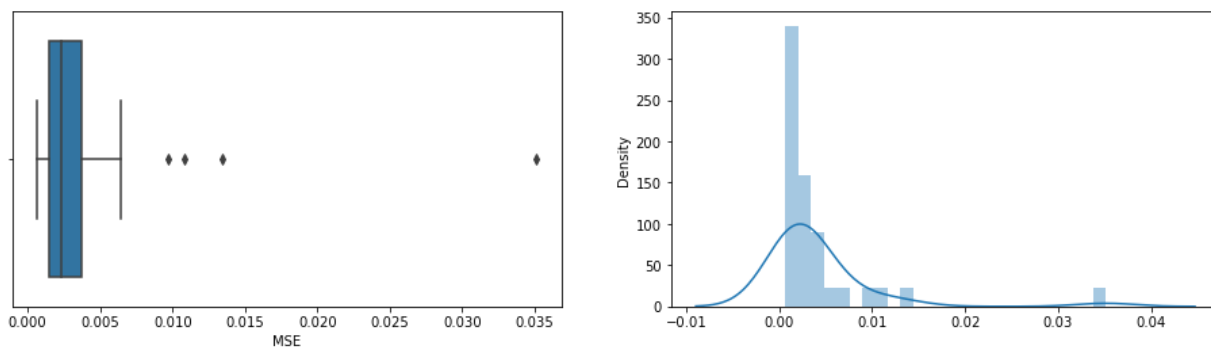


```
Anderson_Darling Test
Statistic: 4.882
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 ********************
Batch: 36
mean=0.006103125,median=0.005195 ,max=0.01921,min=0.00108,variance=2.09381e-05
```
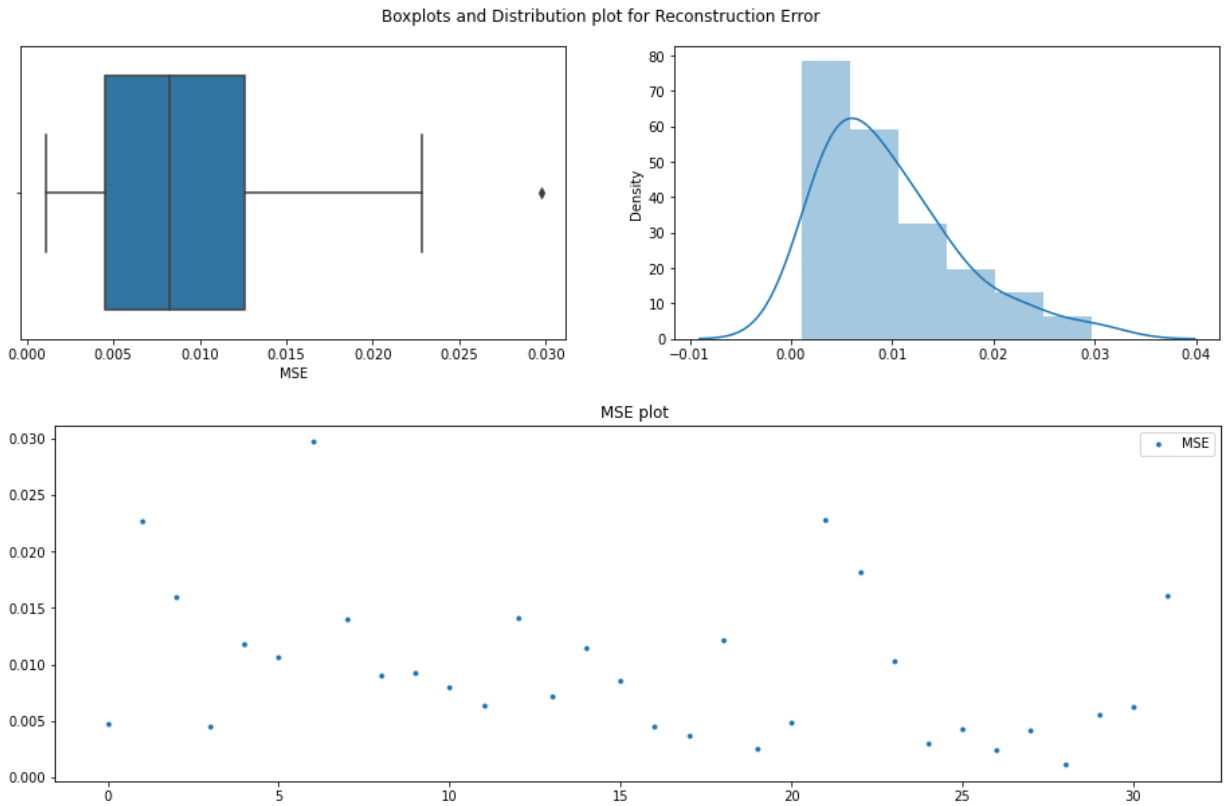
Boxplots and Distribution plot for Reconstruction Error



MSE plot
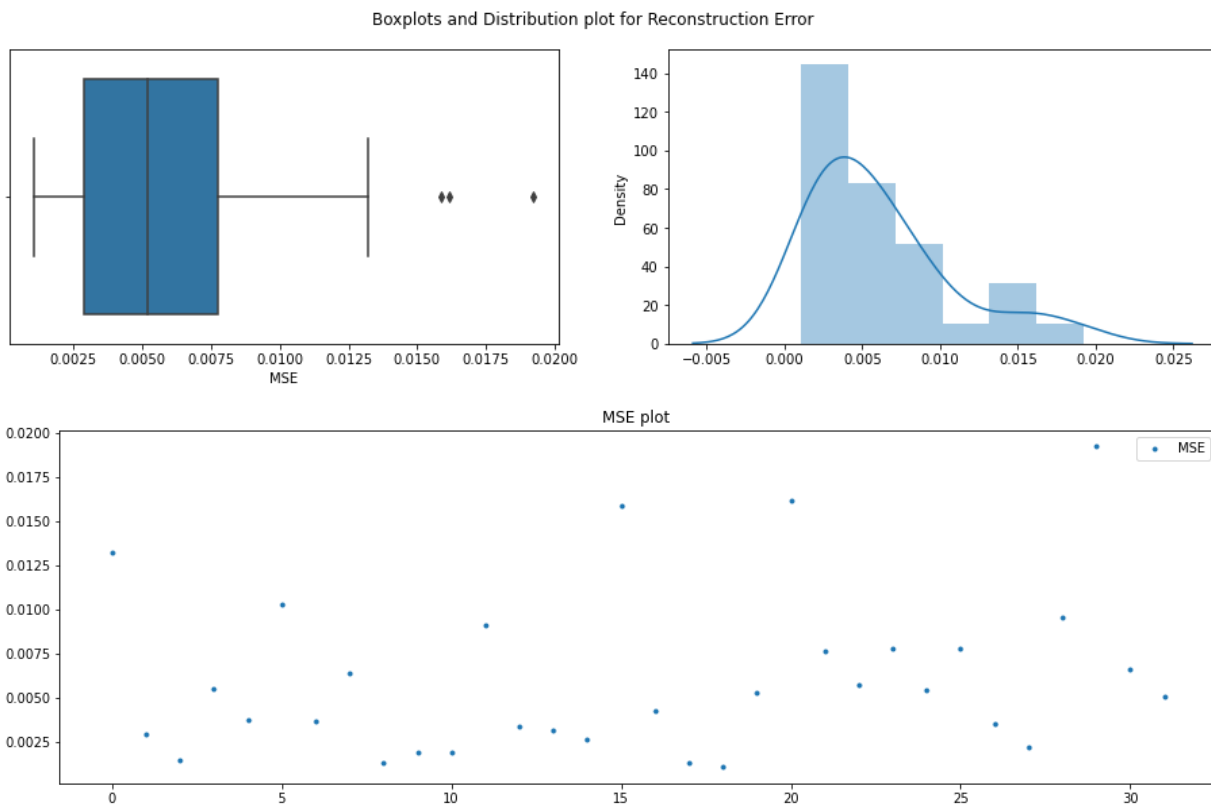


```
Anderson_Darling Test
Statistic: 1.373
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)


 *******************
Batch: 37
mean=0.007956875,median=0.0062 ,max=0.0249,min=0.00012,variance=4.05094e-05
```
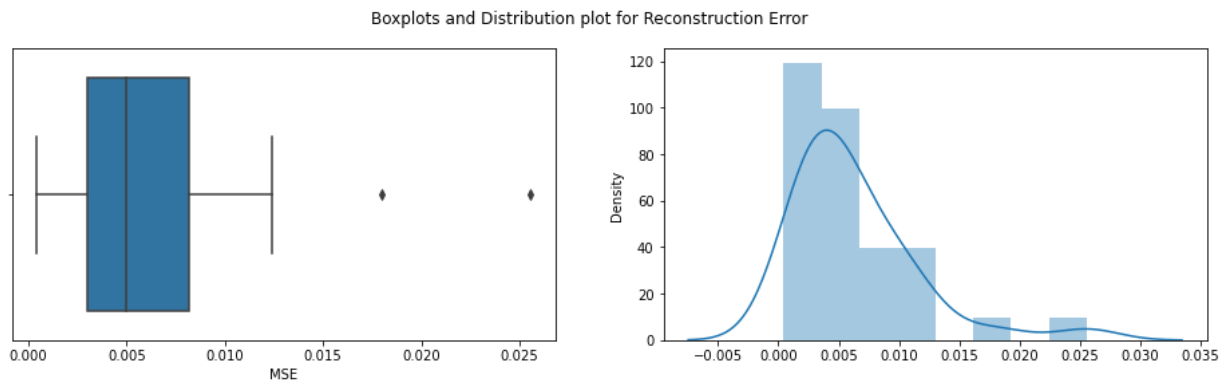
Boxplots and Distribution plot for Reconstruction Error

MSE plot
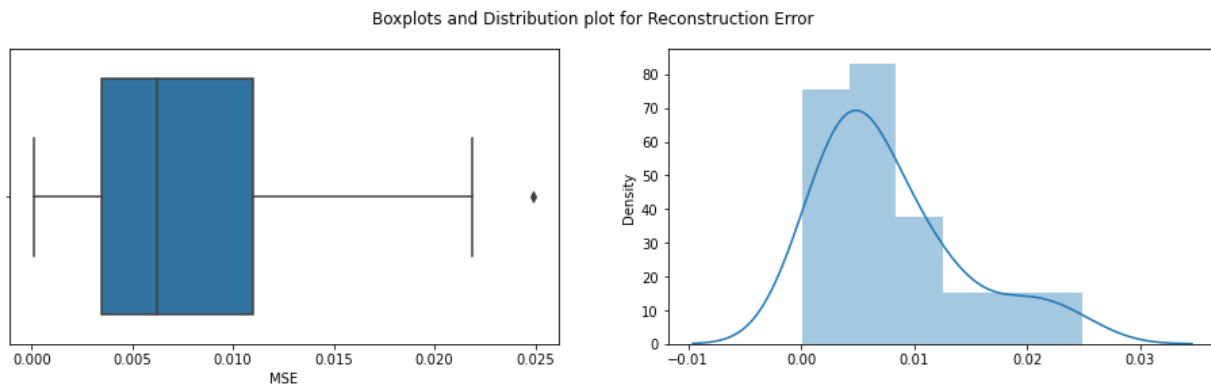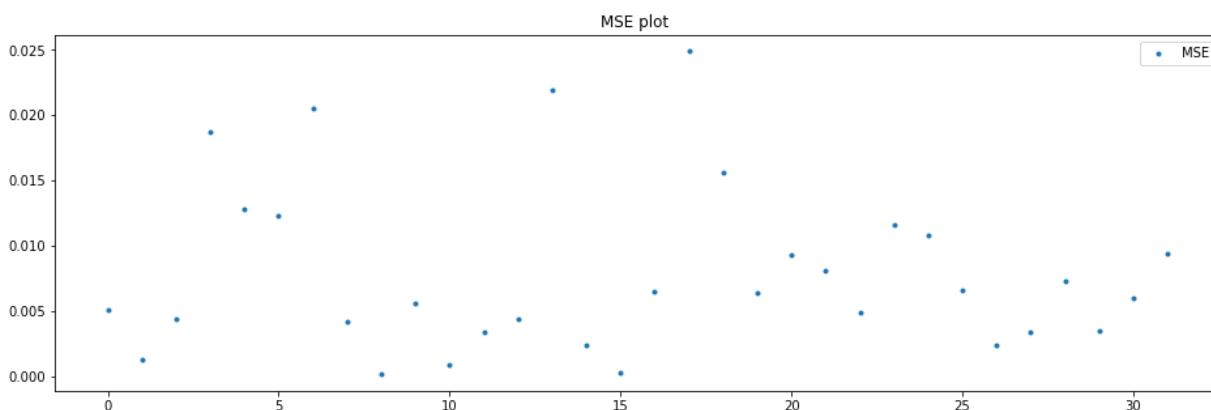
Anderson_Darling Test
Statistic: 1.233
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
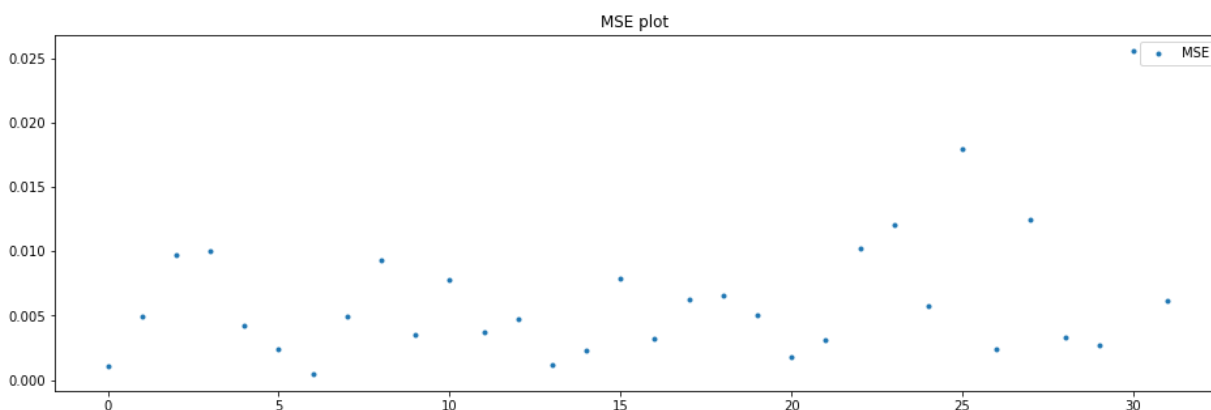5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 38
mean=0.00480125,median=0.0035 ,max=0.02481,min=0.00039,variance=2.75443e-05



Boxplots and Distribution plot for Reconstruction Error



MSE plot
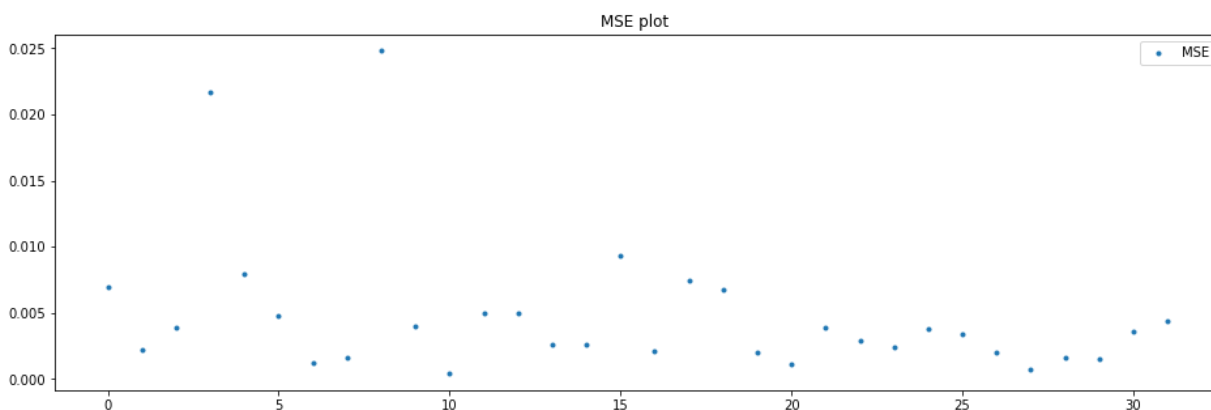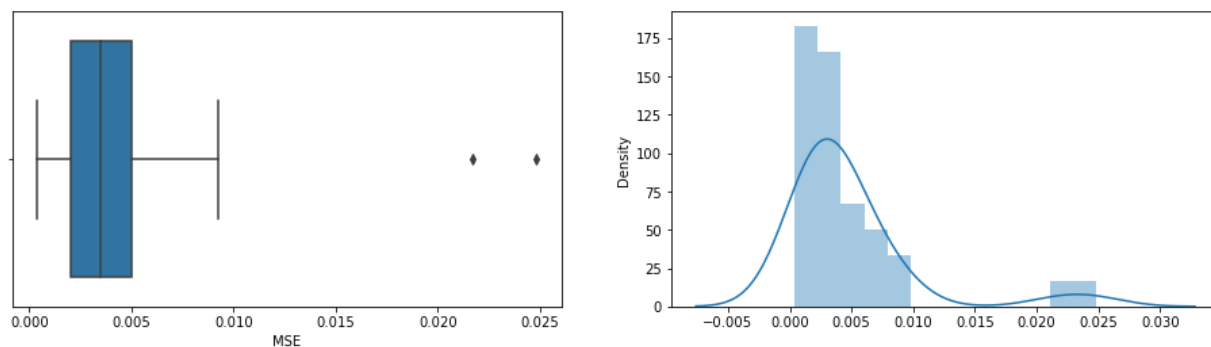
Anderson_Darling Test
Statistic: 3.662
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
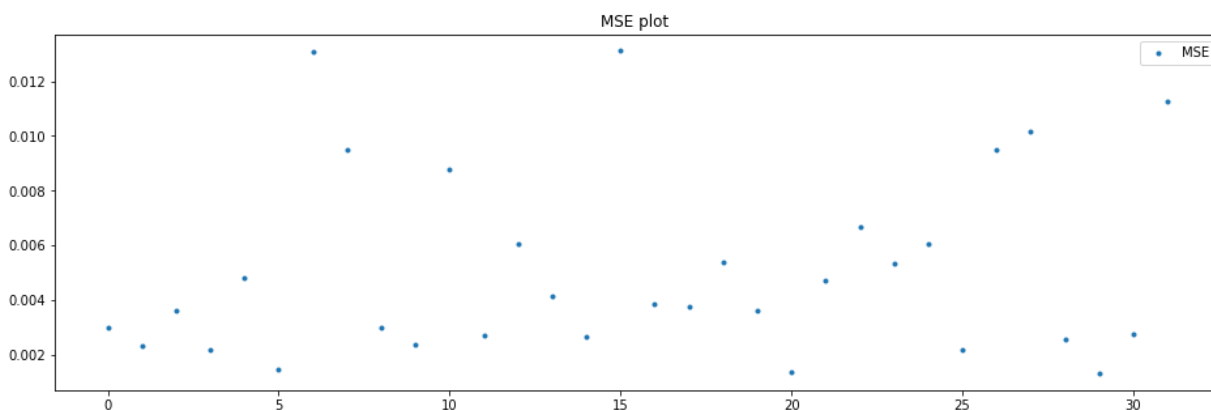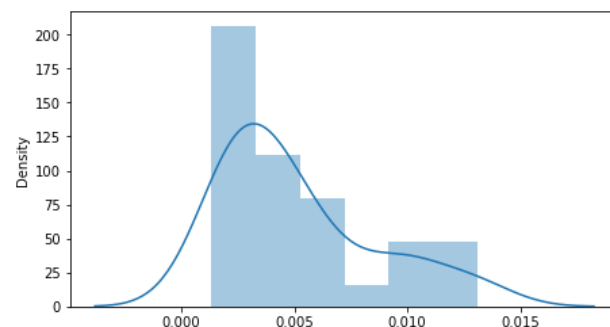5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data does not look normal (reject H0)
1.000: 0.992, data does not look normal (reject H0)

 *******************
Batch: 39
mean=0.0063025,median=0.005195 ,max=0.01747,min=0.00053,variance=1.80776e-05

Boxplots and Distribution plot for Reconstruction Error



MSE plot
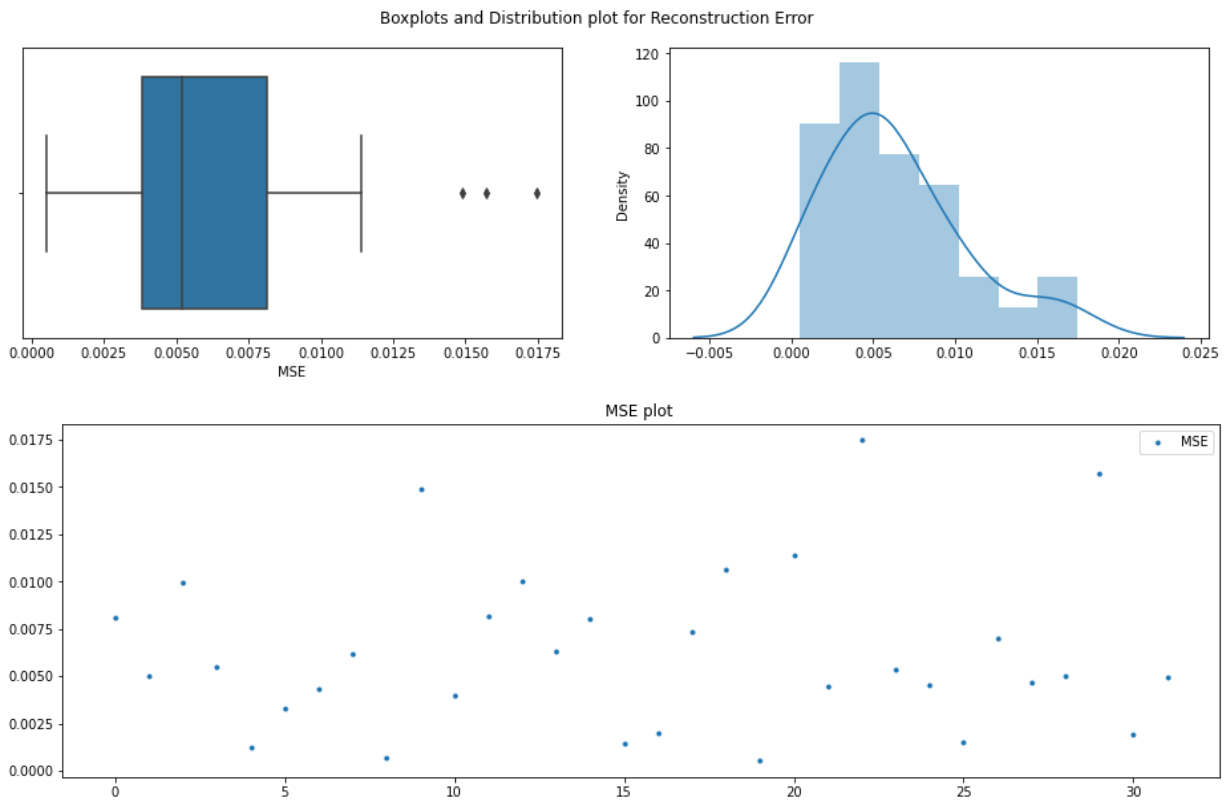


```
Anderson_Darling Test
Statistic: 0.752
15.000: 0.523, data does not look normal (reject H0)
10.000: 0.596, data does not look normal (reject H0)
5.000: 0.715, data does not look normal (reject H0)
2.500: 0.834, data looks normal (fail to reject H0)
1.000: 0.992, data looks normal (fail to reject H0)


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

Batch: 40
mean=0.0110690909,median=0.01102 ,max=0.01995,min=0.00095,variance=4.33433e-05
```

Boxplots and Distribution plot for Reconstruction Error

MSE plot
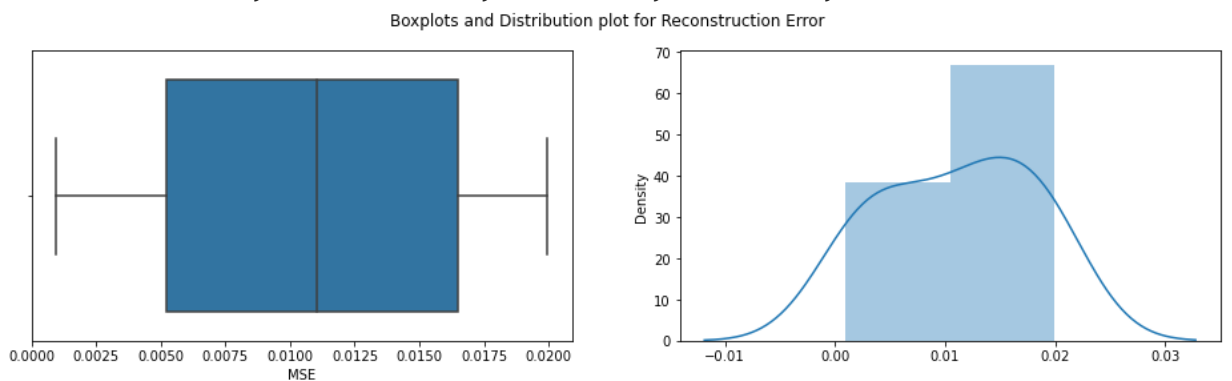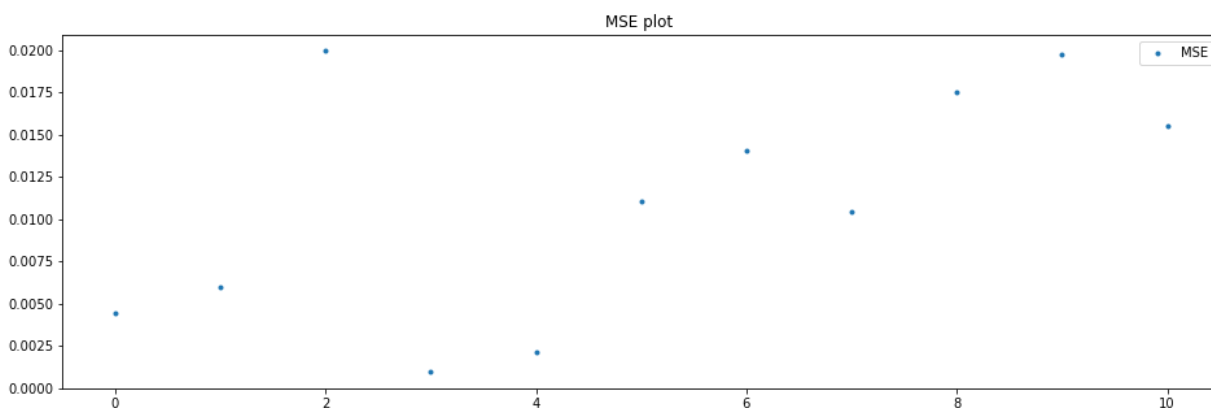
Anderson_Darling Test
Statistic: 0.282
15.000: 0.498, data looks normal (fail to reject H0)
10.000: 0.567, data looks normal (fail to reject H0)
5.000: 0.680, data looks normal (fail to reject H0)
2.500: 0.793, data looks normal (fail to reject H0)
1.000: 0.944, data looks normal (fail to reject H0)

## Instance Threshold

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

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

Out[50]: 0.0202

## 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]: 0.0113

## 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=0.6585365854,median=0.0 ,max=3,min=0,variance=0.8102320048

Boxplots and Distribution plot for Reconstruction Error
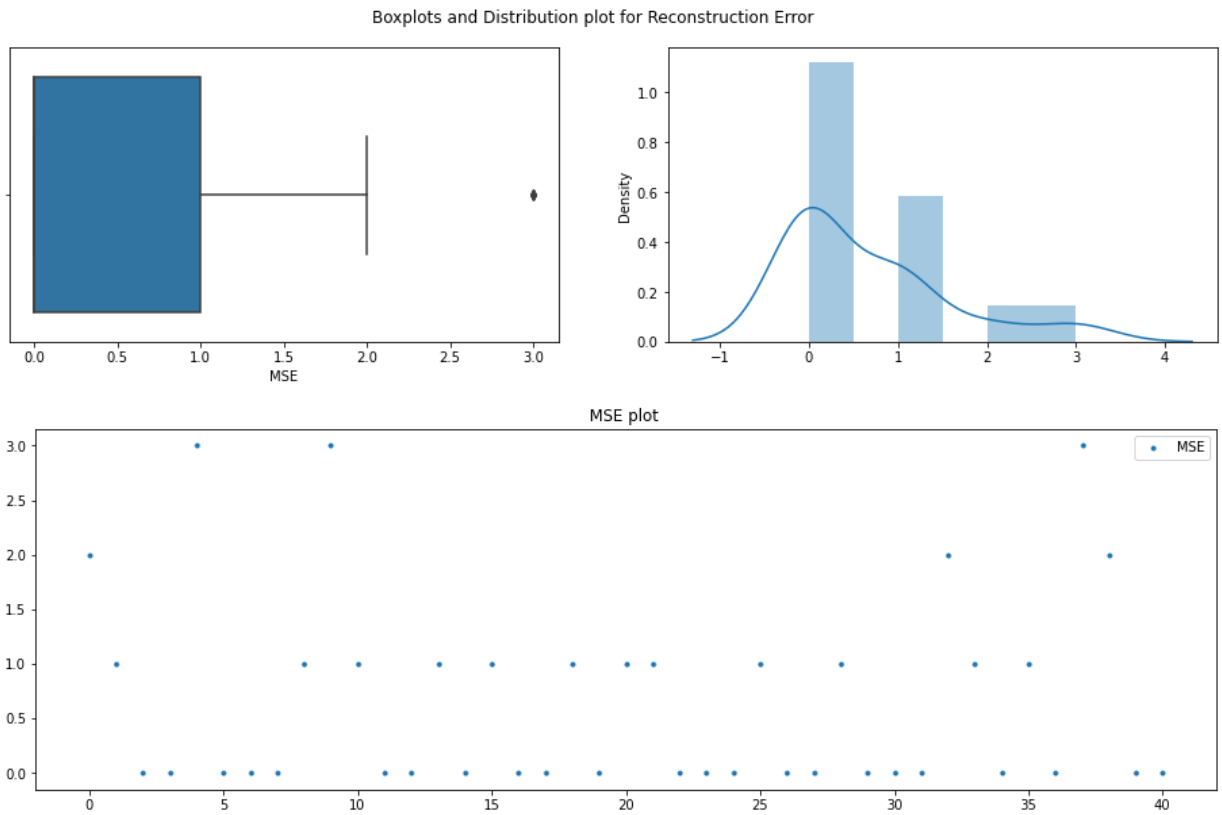


In [56]:
```python
exceed_list_pos;
```

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

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

Out[58]: 0.0

# 6. working on stream data without any drift introduced

In [59]:
```python
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 | cl |
|---|---|---|---|---|---|---|---|---|---|
| **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 Autoend
    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 bat


    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  e
    layer_two_count_threshold=count_thresh_pos if batch_thres_pos>batch_thres_neg  e

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

    # Pass each instance of a batch to Layer 1 AE. Compute Batch MSE and Number of Ir
    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
```

```python
                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]:
```python
def detect_stream_drift(batches,encoder_pos_class,encoder_neg_class,batch_thres_pos,k
    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 thr
    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 : {} '.form
        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_threshold

    return all_excede_list,exceed_count_layer2_instance_thresh ,exceed_count_L2,avg_r
```

In [78]:
```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 ba
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 ba
                    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, 3, 4, 5, 17, 18,
19]

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, 30]

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, 26, 27]

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, 17, 18, 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 : [9, 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 : []

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, 8, 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 : [6]

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 : [1, 10, 11, 12, 17, 18, 2
2]

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, 5, 7, 13, 20, 21
, 29]

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 : [24, 25]

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, 10, 11, 12, 20,
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, 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, 4, 5, 6, 7, 8, 9, 1
0, 11, 12, 13, 14, 15, 16, 17, 19, 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 : 18

Data Points Exceeding Layer 1 Encoder Instance Threshold : [4, 9, 10, 11, 12, 14, 20,
21, 22, 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 : 19

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

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, 26]

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 : [3, 4, 8, 10, 11, 29, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [3]

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


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

Batch Number : 22

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 17, 18, 21, 26, 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 : [0, 20, 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 : [10, 30, 31]

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, 23]

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, 11]

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 : [1, 2, 3, 4, 5, 21]

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, 16, 17, 25, 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, 16, 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 : [0, 1, 2, 5, 6, 11, 12, 17
, 18, 19, 20, 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 : [10, 14, 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 : [0, 7, 8, 10, 22, 23, 30]

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 : [2, 7, 8, 9, 21, 22, 23, 2
4]

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, 6, 13, 14, 18, 19,
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, 11, 14, 15, 17, 26]

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 : [0, 1, 10, 11, 23, 31]

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

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


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

Batch Number : 37

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 7, 21, 22, 23, 27, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [4, 22]

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


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

Batch Number : 38

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 29, 30]

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 : [0, 3, 4, 6, 7, 9, 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 : 40

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8 , 9, 13, 14, 15, 17, 18, 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 : 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, 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, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 30, 31]

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 : [0, 9, 10, 11, 12, 15, 16, 17, 21, 22, 23, 24, 27, 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, 11, 15, 16, 17]

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 : [13, 14]

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 : [0, 1, 2, 10, 13, 20, 27, 28, 29, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [20]

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


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

Batch Number : 47

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 2, 4, 13, 27, 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 : [7, 18, 19, 20, 26, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [15, 19]

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


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

Batch Number : 49

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 7, 8, 9, 12, 16, 17, 18, 19, 22, 23, 25, 30, 31]

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 : [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 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 : 51

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 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 : 52

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 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 : [0, 1, 2, 4, 5, 9, 16, 21,
23]

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 : [7, 16, 22]

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 : [2, 5, 6, 7, 17, 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 : [7, 10, 11]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

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

 Drift Detection at Batch Level
```

# 7. Working with Drifted Data

## Feature Ranking based on Mutual Information

In [68]:
```python
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
```

In [69]:
```python
rank_list=feature_rank(data,'class')
```

In [70]:
```python
rank_list
```

Out[70]:
```
attribute2    0.068132
attribute3    0.056134
attribute8    0.047837
attribute4    0.041622
attribute1    0.031658
attribute7    0.025149
attribute5    0.015025
attribute6    0.012933
dtype: float64
```

In [71]:

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

In [73]:    `stream`

Out[73]:

| | attribute1 | attribute2 | attribute3 | attribute4 | attribute5 | attribute6 | attribute7 | attribute8 | cl |
|---|---|---|---|---|---|---|---|---|---|
| **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 × 9 columns

In [74]:    `stream_top25`

Out[74]:

| | attribute1 | attribute2 | attribute3 | attribute4 | attribute5 | attribute6 | attribute7 | attribute8 |
|---|---|---|---|---|---|---|---|---|
| **0** | 0.352 | 0.472 | 0.008 | 0.137 | 0.222 | 0.191 | 0.338 | 0.399 |
| **1** | 0.444 | 0.566 | 0.006 | 0.012 | 0.168 | 0.130 | 0.397 | 0.504 |
| **2** | 0.466 | 0.572 | 0.006 | 0.137 | 0.158 | 0.210 | 0.448 | 0.515 |
| **3** | 0.462 | 0.556 | 0.007 | 0.226 | 0.208 | 0.210 | 0.440 | 0.523 |
| **4** | 0.376 | 0.477 | 0.008 | 0.210 | 0.201 | 0.170 | 0.347 | 0.429 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... |
| **1811** | 0.425 | 0.009 | 0.446 | 0.278 | 0.441 | 0.512 | 0.423 | 0.461 |
| **1812** | 0.465 | 0.008 | 0.412 | 0.278 | 0.355 | 0.363 | 0.561 | 0.495 |
| **1813** | 0.514 | 0.007 | 0.480 | 0.278 | 0.165 | 0.170 | 0.606 | 0.538 |
| **1814** | 0.519 | 0.007 | 0.515 | 0.278 | 0.115 | 0.149 | 0.515 | 0.536 |
| **1815** | 0.464 | 0.008 | 0.446 | 0.270 | 0.168 | 0.236 | 0.530 | 0.534 |

1816 rows × 8 columns

A) Sudden Drift Top 25 — Top x% (Use Top 40%)

In [75]:
```python
batches_d=make_batches(stream_top25)
```

In [76]:
```python
#batches_d=dict(list(batches_d.items())[:30])
```

## Drift Detection through AE-DDM

In [79]:
```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, 3, 4, 5, 17, 18, 19]

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, 30]

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, 26, 27]

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, 17, 18, 21]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

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

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Batch Number : 4

Data Points Exceeding Layer 1 Encoder Instance Threshold : [9, 14, 15, 22]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

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


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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


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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, 8, 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 : [6]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

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


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Batch Number : 10

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 10, 11, 12, 17, 18, 2
2]

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, 5, 7, 13, 20, 21
, 29]

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 : [24, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: []

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


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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
```

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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, 10, 11, 12, 20,
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, 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, 4, 5, 6, 7, 8, 9, 1
0, 11, 12, 13, 14, 15, 16, 17, 19, 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 : 18

Data Points Exceeding Layer 1 Encoder Instance Threshold : [4, 9, 10, 11, 12, 14, 20,
21, 22, 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
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Batch Number : 19

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

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 : [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, 8,
9, 10, 11, 12, 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: 32



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Batch Number : 21

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, 8,
9, 10, 11, 12, 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: 32



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

Batch Number : 22

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, 30, 31]

Data Points Exceeding Layer 2 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]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 32



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```
Batch Number : 23

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 3, 4, 5, 6, 7, 8, 9
, 11, 12, 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, 8,
9, 10, 11, 12, 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: 32



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Batch Number : 24

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, 8,
9, 10, 11, 12, 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: 32



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Batch Number : 25

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, 8,
9, 10, 11, 12, 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: 32



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Batch Number : 26

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, 8,
9, 10, 11, 12, 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: 32
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**************

Batch Number : 27

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, 8,
9, 10, 11, 12, 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: 32



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

Batch Number : 28

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, 8,
9, 10, 11, 12, 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: 32



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

Batch Number : 29

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, 8,
9, 10, 11, 12, 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: 32



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

Batch Number : 30

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, 8,
9, 10, 11, 12, 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: 32
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**************

Batch Number : 31

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, 8,
9, 10, 11, 12, 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: 32



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

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, 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, 8,
9, 10, 11, 12, 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: 32



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

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, 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]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 32



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

Batch Number : 34

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, 8,
9, 10, 11, 12, 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: 32


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

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: [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]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 32


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

Batch Number : 36

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 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, 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, 3
1]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 31


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

Batch Number : 37

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, 8,
9, 10, 11, 12, 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: 32


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

Batch Number : 38

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, 8,
9, 10, 11, 12, 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: 32

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

Batch Number : 39

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, 8,
9, 10, 11, 12, 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: 32

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

Batch Number : 40

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, 8,
9, 10, 11, 12, 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: 32

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

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, 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, 8,
9, 10, 11, 12, 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: 32

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

Batch Number : 42

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, 8, 9, 10, 11, 12, 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: 32


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

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: [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]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 32


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

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, 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]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 32


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

Batch Number : 45

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 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, 8, 9, 10, 11, 12, 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: 32


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

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, 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]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 32


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

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, 8, 9, 10, 11, 12, 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: 32


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

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, 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]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 32


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

Batch Number : 49

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, 8, 9, 10, 11, 12, 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: 32


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

Batch Number : 50

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, 8,
9, 10, 11, 12, 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: 32


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

Batch Number : 51

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, 8,
9, 10, 11, 12, 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: 32


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

Batch Number : 52

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, 8,
9, 10, 11, 12, 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: 32


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

Batch Number : 53

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, 8,
9, 10, 11, 12, 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: 32


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```
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: [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]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 32



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

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, 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]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 32



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

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, 8,
9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 24

 Drift Detection at Batch Level

 Threshold exceeds at batch : 20
[20]
Warning Level at Batch 20
 Threshold exceeds at batch : 21
[20, 21]
Warning Level at Batch 21
 Threshold exceeds at batch : 22
[20, 21, 22]
 Drift Confirmed at Batch No :  20
 Threshold exceeds at batch : 23
[20, 21, 22, 23]
 Drift Confirmed at Batch No :  21
 Threshold exceeds at batch : 24
[20, 21, 22, 23, 24]
 Drift Confirmed at Batch No :  22
 Threshold exceeds at batch : 25
[20, 21, 22, 23, 24, 25]
 Drift Confirmed at Batch No :  23
```

```
 Threshold exceeds at batch : 26
[20, 21, 22, 23, 24, 25, 26]
 Drift Confirmed at Batch No :   24
 Threshold exceeds at batch : 27
[20, 21, 22, 23, 24, 25, 26, 27]
 Drift Confirmed at Batch No :   25
 Threshold exceeds at batch : 28
[20, 21, 22, 23, 24, 25, 26, 27, 28]
 Drift Confirmed at Batch No :   26
 Threshold exceeds at batch : 29
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29]
 Drift Confirmed at Batch No :   27
 Threshold exceeds at batch : 30
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30]
 Drift Confirmed at Batch No :   28
 Threshold exceeds at batch : 31
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]
 Drift Confirmed at Batch No :   29
 Threshold exceeds at batch : 32
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32]
 Drift Confirmed at Batch No :   30
 Threshold exceeds at batch : 33
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33]
 Drift Confirmed at Batch No :   31
 Threshold exceeds at batch : 34
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34]
 Drift Confirmed at Batch No :   32
 Threshold exceeds at batch : 35
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35]
 Drift Confirmed at Batch No :   33
 Threshold exceeds at batch : 36
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36]
 Drift Confirmed at Batch No :   34
 Threshold exceeds at batch : 37
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37]
 Drift Confirmed at Batch No :   35
 Threshold exceeds at batch : 38
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   36
 Threshold exceeds at batch : 39
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39]
 Drift Confirmed at Batch No :   37
 Threshold exceeds at batch : 40
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40]
 Drift Confirmed at Batch No :   38
 Threshold exceeds at batch : 41
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41]
 Drift Confirmed at Batch No :   39
 Threshold exceeds at batch : 42
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42]
 Drift Confirmed at Batch No :   40
 Threshold exceeds at batch : 43
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 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
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 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
```

```
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 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
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 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
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 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
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 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
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 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 : 50
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42, 43, 44, 45, 46, 47, 48, 49, 50]
 Drift Confirmed at Batch No :   48
 Threshold exceeds at batch : 51
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51]
 Drift Confirmed at Batch No :   49
 Threshold exceeds at batch : 52
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52]
 Drift Confirmed at Batch No :   50
 Threshold exceeds at batch : 53
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53]
 Drift Confirmed at Batch No :   51
 Threshold exceeds at batch : 54
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54]
 Drift Confirmed at Batch No :   52
 Threshold exceeds at batch : 55
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55]
 Drift Confirmed at Batch No :   53
 Threshold exceeds at batch : 56
[20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40,
41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56]
 Drift Confirmed at Batch No :   54
```

## Students t Test

In [80]:
```python
# 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 [81]:
```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=0.0


    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_n
```

In [82]:
```python
perform_t_test()
```

```
Layer 1 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 7.656917
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 -6.623475
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 7.867447
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 10.043712
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.
```

## Drift Analysis Through Plots

In [83]:

```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-o
    fig.update_layout(showlegend=True,
    legend=dict(
        yanchor='top',
        y=.95,
        xanchor='left',
        x=0.01),xaxis_title="Batch Number ", yaxis_title="Reconstruction Error" , leg

    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", lege
    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", lege
    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_tit

        fig4.show(config=config)


        return df_plotting , df_plotting_counts
```

In [84]:
```
df_plotting=visual_analysis()
```
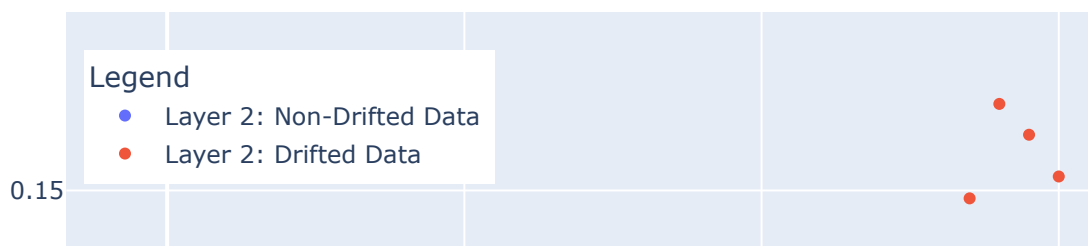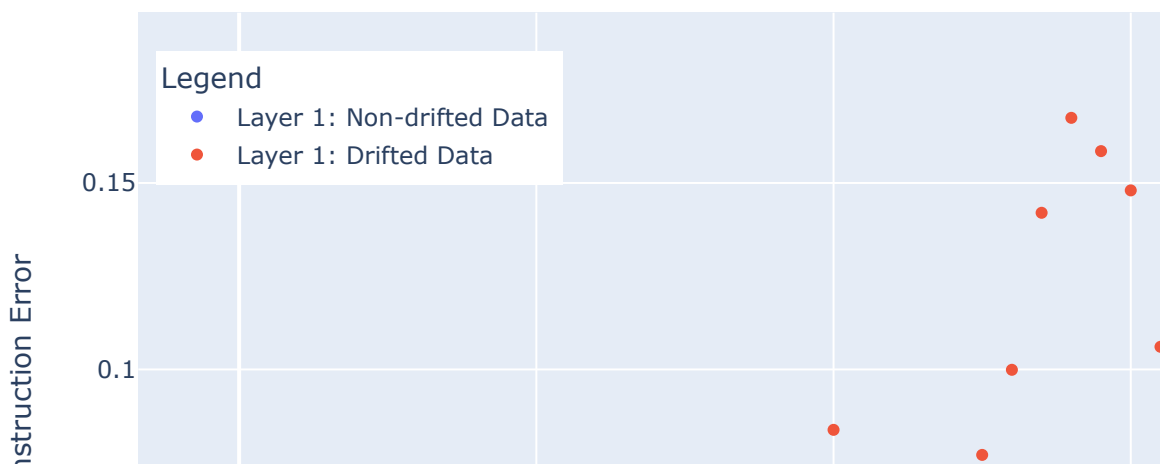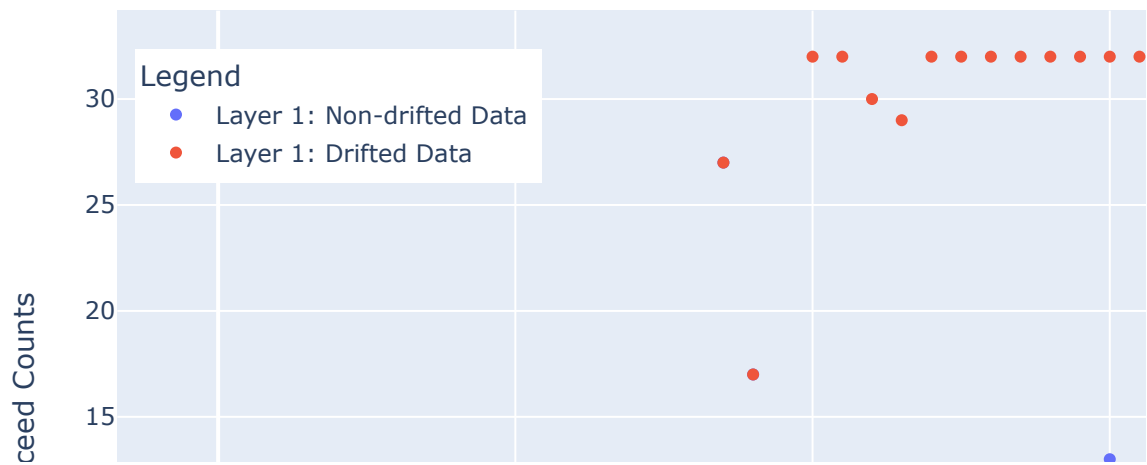
Effect on Classification Perfromance

```
In [85]:  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)
```

```
            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]:
```
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]:
```
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 :0.7901982378854625
Train Recall Score : 1.0 , Test Recall Score :0.5213013168086754
Train Precision Score: 1.0 , Test Precision score: 0.6385199240986716
Train f1 Score: 1.0 , Test f1 socre score: 0.8237454100367197
Training KNN:
Train Accuracy : 0.8480056643851782 , Test Accuracy :0.7601872246696035
Train Recall Score : 0.672790202342918 , Test Recall Score :0.49961270333075136
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 :0.7420154185022027
Train Recall Score : 1.0 , Test Recall Score :0.5344694035631293
Train Precision Score: 1.0 , Test Precision score: 0.5955977557186017
Train f1 Score: 1.0 , Test f1 socre score: 0.672514619883041
Training MLP:
Train Accuracy : 0.809220360317835 , Test Accuracy :0.7866189427312775
Train Recall Score : 0.5686900958466453 , Test Recall Score :0.5236250968241674
Train Precision Score: 0.7262835770146209 , Test Precision score: 0.6356370474847204
```

```
       Train f1 Score: 0.6378975660743615 , Test f1 socre score: 0.8086124401913876
```

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 ea

    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 :0.906
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 :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
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 :0.875
Recall: 0.8
Precision:0.923
F1_Score:0.857
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 :0.719
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 :0.781
Recall: 0.857
Precision:0.818
F1_Score:0.837
Batch 3:MLP
Accuracy :0.938
Recall: 0.905
Precision:1.0
F1_Score:0.95
Batch 4:LogReg
Accuracy :0.719
Recall: 0.65
Precision:0.867
F1_Score:0.743
Batch 4:RF
Accuracy :0.781
Recall: 0.65
Precision:1.0
F1_Score:0.788
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 :0.625
Recall: 0.5
Precision:0.833
F1_Score:0.625
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 :0.719
Recall: 0.462
Precision:0.75
F1_Score:0.571
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 :0.656
Recall: 0.385
Precision:0.625
F1_Score:0.476
Batch 5:MLP
Accuracy :0.812
Recall: 0.538
Precision:1.0
F1_Score:0.7
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 :0.75
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 :0.75
Recall: 0.333
Precision:1.0
F1_Score:0.5
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 :0.562
Recall: 0.333
Precision:0.4
F1_Score:0.364
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 :0.781
Recall: 0.462
Precision:1.0
F1_Score:0.632
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 :0.656
Recall: 0.625
Precision:0.385
F1_Score:0.476
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 :0.781
Recall: 0.25
Precision:0.667
F1_Score:0.364
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 :0.812
Recall: 0.5
Precision:0.667
```

```
F1_Score:0.571
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 :0.812
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 :0.781
Recall: 0.571
Precision:0.5
F1_Score:0.533
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 :0.844
Recall: 0.571
Precision:0.667
F1_Score:0.615
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 :0.844
Recall: 0.4
Precision:0.5
F1_Score:0.444
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 :0.688
                    Recall: 0.333
                    Precision:1.0
                    F1_Score:0.5
                    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 :0.625
                    Recall: 0.467
                    Precision:0.636
                    F1_Score:0.538
                    Batch 14:MLP
                    Accuracy :0.625
                    Recall: 0.2
                    Precision:1.0
                    F1_Score:0.333
                    Batch 15:LogReg
                    Accuracy :0.625
                    Recall: 0.64
                    Precision:0.842
                    F1_Score:0.727
                    Batch 15:RF
                    Accuracy :0.812
                    Recall: 0.84
                    Precision:0.913
                    F1_Score:0.875
                    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 :0.75
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 :0.656
Recall: 0.308
Precision:0.667
F1_Score:0.421
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 :0.594
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 :0.438
Recall: 0.286
Precision:0.333
F1_Score:0.308
Batch 17:MLP
Accuracy :0.656
Recall: 0.643
Precision:0.6
F1_Score:0.621
Batch 18:LogReg
Accuracy :0.469
Recall: 0.909
Precision:0.385
F1_Score:0.541
Batch 18:RF
Accuracy :0.625
Recall: 0.818
Precision:0.474
F1_Score:0.6
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 :0.531
Recall: 0.545
Precision:0.375
F1_Score:0.444
Batch 18:MLP
Accuracy :0.594
Recall: 0.818
Precision:0.45
F1_Score:0.581
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 :0.75
Recall: 0.625
Precision:0.5
F1_Score:0.556
Batch 19:MLP
Accuracy :0.812
Recall: 0.75
Precision:0.6
F1_Score:0.667
Batch 20:LogReg
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 20:RF
```

```
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 20:KNN
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 20:DT
Accuracy :0.781
Recall: 0.125
Precision:1.0
F1_Score:0.222
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 :0.594
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 21:KNN
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
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: 0.0
Precision:0.0
F1_Score:0.0
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: 0.0
Precision:0.0
F1_Score:0.0
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 :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 22:DT
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
```

```
Batch 23:KNN
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 24:KNN
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
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: 0.125
Precision:1.0
F1_Score:0.222
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 :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 25:KNN
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 25:DT
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 26:KNN
Accuracy :0.562
Recall: 0.0
Precision:0.0
```

```
F1_Score:0.0
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 :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 27:KNN
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 27:DT
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.656
                    Recall: 0.0
                    Precision:0.0
                    F1_Score:0.0
                    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 :0.656
                    Recall: 0.0
                    Precision:0.0
                    F1_Score:0.0
                    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 :0.656
                    Recall: 0.0
                    Precision:0.0
                    F1_Score:0.0
                    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 :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 31:KNN
Accuracy :0.656
Recall: 0.083
Precision:1.0
F1_Score:0.154
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 :0.656
Recall: 0.083
Precision:1.0
F1_Score:0.154
Batch 31:DT
Accuracy :0.625
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.688
Recall: 0.182
Precision:0.667
F1_Score:0.286
Batch 32:KNN
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 32:DT
Accuracy :0.688
Recall: 0.091
Precision:1.0
F1_Score:0.167
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 :0.844
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 33:KNN
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 34:KNN
Accuracy :0.688
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 :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.844
Recall: 0.5
Precision:1.0
F1_Score:0.667
Batch 35:KNN
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 35:DT
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.594
Recall: 0.133
Precision:1.0
F1_Score:0.235
Batch 36:KNN
Accuracy :0.531
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 36:SVM
Accuracy :0.531
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 36:GNB
Accuracy :0.5
Recall: 1.0
Precision:0.484
F1_Score:0.652
Batch 36:XGB
Accuracy :0.531
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 36:DT
Accuracy :0.531
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.375
Recall: 0.0
```

```
Precision:0.0
F1_Score:0.0
Batch 37:KNN
Accuracy :0.406
Recall: 0.05
Precision:1.0
F1_Score:0.095
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 :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 37:DT
Accuracy :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.281
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 38:KNN
Accuracy :0.281
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.281
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 39:KNN
Accuracy :0.375
Recall: 0.0
Precision:0.0
F1_Score:0.0
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: 0.0
Precision:0.0
F1_Score:0.0
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 :0.562
```

```
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.781
Recall: 0.125
Precision:1.0
F1_Score:0.222
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 :0.75
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 :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 42:KNN
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 42:DT
Accuracy :0.562
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 :0.656
Recall: 0.214
Precision:1.0
F1_Score:0.353
Batch 43:KNN
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 43:DT
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.906
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 44:KNN
Accuracy :0.906
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 :0.906
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 44:DT
Accuracy :0.906
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 :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.75
Recall: 0.273
Precision:1.0
F1_Score:0.429
Batch 46:KNN
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 47:KNN
Accuracy :0.844
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.844
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 48:KNN
Accuracy :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 48:DT
Accuracy :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 49:KNN
Accuracy :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.406
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 49:DT
Accuracy :0.406
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 :0.469
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 50:KNN
Accuracy :0.469
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.594
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.719
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.719
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 :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 53:KNN
Accuracy :0.656
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.656
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 :0.906
Recall: 0.0
Precision:0.0
F1_Score:0.0
```

```
Batch 54:KNN
Accuracy :0.906
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 :0.906
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 :0.844
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 55:KNN
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
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 :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 55:DT
Accuracy :0.812
```

```
                    Recall: 0.0
                    Precision:0.0
                    F1_Score:0.0
                    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 :0.917
                    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 :0.917
                    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 | 0.8562 | 0.8946 | 0.7246 |
| 1 | 0.6686 | 0.6230 | 0.5334 | 0.5332 | 0.7500 | 0.7594 | 0.4208 |
| 2 | 0.7498 | 0.6310 | 0.2630 | 0.3386 | 0.8062 | 0.7976 | 0.3966 |
| 3 | 0.6312 | 0.6178 | 0.7590 | 0.6464 | 0.7000 | 0.6214 | 0.6796 |

| | LogReg_accuracy | LogReg_precision | LogReg_recall | LogReg | RF_accuracy | RF_precision | RF_recall |
|---|---|---|---|---|---|---|---|
| **4** | 0.7624 | 0.0000 | 0.0000 | 0.0000 | 0.7688 | 0.2000 | 0.0666 |
| **5** | 0.6186 | 0.0000 | 0.0000 | 0.0000 | 0.6186 | 0.0000 | 0.0000 |
| **6** | 0.6874 | 0.0000 | 0.0000 | 0.0000 | 0.7002 | 0.3334 | 0.0698 |
| **7** | 0.4500 | 0.0000 | 0.0000 | 0.0000 | 0.4938 | 0.4000 | 0.1266 |
| **8** | 0.6684 | 0.0000 | 0.0000 | 0.0000 | 0.6872 | 0.2000 | 0.0428 |
| **9** | 0.6374 | 0.0000 | 0.0000 | 0.0000 | 0.6498 | 0.2000 | 0.0546 |
| **10** | 0.6688 | 0.0000 | 0.0000 | 0.0000 | 0.6688 | 0.0000 | 0.0000 |
| **11** | 0.8645 | 0.0000 | 0.0000 | 0.0000 | 0.8805 | 0.5000 | 0.0835 |

12 rows × 32 columns

## Perfromance Analysis using Graphs

In [91]:
```python
## df : accuracy , recall and precision measures for all 8 classifiers for each batc
## 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['KN
    #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_j

    #fig6.show()
```

In [92]:
```python
plt_classification_results(df,df2)
```
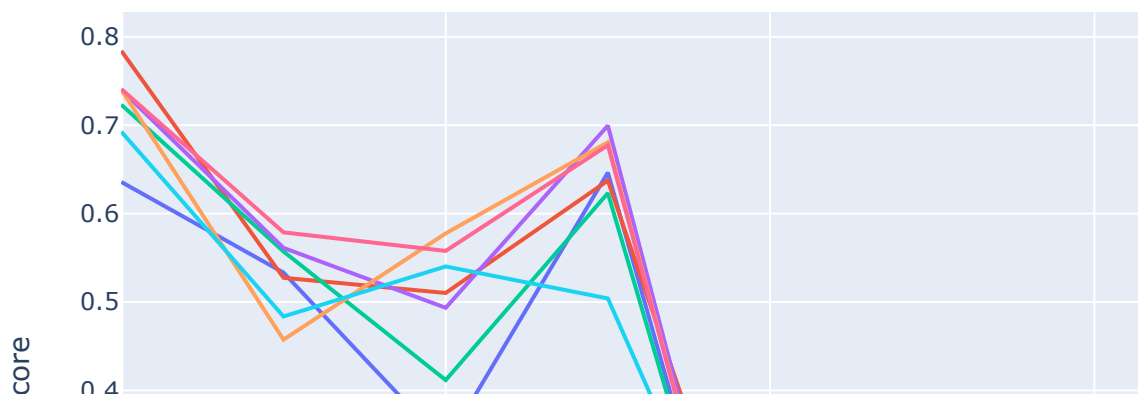
## B. Bottom 25 Sudden Drift

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

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

In [95]:
```
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, 3, 4, 5, 17, 18, 19]

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, 30]

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, 26, 27]

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, 17, 18, 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 : [9, 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 : []

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, 8, 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 : [6]

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 : [1, 10, 11, 12, 17, 18, 2
2]

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, 5, 7, 13, 20, 21
, 29]

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 : [24, 25]

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, 10, 11, 12, 20, 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, 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, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 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 : 18

Data Points Exceeding Layer 1 Encoder Instance Threshold : [4, 9, 10, 11, 12, 14, 20, 21, 22, 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 : 19

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

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, 26]

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 : [3, 4, 8, 10, 11, 29, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [3]

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


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

Batch Number : 22

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 4, 17, 18, 21, 27]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [22, 27, 28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3


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

Batch Number : 23

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 20, 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 : [10, 30, 31]

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, 23]

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, 2, 11]

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 : [1, 2, 3, 4, 5, 21]

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, 16, 17, 25, 26, 27, 2
8]

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, 16, 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 : [0, 1, 2, 6, 11, 12, 17, 1
8, 19, 20, 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 : [10, 14, 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 : [0, 7, 8, 10, 22, 23, 30]

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 : [2, 7, 8, 9, 21, 22, 23, 24]

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, 6, 13, 14, 18, 19, 20, 21, 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, 11, 14, 15, 17, 26]

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 : [0, 1, 2, 10, 11, 23, 31]

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

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


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

Batch Number : 37

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 7, 19, 21, 22, 23, 27, 28, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [4, 22]

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


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

Batch Number : 38

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 29, 30]

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 : [0, 3, 4, 6, 7, 9, 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 : 40

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 14, 15, 17, 18, 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 : 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, 18, 19, 20, 21, 22, 23, 24, 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 : [1, 2, 3, 4, 5, 9, 10, 11,

12, 13, 14, 15, 17, 18, 19, 30, 31]

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 : [0, 9, 10, 11, 12, 15, 16, 17, 21, 22, 23, 24, 27]

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, 11, 15, 16, 17]

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 : [13, 14]

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 : [0, 1, 2, 10, 20, 27, 28, 29, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [20]

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


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

Batch Number : 47

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 2, 4, 13, 27]

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 : [4, 7, 14, 18, 19, 20, 26, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [15, 19]

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


\*\*\*\*\*\*\*\*\*\*\*\*\*

Batch Number : 49

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 5, 6, 7, 8, 9, 12, 16, 17, 18, 19, 22, 23, 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 : 50

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8 , 9, 10, 11, 12, 13, 14, 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, 2, 3, 4, 5, 6, 7, 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 : 52

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, 21, 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 : [0, 1, 2, 4, 5, 9, 16, 22,
23]

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 : [2, 16, 22]

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 : [2, 5, 6, 7, 17, 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 : [7, 10, 11]

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 [96]:
```python
perform_t_test()
```

```
Layer 1 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 0.003526
p-value for two tailed test is 0.997193
Accept H0: There is no drift in the dataset

Layer 1 Exceed Count   Values for Normal and Drifted Data
Test statistic is -0.057178
p-value for two tailed test is 0.954505
Accept H0: There is no drift in the dataset

Layer 2 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 0.292930
p-value for two tailed test is 0.770117
Accept H0: There is no drift in the dataset

Layer 2 Exceed Count   Values for Normal and Drifted Data
Test statistic is 0.455983
p-value for two tailed test is 0.649285
Accept H0: There is no drift in the dataset
```

In [97]:
```python
df_plotting=visual_analysis()
```
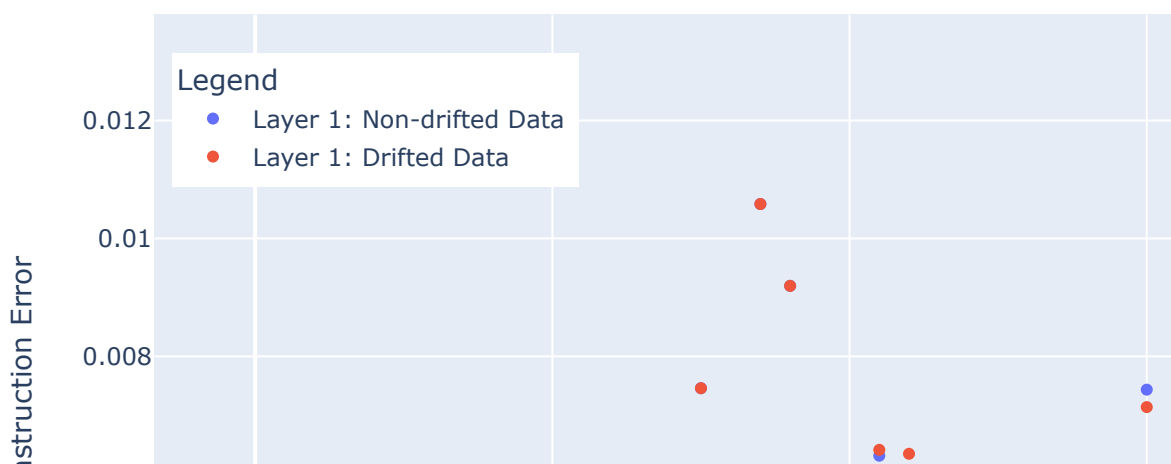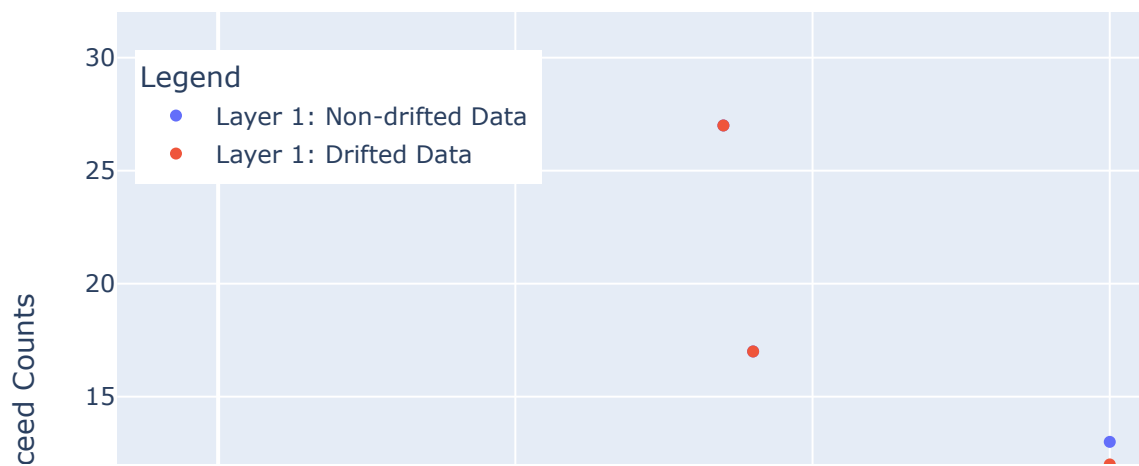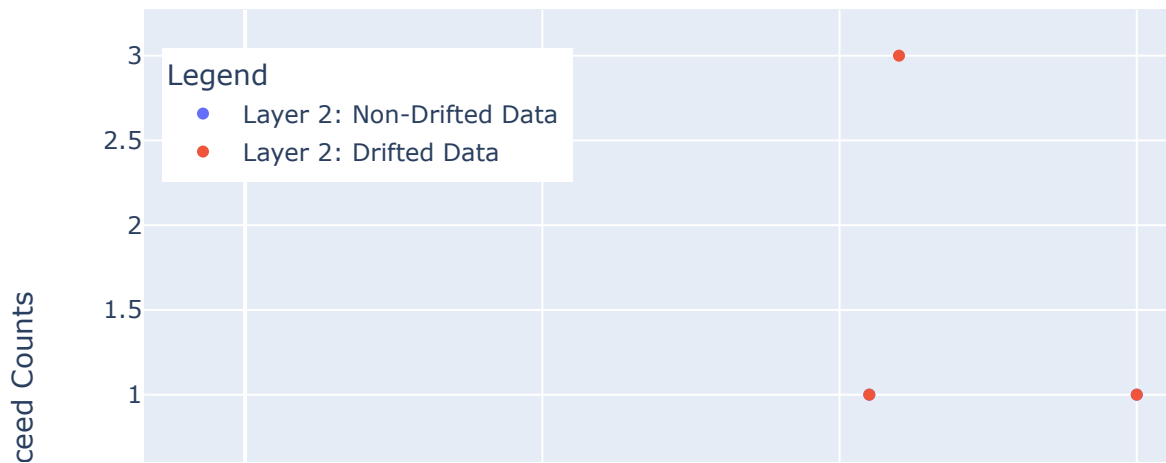
```
In [98]:  df,df2=classify_batches(models,stream_bottom25 ,stream,'class',batch_size=32)
```

```
Batch 0:LogReg
Accuracy :0.938
Recall: 0.714
Precision:1.0
F1_Score:0.833
Batch 0:RF
Accuracy :0.906
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 :0.906
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 :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
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 :0.875
Recall: 0.8
Precision:0.923
F1_Score:0.857
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 :0.719
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 :0.781
Recall: 0.857
Precision:0.818
F1_Score:0.837
Batch 3:MLP
Accuracy :0.938
Recall: 0.905
Precision:1.0
F1_Score:0.95
Batch 4:LogReg
Accuracy :0.719
Recall: 0.65
Precision:0.867
F1_Score:0.743
Batch 4:RF
Accuracy :0.781
Recall: 0.65
Precision:1.0
F1_Score:0.788
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 :0.625
Recall: 0.5
Precision:0.833
F1_Score:0.625
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 :0.719
Recall: 0.462
Precision:0.75
F1_Score:0.571
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 :0.656
Recall: 0.385
Precision:0.625
F1_Score:0.476
Batch 5:MLP
Accuracy :0.812
Recall: 0.538
Precision:1.0
F1_Score:0.7
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 :0.75
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 :0.75
Recall: 0.333
Precision:1.0
F1_Score:0.5
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 :0.562
Recall: 0.333
Precision:0.4
F1_Score:0.364
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 :0.781
Recall: 0.462
```

```
Precision:1.0
F1_Score:0.632
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 :0.656
Recall: 0.625
Precision:0.385
F1_Score:0.476
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 :0.781
Recall: 0.25
Precision:0.667
F1_Score:0.364
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 :0.812
Recall: 0.5
Precision:0.667
F1_Score:0.571
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 :0.812
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 :0.781
Recall: 0.571
Precision:0.5
F1_Score:0.533
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 :0.844
Recall: 0.571
Precision:0.667
```

```
F1_Score:0.615
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 :0.844
Recall: 0.4
Precision:0.5
F1_Score:0.444
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 :0.688
Recall: 0.333
Precision:1.0
F1_Score:0.5
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 :0.625
Recall: 0.467
Precision:0.636
F1_Score:0.538
Batch 14:MLP
Accuracy :0.625
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 15:LogReg
Accuracy :0.625
Recall: 0.64
Precision:0.842
F1_Score:0.727
Batch 15:RF
Accuracy :0.812
Recall: 0.84
Precision:0.913
F1_Score:0.875
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 :0.75
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 :0.656
Recall: 0.308
Precision:0.667
F1_Score:0.421
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 :0.594
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 :0.438
Recall: 0.286
Precision:0.333
F1_Score:0.308
Batch 17:MLP
Accuracy :0.656
Recall: 0.643
Precision:0.6
F1_Score:0.621
Batch 18:LogReg
Accuracy :0.469
Recall: 0.909
Precision:0.385
F1_Score:0.541
Batch 18:RF
Accuracy :0.625
Recall: 0.818
Precision:0.474
F1_Score:0.6
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 :0.531
Recall: 0.545
Precision:0.375
F1_Score:0.444
Batch 18:MLP
Accuracy :0.594
Recall: 0.818
Precision:0.45
F1_Score:0.581
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 :0.75
Recall: 0.625
Precision:0.5
F1_Score:0.556
Batch 19:MLP
Accuracy :0.812
Recall: 0.75
Precision:0.6
F1_Score:0.667
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 :0.875
                    Recall: 0.875
                    Precision:0.7
                    F1_Score:0.778
                    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 :0.562
                    Recall: 0.25
                    Precision:0.375
                    F1_Score:0.3
                    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 :0.844
Recall: 0.667
Precision:0.571
F1_Score:0.615
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 :0.875
Recall: 0.5
Precision:0.5
F1_Score:0.5
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 :0.781
Recall: 0.625
Precision:0.556
F1_Score:0.588
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 :0.75
Recall: 0.6
Precision:0.6
F1_Score:0.6
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 :0.812
Recall: 0.571
Precision:1.0
F1_Score:0.727
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 :0.625
```

```
Recall: 0.571
Precision:0.571
F1_Score:0.571
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 :0.781
Recall: 0.571
Precision:0.889
F1_Score:0.696
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 :0.625
Recall: 0.167
Precision:0.5
F1_Score:0.25
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 :0.656
Recall: 0.25
Precision:0.6
F1_Score:0.353
Batch 28:MLP
Accuracy :0.719
Recall: 0.417
Precision:0.714
F1_Score:0.526
Batch 29:LogReg
Accuracy :0.531
Recall: 0.727
Precision:0.4
F1_Score:0.516
Batch 29:RF
Accuracy :0.75
Recall: 0.545
Precision:0.667
F1_Score:0.6
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 :0.75
Recall: 0.636
Precision:0.636
F1_Score:0.636
Batch 30:LogReg
Accuracy :0.562
Recall: 0.818
Precision:0.429
F1_Score:0.562
Batch 30:RF
Accuracy :0.625
Recall: 0.455
Precision:0.455
F1_Score:0.455
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: 0.455
Precision:0.312
F1_Score:0.37
Batch 30:MLP
Accuracy :0.625
Recall: 0.818
Precision:0.474
F1_Score:0.6
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 :0.656
                    Recall: 0.667
                    Precision:0.533
                    F1_Score:0.593
                    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 :0.719
Recall: 0.667
Precision:0.364
F1_Score:0.471
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 :0.625
Recall: 0.3
Precision:0.375
F1_Score:0.333
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 :0.688
              Recall: 0.4
              Precision:0.5
              F1_Score:0.444
              Batch 35:LogReg
              Accuracy :0.75
              Recall: 0.8
              Precision:0.571
              F1_Score:0.667
              Batch 35:RF
              Accuracy :0.875
              Recall: 1.0
              Precision:0.714
              F1_Score:0.833
              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 :0.844
              Recall: 1.0
              Precision:0.667
              F1_Score:0.8
              Batch 35:MLP
              Accuracy :0.844
              Recall: 1.0
              Precision:0.667
              F1_Score:0.8
              Batch 36:LogReg
              Accuracy :0.719
              Recall: 0.6
              Precision:0.75
```

```
F1_Score:0.667
Batch 36:RF
Accuracy :0.781
Recall: 0.8
Precision:0.75
F1_Score:0.774
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 :0.812
Recall: 0.867
Precision:0.765
F1_Score:0.812
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 :0.812
Recall: 0.85
Precision:0.85
F1_Score:0.85
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 :0.75
Recall: 0.85
Precision:0.773
F1_Score:0.81
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 :0.688
Recall: 0.696
Precision:0.842
F1_Score:0.762
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 :0.719
Recall: 0.739
Precision:0.85
F1_Score:0.791
Batch 38:MLP
Accuracy :0.656
Recall: 0.565
Precision:0.929
F1_Score:0.703
Batch 39:LogReg
Accuracy :0.781
Recall: 0.95
Precision:0.76
F1_Score:0.844
Batch 39:RF
Accuracy :0.5
Recall: 0.4
```

```
Precision:0.667
F1_Score:0.5
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 :0.438
Recall: 0.35
Precision:0.583
F1_Score:0.438
Batch 39:MLP
Accuracy :0.656
Recall: 0.6
Precision:0.8
F1_Score:0.686
Batch 40:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:RF
Accuracy :0.844
Recall: 0.714
Precision:0.909
F1_Score:0.8
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 :0.781
Recall: 0.643
Precision:0.818
F1_Score:0.72
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 :0.75
Recall: 0.625
Precision:0.5
F1_Score:0.556
Batch 41:MLP
Accuracy :0.844
Recall: 0.625
Precision:0.714
F1_Score:0.667
Batch 42:LogReg
Accuracy :0.781
Recall: 0.786
Precision:0.733
F1_Score:0.759
Batch 42:RF
Accuracy :0.719
Recall: 0.643
Precision:0.692
F1_Score:0.667
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: 0.643
Precision:0.529
F1_Score:0.581
Batch 42:MLP
Accuracy :0.656
Recall: 0.643
Precision:0.6
F1_Score:0.621
Batch 43:LogReg
Accuracy :0.812
Recall: 0.786
Precision:0.786
F1_Score:0.786
Batch 43:RF
Accuracy :0.688
Recall: 0.929
Precision:0.591
F1_Score:0.722
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 :0.562
Recall: 0.786
Precision:0.5
```

```
F1_Score:0.611
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 :0.656
Recall: 1.0
Precision:0.214
F1_Score:0.353
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 :0.594
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 44:MLP
Accuracy :0.656
Recall: 0.667
Precision:0.167
F1_Score:0.267
Batch 45:LogReg
Accuracy :0.812
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 45:RF
Accuracy :0.875
Recall: 0.5
Precision:0.5
F1_Score:0.5
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: 0.5
Precision:0.182
F1_Score:0.267
Batch 45:MLP
Accuracy :0.906
Recall: 0.5
Precision:0.667
F1_Score:0.571
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 :0.656
Recall: 0.818
Precision:0.5
F1_Score:0.621
Batch 46:MLP
Accuracy :0.875
Recall: 0.818
```

```
Precision:0.818
F1_Score:0.818
Batch 47:LogReg
Accuracy :0.812
Recall: 0.4
Precision:0.4
F1_Score:0.4
Batch 47:RF
Accuracy :0.719
Recall: 0.6
Precision:0.3
F1_Score:0.4
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 :0.5
Recall: 0.8
Precision:0.211
F1_Score:0.333
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 :0.75
Recall: 1.0
Precision:0.704
F1_Score:0.826
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: 0.789
Precision:0.75
F1_Score:0.769
Batch 49:MLP
Accuracy :0.875
Recall: 0.895
Precision:0.895
F1_Score:0.895
Batch 50:LogReg
Accuracy :0.656
```

```
Recall: 0.941
Precision:0.615
F1_Score:0.744
Batch 50:RF
Accuracy :0.594
Recall: 0.647
Precision:0.611
F1_Score:0.629
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 :0.75
Recall: 0.882
Precision:0.714
F1_Score:0.789
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 :0.594
                    Recall: 0.444
                    Precision:0.333
                    F1_Score:0.381
                    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 :0.656
                    Recall: 0.333
                    Precision:0.375
                    F1_Score:0.353
                    Batch 52:MLP
                    Accuracy :0.562
                    Recall: 0.556
                    Precision:0.333
                    F1_Score:0.417
                    Batch 53:LogReg
                    Accuracy :0.812
                    Recall: 0.545
                    Precision:0.857
                    F1_Score:0.667
                    Batch 53:RF
```

```
Accuracy :0.906
Recall: 0.818
Precision:0.9
F1_Score:0.857
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 :0.969
Recall: 0.909
Precision:1.0
F1_Score:0.952
Batch 54:LogReg
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 54:RF
Accuracy :0.625
Recall: 0.333
Precision:0.091
F1_Score:0.143
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 :0.344
Recall: 0.333
Precision:0.05
F1_Score:0.087
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 :0.812
Recall: 1.0
Precision:0.5
F1_Score:0.667
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 :0.667
Recall: 0.5
Precision:0.125
F1_Score:0.2
Batch 56:MLP
Accuracy :0.917
Recall: 0.5
Precision:0.5
F1_Score:0.5
```

In [99]:
```
plt_classification_results(df,df2)
```
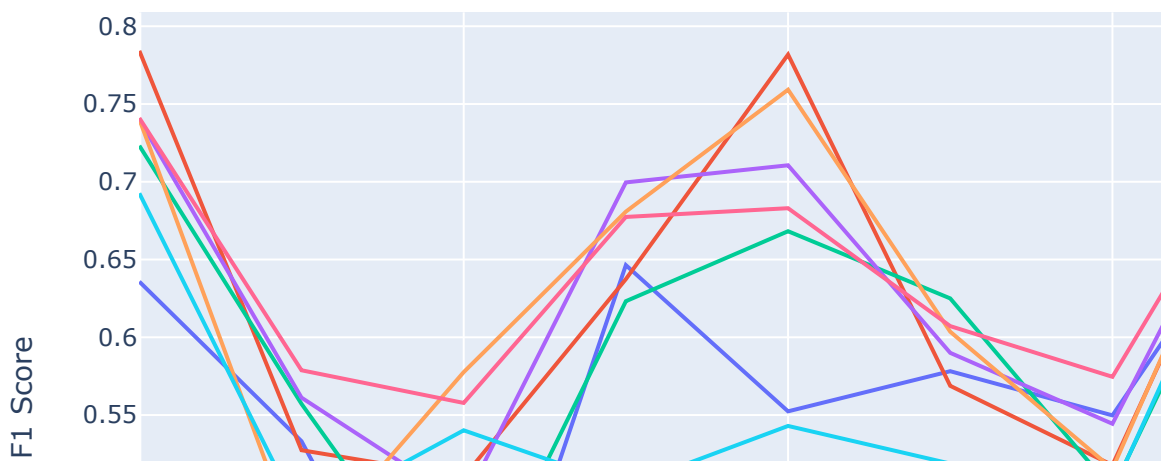
## C Gradual Drift Top25

In [100…

```python
shift=int(0.1*len(stream)/32)*32
shift/32
```

Out[100… 5.0

In [101…

```python
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=True
    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 chun
    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 [102…
```
df_drifted_top25_all,df_drifted_bottom25_all=inject_gradual_drift(stream,rank_list,ba
```

In [103…
```
batches_d=make_batches(df_drifted_top25_all)
```

In [104…
```
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, 3, 4, 5, 17, 18,
19]

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, 30]

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, 26, 27]

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, 17, 18, 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 : [9, 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, 8, 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 : [17, 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, 8, 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 : [6]

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 : [1, 10, 11, 12, 17, 18, 22
, 23, 26]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 12, 14]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3


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

Batch Number : 11

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 3, 4, 5, 7, 13, 19, 20
, 21, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [9, 10, 21, 22]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 4


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

Batch Number : 12

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 : 13

Data Points Exceeding Layer 1 Encoder Instance Threshold : [24, 29]

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, 9, 10, 11, 12, 19, 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 : [0, 2, 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, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 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 : 18

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 4, 5, 6, 8, 9, 10, 11,
12, 14, 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 : 19

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 6, 7, 9, 10, 11, 14, 1
6, 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 : [5, 6, 11, 12, 14, 18, 24,
25, 26]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [12, 19]

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


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

Batch Number : 21

```
Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 3, 4, 5, 7, 8, 9, 1
0, 11, 12, 17, 18, 20, 21, 22, 23, 28, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [3, 11]

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



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

Batch Number : 22

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 4, 8, 9, 13, 14, 16
, 17, 18, 19, 20, 21, 26, 27, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [22, 27]

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



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

Batch Number : 23

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 6, 19, 20, 21, 22, 23,
24, 26, 27, 30]

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

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



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

Batch Number : 24

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 4, 5, 10, 11, 12
, 13, 24, 25, 29, 30, 31]

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

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



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

Batch Number : 25

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 4, 5, 8, 9, 13,
14, 15, 16, 17, 21, 22, 23, 25, 26, 27, 29, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [14, 17]

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

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

Batch Number : 26

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 6, 7, 8, 9, 10,
11, 12, 16, 17, 20, 21, 25]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 9]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3



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

Batch Number : 27

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 12, 17, 18, 19, 20, 21, 22, 23, 24, 26]

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, 16, 17, 18, 25, 26, 2
7, 28, 31]

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, 7, 8, 14, 15, 16, 1
7, 18, 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 : [0, 1, 2, 3, 5, 6, 7, 11,
12, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [6, 18]

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

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

Batch Number : 31

Data Points Exceeding Layer 1 Encoder Instance Threshold : [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: [14, 15, 26, 27, 28, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 6

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

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: [2, 3, 4, 8, 9, 10, 12, 13, 19, 22, 24, 30]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 12

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

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: [1, 7, 8, 13, 17, 21, 22, 23, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 9

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

Batch Number : 34

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 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: [3, 24, 25, 30]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 4

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

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: [4, 7, 11, 14, 15, 16, 17,
22]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 8


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

Batch Number : 36

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, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30,
31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 2, 10, 11, 15, 25]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 6


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

Batch Number : 37

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, 4, 7, 8, 17, 18, 21,
22]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 9


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

Batch Number : 38

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: [13]

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


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

Batch Number : 39

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 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 : 40

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: []

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, 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,
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, 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, 19, 28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3

\*\*\*\*\*\*\*\*\*\*\*\*\*\*

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, 16, 17, 18, 19, 20, 21,
22, 23, 24, 25, 26, 27, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 14

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

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: [2, 8, 10, 15, 18, 19, 21,
24, 25, 26, 27]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 11



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

Batch Number : 45

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: [7, 8, 9, 13, 17, 22, 24, 2
5, 26, 27, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 12



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

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, 7, 8, 9, 10
, 12, 13, 15, 20, 21, 25, 26, 27, 28, 29, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 21



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

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, 4, 6, 7, 13, 14,
15, 16, 22, 27, 28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 13



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

```
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: [10, 15, 19, 20, 21, 22, 3
1]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 7



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

Batch Number : 49

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: [6, 8]

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



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

Batch Number : 50

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: []

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



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

Batch Number : 51

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: []

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, 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 : 53

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: [18, 29, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3


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

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: [15, 19, 26]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3


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

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, 6, 9, 13, 14, 17, 18
, 19, 22, 23, 27, 28, 29, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 16


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

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, 20, 21, 22, 23]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 20

```
              Drift Detection at Batch Level

              Threshold exceeds at batch : 11
[11]
Warning Level at Batch 11
 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 : 31
[31]
Warning Level at Batch 31
 Threshold exceeds at batch : 32
[31, 32]
Warning Level at Batch 32
 Threshold exceeds at batch : 33
[31, 32, 33]
 Drift Confirmed at Batch No :   31
 Threshold exceeds at batch : 34
[31, 32, 33, 34]
 Drift Confirmed at Batch No :   32
 Threshold exceeds at batch : 35
[31, 32, 33, 34, 35]
 Drift Confirmed at Batch No :   33
 Threshold exceeds at batch : 36
[31, 32, 33, 34, 35, 36]
 Drift Confirmed at Batch No :   34
 Threshold exceeds at batch : 37
[31, 32, 33, 34, 35, 36, 37]
 Drift Confirmed at Batch No :   35
 Threshold exceeds at batch : 38
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   36
 Threshold exceeds at batch : 41
[31, 32, 33, 34, 35, 36, 37, 38]
 Threshold exceeds at batch : 42
[31, 32, 33, 34, 35, 36, 37, 38]
 Threshold exceeds at batch : 43
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   41
 Threshold exceeds at batch : 44
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   42
 Threshold exceeds at batch : 45
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   43
 Threshold exceeds at batch : 46
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   44
 Threshold exceeds at batch : 47
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   45
 Threshold exceeds at batch : 48
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   46
 Threshold exceeds at batch : 49
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   47
 Threshold exceeds at batch : 53
```

```
[31, 32, 33, 34, 35, 36, 37, 38]
 Threshold exceeds at batch : 54
[31, 32, 33, 34, 35, 36, 37, 38]
 Threshold exceeds at batch : 55
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   53
 Threshold exceeds at batch : 56
[31, 32, 33, 34, 35, 36, 37, 38]
 Drift Confirmed at Batch No :   54
```

In [105…

```python
perform_t_test()
```

```
Layer 1 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 6.328754
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 -5.600620
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 6.693143
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 4.862215
p-value for two tailed test is 0.000004
Conclusion :
Since p-value(=0.000004) < 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 [106…

```python
df_plotting=visual_analysis()
```
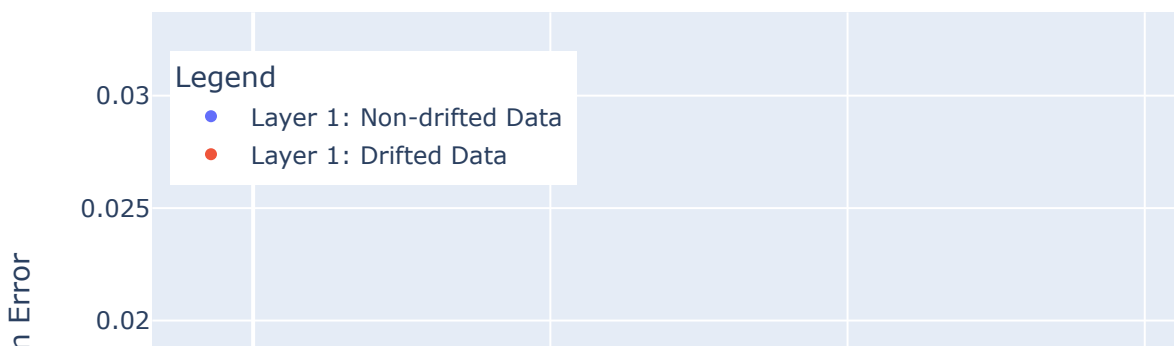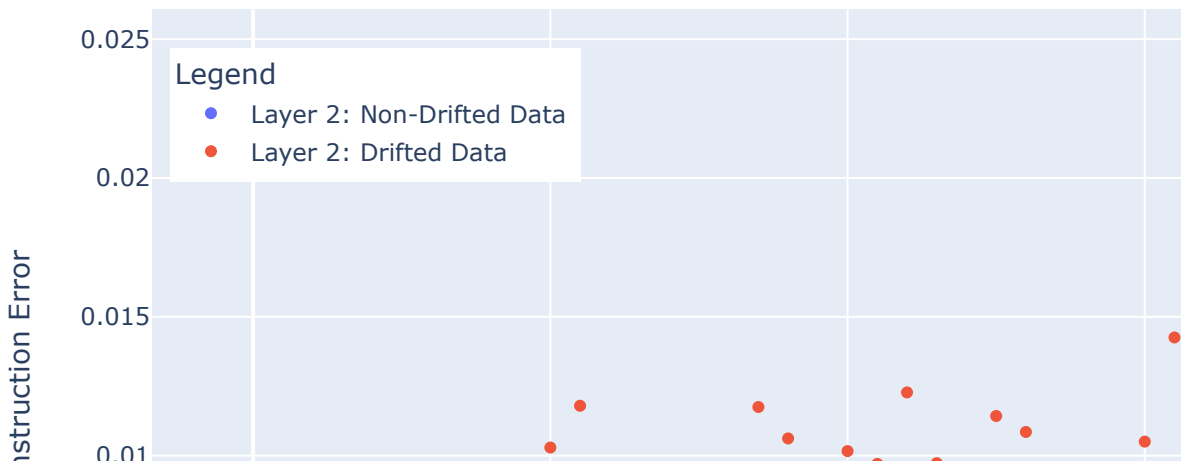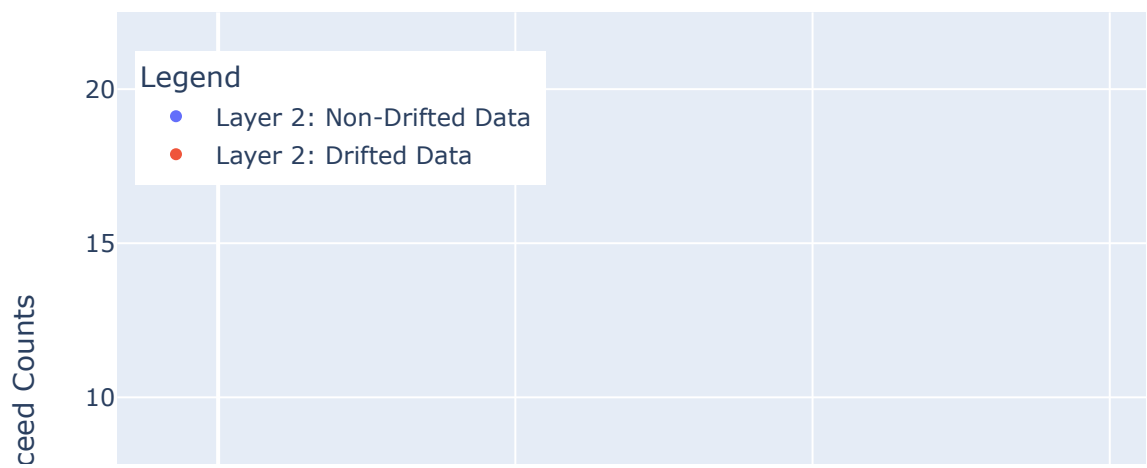
In [107…

```
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 :0.906
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 :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
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 :0.875
Recall: 0.8
Precision:0.923
F1_Score:0.857
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 :0.719
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 :0.781
Recall: 0.857
Precision:0.818
F1_Score:0.837
Batch 3:MLP
Accuracy :0.938
Recall: 0.905
Precision:1.0
F1_Score:0.95
Batch 4:LogReg
Accuracy :0.719
Recall: 0.65
Precision:0.867
F1_Score:0.743
Batch 4:RF
Accuracy :0.781
Recall: 0.65
Precision:1.0
F1_Score:0.788
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 :0.625
Recall: 0.5
Precision:0.833
F1_Score:0.625
Batch 4:MLP
Accuracy :0.781
Recall: 0.65
Precision:1.0
F1_Score:0.788
Batch 5:LogReg
Accuracy :0.562
Recall: 0.923
Precision:0.48
F1_Score:0.632
Batch 5:RF
Accuracy :0.688
Recall: 0.462
Precision:0.667
F1_Score:0.545
Batch 5:KNN
Accuracy :0.656
Recall: 0.692
Precision:0.562
F1_Score:0.621
Batch 5:SVM
Accuracy :0.625
Recall: 0.538
Precision:0.538
F1_Score:0.538
Batch 5:GNB
Accuracy :0.5
Recall: 0.923
Precision:0.444
F1_Score:0.6
Batch 5:XGB
Accuracy :0.688
Recall: 0.462
Precision:0.667
F1_Score:0.545
Batch 5:DT
Accuracy :0.656
Recall: 0.538
Precision:0.583
F1_Score:0.56
Batch 5:MLP
Accuracy :0.656
Recall: 0.538
Precision:0.583
F1_Score:0.56
Batch 6:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.3
F1_Score:0.462
```

```
Batch 6:RF
Accuracy :0.656
Recall: 0.111
Precision:0.25
F1_Score:0.154
Batch 6:KNN
Accuracy :0.688
Recall: 0.556
Precision:0.455
F1_Score:0.5
Batch 6:SVM
Accuracy :0.75
Recall: 0.444
Precision:0.571
F1_Score:0.5
Batch 6:GNB
Accuracy :0.5
Recall: 1.0
Precision:0.36
F1_Score:0.529
Batch 6:XGB
Accuracy :0.719
Recall: 0.111
Precision:0.5
F1_Score:0.182
Batch 6:DT
Accuracy :0.656
Recall: 0.556
Precision:0.417
F1_Score:0.476
Batch 6:MLP
Accuracy :0.688
Recall: 0.667
Precision:0.462
F1_Score:0.545
Batch 7:LogReg
Accuracy :0.625
Recall: 0.917
Precision:0.5
F1_Score:0.647
Batch 7:RF
Accuracy :0.75
Recall: 0.417
Precision:0.833
F1_Score:0.556
Batch 7:KNN
Accuracy :0.625
Recall: 0.417
Precision:0.5
F1_Score:0.455
Batch 7:SVM
Accuracy :0.812
Recall: 0.75
Precision:0.75
F1_Score:0.75
Batch 7:GNB
Accuracy :0.406
Recall: 0.833
Precision:0.37
F1_Score:0.513
Batch 7:XGB
Accuracy :0.781
```

```
                    Recall: 0.417
                    Precision:1.0
                    F1_Score:0.588
                    Batch 7:DT
                    Accuracy :0.594
                    Recall: 0.333
                    Precision:0.444
                    F1_Score:0.381
                    Batch 7:MLP
                    Accuracy :0.875
                    Recall: 0.917
                    Precision:0.786
                    F1_Score:0.846
                    Batch 8:LogReg
                    Accuracy :0.844
                    Recall: 0.615
                    Precision:1.0
                    F1_Score:0.762
                    Batch 8:RF
                    Accuracy :0.844
                    Recall: 0.769
                    Precision:0.833
                    F1_Score:0.8
                    Batch 8:KNN
                    Accuracy :0.719
                    Recall: 0.769
                    Precision:0.625
                    F1_Score:0.69
                    Batch 8:SVM
                    Accuracy :0.938
                    Recall: 0.923
                    Precision:0.923
                    F1_Score:0.923
                    Batch 8:GNB
                    Accuracy :0.688
                    Recall: 0.846
                    Precision:0.579
                    F1_Score:0.688
                    Batch 8:XGB
                    Accuracy :0.844
                    Recall: 0.692
                    Precision:0.9
                    F1_Score:0.783
                    Batch 8:DT
                    Accuracy :0.812
                    Recall: 0.615
                    Precision:0.889
                    F1_Score:0.727
                    Batch 8:MLP
                    Accuracy :0.906
                    Recall: 0.846
                    Precision:0.917
                    F1_Score:0.88
                    Batch 9:LogReg
                    Accuracy :0.812
                    Recall: 0.5
                    Precision:0.667
                    F1_Score:0.571
                    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 :0.812
Recall: 0.625
Precision:0.625
F1_Score:0.625
Batch 9:GNB
Accuracy :0.781
Recall: 0.125
Precision:1.0
F1_Score:0.222
Batch 9:XGB
Accuracy :0.812
Recall: 0.625
Precision:0.625
F1_Score:0.625
Batch 9:DT
Accuracy :0.719
Recall: 0.625
Precision:0.455
F1_Score:0.526
Batch 9:MLP
Accuracy :0.719
Recall: 0.5
Precision:0.444
F1_Score:0.471
Batch 10:LogReg
Accuracy :0.719
Recall: 0.875
Precision:0.467
F1_Score:0.609
Batch 10:RF
Accuracy :0.75
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 10:KNN
Accuracy :0.75
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 10:SVM
Accuracy :0.844
Recall: 0.875
Precision:0.636
F1_Score:0.737
Batch 10:GNB
Accuracy :0.75
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 10:XGB
Accuracy :0.812
Recall: 0.625
Precision:0.625
F1_Score:0.625
Batch 10:DT
```

```
Accuracy :0.594
Recall: 0.375
Precision:0.273
F1_Score:0.316
Batch 10:MLP
Accuracy :0.688
Recall: 0.875
Precision:0.438
F1_Score:0.583
Batch 11:LogReg
Accuracy :0.781
Recall: 0.714
Precision:0.5
F1_Score:0.588
Batch 11:RF
Accuracy :0.812
Recall: 0.571
Precision:0.571
F1_Score:0.571
Batch 11:KNN
Accuracy :0.781
Recall: 0.571
Precision:0.5
F1_Score:0.533
Batch 11:SVM
Accuracy :0.812
Recall: 0.714
Precision:0.556
F1_Score:0.625
Batch 11:GNB
Accuracy :0.781
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 11:XGB
Accuracy :0.812
Recall: 0.857
Precision:0.545
F1_Score:0.667
Batch 11:DT
Accuracy :0.625
Recall: 0.571
Precision:0.308
F1_Score:0.4
Batch 11:MLP
Accuracy :0.812
Recall: 0.714
Precision:0.556
F1_Score:0.625
Batch 12:LogReg
Accuracy :0.875
Recall: 0.714
Precision:0.714
F1_Score:0.714
Batch 12:RF
Accuracy :0.906
Recall: 0.714
Precision:0.833
F1_Score:0.769
Batch 12:KNN
Accuracy :0.875
Recall: 0.714
```

```
Precision:0.714
F1_Score:0.714
Batch 12:SVM
Accuracy :0.906
Recall: 0.714
Precision:0.833
F1_Score:0.769
Batch 12:GNB
Accuracy :0.781
Recall: 0.143
Precision:0.5
F1_Score:0.222
Batch 12:XGB
Accuracy :0.844
Recall: 0.571
Precision:0.667
F1_Score:0.615
Batch 12:DT
Accuracy :0.844
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 12:MLP
Accuracy :0.844
Recall: 0.714
Precision:0.625
F1_Score:0.667
Batch 13:LogReg
Accuracy :0.875
Recall: 0.8
Precision:0.571
F1_Score:0.667
Batch 13:RF
Accuracy :0.875
Recall: 0.4
Precision:0.667
F1_Score:0.5
Batch 13:KNN
Accuracy :0.812
Recall: 0.4
Precision:0.4
F1_Score:0.4
Batch 13:SVM
Accuracy :0.875
Recall: 0.6
Precision:0.6
F1_Score:0.6
Batch 13:GNB
Accuracy :0.844
Recall: 0.2
Precision:0.5
F1_Score:0.286
Batch 13:XGB
Accuracy :0.906
Recall: 0.6
Precision:0.75
F1_Score:0.667
Batch 13:DT
Accuracy :0.719
Recall: 0.4
Precision:0.25
F1_Score:0.308
```

```
Batch 13:MLP
Accuracy :0.844
Recall: 0.6
Precision:0.5
F1_Score:0.545
Batch 14:LogReg
Accuracy :0.75
Recall: 0.6
Precision:0.818
F1_Score:0.692
Batch 14:RF
Accuracy :0.75
Recall: 0.667
Precision:0.769
F1_Score:0.714
Batch 14:KNN
Accuracy :0.844
Recall: 0.867
Precision:0.812
F1_Score:0.839
Batch 14:SVM
Accuracy :0.781
Recall: 0.8
Precision:0.75
F1_Score:0.774
Batch 14:GNB
Accuracy :0.781
Recall: 0.8
Precision:0.75
F1_Score:0.774
Batch 14:XGB
Accuracy :0.656
Recall: 0.467
Precision:0.7
F1_Score:0.56
Batch 14:DT
Accuracy :0.625
Recall: 0.4
Precision:0.667
F1_Score:0.5
Batch 14:MLP
Accuracy :0.75
Recall: 0.8
Precision:0.706
F1_Score:0.75
Batch 15:LogReg
Accuracy :0.812
Recall: 1.0
Precision:0.806
F1_Score:0.893
Batch 15:RF
Accuracy :0.875
Recall: 1.0
Precision:0.862
F1_Score:0.926
Batch 15:KNN
Accuracy :0.844
Recall: 0.96
Precision:0.857
F1_Score:0.906
Batch 15:SVM
Accuracy :0.844
```

```
Recall: 1.0
Precision:0.833
F1_Score:0.909
Batch 15:GNB
Accuracy :0.719
Recall: 0.92
Precision:0.767
F1_Score:0.836
Batch 15:XGB
Accuracy :0.875
Recall: 1.0
Precision:0.862
F1_Score:0.926
Batch 15:DT
Accuracy :0.812
Recall: 0.84
Precision:0.913
F1_Score:0.875
Batch 15:MLP
Accuracy :0.781
Recall: 1.0
Precision:0.781
F1_Score:0.877
Batch 16:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.419
F1_Score:0.591
Batch 16:RF
Accuracy :0.781
Recall: 0.462
Precision:1.0
F1_Score:0.632
Batch 16:KNN
Accuracy :0.688
Recall: 0.769
Precision:0.588
F1_Score:0.667
Batch 16:SVM
Accuracy :0.719
Recall: 0.846
Precision:0.611
F1_Score:0.71
Batch 16:GNB
Accuracy :0.469
Recall: 1.0
Precision:0.433
F1_Score:0.605
Batch 16:XGB
Accuracy :0.75
Recall: 0.462
Precision:0.857
F1_Score:0.6
Batch 16:DT
Accuracy :0.625
Recall: 0.615
Precision:0.533
F1_Score:0.571
Batch 16:MLP
Accuracy :0.656
Recall: 0.923
Precision:0.545
```

```
F1_Score:0.686
Batch 17:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 17:RF
Accuracy :0.594
Recall: 0.143
Precision:0.667
F1_Score:0.235
Batch 17:KNN
Accuracy :0.594
Recall: 0.643
Precision:0.529
F1_Score:0.581
Batch 17:SVM
Accuracy :0.438
Recall: 0.857
Precision:0.429
F1_Score:0.571
Batch 17:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 17:XGB
Accuracy :0.594
Recall: 0.429
Precision:0.545
F1_Score:0.48
Batch 17:DT
Accuracy :0.531
Recall: 0.214
Precision:0.429
F1_Score:0.286
Batch 17:MLP
Accuracy :0.469
Recall: 0.929
Precision:0.448
F1_Score:0.605
Batch 18:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 18:RF
Accuracy :0.625
Recall: 0.364
Precision:0.444
F1_Score:0.4
Batch 18:KNN
Accuracy :0.469
Recall: 0.636
Precision:0.35
F1_Score:0.452
Batch 18:SVM
Accuracy :0.375
Recall: 0.818
Precision:0.333
F1_Score:0.474
Batch 18:GNB
```

```
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 18:XGB
Accuracy :0.656
Recall: 0.636
Precision:0.5
F1_Score:0.56
Batch 18:DT
Accuracy :0.531
Recall: 0.182
Precision:0.25
F1_Score:0.211
Batch 18:MLP
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 19:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.276
F1_Score:0.432
Batch 19:RF
Accuracy :0.594
Recall: 0.75
Precision:0.353
F1_Score:0.48
Batch 19:KNN
Accuracy :0.375
Recall: 1.0
Precision:0.286
F1_Score:0.444
Batch 19:SVM
Accuracy :0.312
Recall: 1.0
Precision:0.267
F1_Score:0.421
Batch 19:GNB
Accuracy :0.375
Recall: 1.0
Precision:0.286
F1_Score:0.444
Batch 19:XGB
Accuracy :0.594
Recall: 0.75
Precision:0.353
F1_Score:0.48
Batch 19:DT
Accuracy :0.656
Recall: 0.75
Precision:0.4
F1_Score:0.522
Batch 19:MLP
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 20:LogReg
Accuracy :0.375
Recall: 1.0
```

```
                Precision:0.286
                F1_Score:0.444
                Batch 20:RF
                Accuracy :0.656
                Recall: 1.0
                Precision:0.421
                F1_Score:0.593
                Batch 20:KNN
                Accuracy :0.406
                Recall: 1.0
                Precision:0.296
                F1_Score:0.457
                Batch 20:SVM
                Accuracy :0.375
                Recall: 1.0
                Precision:0.286
                F1_Score:0.444
                Batch 20:GNB
                Accuracy :0.594
                Recall: 1.0
                Precision:0.381
                F1_Score:0.552
                Batch 20:XGB
                Accuracy :0.688
                Recall: 0.875
                Precision:0.438
                F1_Score:0.583
                Batch 20:DT
                Accuracy :0.656
                Recall: 1.0
                Precision:0.421
                F1_Score:0.593
                Batch 20:MLP
                Accuracy :0.312
                Recall: 1.0
                Precision:0.267
                F1_Score:0.421
                Batch 21:LogReg
                Accuracy :0.469
                Recall: 1.0
                Precision:0.414
                F1_Score:0.585
                Batch 21:RF
                Accuracy :0.75
                Recall: 0.667
                Precision:0.667
                F1_Score:0.667
                Batch 21:KNN
                Accuracy :0.688
                Recall: 1.0
                Precision:0.545
                F1_Score:0.706
                Batch 21:SVM
                Accuracy :0.5
                Recall: 1.0
                Precision:0.429
                F1_Score:0.6
                Batch 21:GNB
                Accuracy :0.688
                Recall: 0.167
                Precision:1.0
                F1_Score:0.286
```

```
Batch 21:XGB
Accuracy :0.688
Recall: 0.833
Precision:0.556
F1_Score:0.667
Batch 21:DT
Accuracy :0.375
Recall: 0.417
Precision:0.278
F1_Score:0.333
Batch 21:MLP
Accuracy :0.469
Recall: 1.0
Precision:0.414
F1_Score:0.585
Batch 22:LogReg
Accuracy :0.5
Recall: 0.833
Precision:0.25
F1_Score:0.385
Batch 22:RF
Accuracy :0.875
Recall: 0.667
Precision:0.667
F1_Score:0.667
Batch 22:KNN
Accuracy :0.844
Recall: 0.667
Precision:0.571
F1_Score:0.615
Batch 22:SVM
Accuracy :0.625
Recall: 0.667
Precision:0.286
F1_Score:0.4
Batch 22:GNB
Accuracy :0.844
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 22:XGB
Accuracy :0.781
Recall: 0.667
Precision:0.444
F1_Score:0.533
Batch 22:DT
Accuracy :0.594
Recall: 0.5
Precision:0.231
F1_Score:0.316
Batch 22:MLP
Accuracy :0.625
Recall: 0.667
Precision:0.286
F1_Score:0.4
Batch 23:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.182
F1_Score:0.308
Batch 23:RF
Accuracy :0.781
```

```
Recall: 0.75
Precision:0.333
F1_Score:0.462
Batch 23:KNN
Accuracy :0.625
Recall: 0.75
Precision:0.214
F1_Score:0.333
Batch 23:SVM
Accuracy :0.5
Recall: 1.0
Precision:0.2
F1_Score:0.333
Batch 23:GNB
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 23:XGB
Accuracy :0.688
Recall: 0.75
Precision:0.25
F1_Score:0.375
Batch 23:DT
Accuracy :0.594
Recall: 0.25
Precision:0.091
F1_Score:0.133
Batch 23:MLP
Accuracy :0.5
Recall: 1.0
Precision:0.2
F1_Score:0.333
Batch 24:LogReg
Accuracy :0.5
Recall: 0.875
Precision:0.318
F1_Score:0.467
Batch 24:RF
Accuracy :0.719
Recall: 0.625
Precision:0.455
F1_Score:0.526
Batch 24:KNN
Accuracy :0.562
Recall: 0.875
Precision:0.35
F1_Score:0.5
Batch 24:SVM
Accuracy :0.344
Recall: 0.875
Precision:0.259
F1_Score:0.4
Batch 24:GNB
Accuracy :0.75
Recall: 0.375
Precision:0.5
F1_Score:0.429
Batch 24:XGB
Accuracy :0.656
Recall: 0.75
Precision:0.4
```

```
F1_Score:0.522
Batch 24:DT
Accuracy :0.562
Recall: 0.625
Precision:0.312
F1_Score:0.417
Batch 24:MLP
Accuracy :0.344
Recall: 0.875
Precision:0.259
F1_Score:0.4
Batch 25:LogReg
Accuracy :0.469
Recall: 1.0
Precision:0.37
F1_Score:0.541
Batch 25:RF
Accuracy :0.688
Recall: 1.0
Precision:0.5
F1_Score:0.667
Batch 25:KNN
Accuracy :0.562
Recall: 0.9
Precision:0.409
F1_Score:0.563
Batch 25:SVM
Accuracy :0.438
Recall: 1.0
Precision:0.357
F1_Score:0.526
Batch 25:GNB
Accuracy :0.656
Recall: 0.9
Precision:0.474
F1_Score:0.621
Batch 25:XGB
Accuracy :0.719
Recall: 0.9
Precision:0.529
F1_Score:0.667
Batch 25:DT
Accuracy :0.625
Recall: 1.0
Precision:0.455
F1_Score:0.625
Batch 25:MLP
Accuracy :0.406
Recall: 1.0
Precision:0.345
F1_Score:0.513
Batch 26:LogReg
Accuracy :0.469
Recall: 0.929
Precision:0.448
F1_Score:0.605
Batch 26:RF
Accuracy :0.625
Recall: 0.857
Precision:0.545
F1_Score:0.667
Batch 26:KNN
```

```
Accuracy :0.562
Recall: 0.929
Precision:0.5
F1_Score:0.65
Batch 26:SVM
Accuracy :0.5
Recall: 0.929
Precision:0.464
F1_Score:0.619
Batch 26:GNB
Accuracy :0.469
Recall: 0.857
Precision:0.444
F1_Score:0.585
Batch 26:XGB
Accuracy :0.594
Recall: 0.786
Precision:0.524
F1_Score:0.629
Batch 26:DT
Accuracy :0.562
Recall: 0.714
Precision:0.5
F1_Score:0.588
Batch 26:MLP
Accuracy :0.406
Recall: 0.929
Precision:0.419
F1_Score:0.578
Batch 27:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 27:RF
Accuracy :0.719
Recall: 0.643
Precision:0.692
F1_Score:0.667
Batch 27:KNN
Accuracy :0.656
Recall: 0.929
Precision:0.565
F1_Score:0.703
Batch 27:SVM
Accuracy :0.719
Recall: 1.0
Precision:0.609
F1_Score:0.757
Batch 27:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 27:XGB
Accuracy :0.656
Recall: 0.571
Precision:0.615
F1_Score:0.593
Batch 27:DT
Accuracy :0.656
Recall: 0.5
```

```
Precision:0.636
F1_Score:0.56
Batch 27:MLP
Accuracy :0.594
Recall: 1.0
Precision:0.519
F1_Score:0.683
Batch 28:LogReg
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 28:RF
Accuracy :0.625
Recall: 0.167
Precision:0.5
F1_Score:0.25
Batch 28:KNN
Accuracy :0.688
Recall: 0.75
Precision:0.562
F1_Score:0.643
Batch 28:SVM
Accuracy :0.719
Recall: 0.917
Precision:0.579
F1_Score:0.71
Batch 28:GNB
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 28:XGB
Accuracy :0.656
Recall: 0.25
Precision:0.6
F1_Score:0.353
Batch 28:DT
Accuracy :0.594
Recall: 0.25
Precision:0.429
F1_Score:0.316
Batch 28:MLP
Accuracy :0.688
Recall: 1.0
Precision:0.545
F1_Score:0.706
Batch 29:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 29:RF
Accuracy :0.812
Recall: 0.636
Precision:0.778
F1_Score:0.7
Batch 29:KNN
Accuracy :0.5
Recall: 0.727
Precision:0.381
F1_Score:0.5
```

```
Batch 29:SVM
Accuracy :0.625
Recall: 0.818
Precision:0.474
F1_Score:0.6
Batch 29:GNB
Accuracy :0.375
Recall: 1.0
Precision:0.355
F1_Score:0.524
Batch 29:XGB
Accuracy :0.719
Recall: 0.545
Precision:0.6
F1_Score:0.571
Batch 29:DT
Accuracy :0.531
Recall: 0.545
Precision:0.375
F1_Score:0.444
Batch 29:MLP
Accuracy :0.5
Recall: 0.909
Precision:0.4
F1_Score:0.556
Batch 30:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 30:RF
Accuracy :0.594
Recall: 0.364
Precision:0.4
F1_Score:0.381
Batch 30:KNN
Accuracy :0.438
Recall: 0.636
Precision:0.333
F1_Score:0.437
Batch 30:SVM
Accuracy :0.438
Recall: 0.818
Precision:0.36
F1_Score:0.5
Batch 30:GNB
Accuracy :0.312
Recall: 0.909
Precision:0.323
F1_Score:0.476
Batch 30:XGB
Accuracy :0.531
Recall: 0.364
Precision:0.333
F1_Score:0.348
Batch 30:DT
Accuracy :0.594
Recall: 0.636
Precision:0.438
F1_Score:0.519
Batch 30:MLP
Accuracy :0.406
```

```
Recall: 1.0
Precision:0.367
F1_Score:0.537
Batch 31:LogReg
Accuracy :0.375
Recall: 1.0
Precision:0.375
F1_Score:0.545
Batch 31:RF
Accuracy :0.75
Recall: 0.917
Precision:0.611
F1_Score:0.733
Batch 31:KNN
Accuracy :0.469
Recall: 1.0
Precision:0.414
F1_Score:0.585
Batch 31:SVM
Accuracy :0.438
Recall: 1.0
Precision:0.4
F1_Score:0.571
Batch 31:GNB
Accuracy :0.5
Recall: 0.75
Precision:0.409
F1_Score:0.529
Batch 31:XGB
Accuracy :0.625
Recall: 0.917
Precision:0.5
F1_Score:0.647
Batch 31:DT
Accuracy :0.562
Recall: 0.75
Precision:0.45
F1_Score:0.563
Batch 31:MLP
Accuracy :0.438
Recall: 1.0
Precision:0.4
F1_Score:0.571
Batch 32:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 32:RF
Accuracy :0.594
Recall: 0.818
Precision:0.45
F1_Score:0.581
Batch 32:KNN
Accuracy :0.562
Recall: 1.0
Precision:0.44
F1_Score:0.611
Batch 32:SVM
Accuracy :0.375
Recall: 1.0
Precision:0.355
```

```
F1_Score:0.524
Batch 32:GNB
Accuracy :0.719
Recall: 0.364
Precision:0.667
F1_Score:0.471
Batch 32:XGB
Accuracy :0.594
Recall: 1.0
Precision:0.458
F1_Score:0.629
Batch 32:DT
Accuracy :0.562
Recall: 0.909
Precision:0.435
F1_Score:0.588
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 :0.656
Recall: 0.833
Precision:0.333
F1_Score:0.476
Batch 33:KNN
Accuracy :0.344
Recall: 1.0
Precision:0.222
F1_Score:0.364
Batch 33:SVM
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 33:GNB
Accuracy :0.844
Recall: 0.167
Precision:1.0
F1_Score:0.286
Batch 33:XGB
Accuracy :0.312
Recall: 0.833
Precision:0.192
F1_Score:0.312
Batch 33:DT
Accuracy :0.281
Recall: 0.5
Precision:0.13
F1_Score:0.207
Batch 33:MLP
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 34:LogReg
```

```
Accuracy :0.406
Recall: 1.0
Precision:0.345
F1_Score:0.513
Batch 34:RF
Accuracy :0.594
Recall: 0.7
Precision:0.412
F1_Score:0.519
Batch 34:KNN
Accuracy :0.531
Recall: 0.8
Precision:0.381
F1_Score:0.516
Batch 34:SVM
Accuracy :0.438
Recall: 1.0
Precision:0.357
F1_Score:0.526
Batch 34:GNB
Accuracy :0.688
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 34:XGB
Accuracy :0.562
Recall: 0.9
Precision:0.409
F1_Score:0.563
Batch 34:DT
Accuracy :0.625
Recall: 0.4
Precision:0.4
F1_Score:0.4
Batch 34:MLP
Accuracy :0.438
Recall: 1.0
Precision:0.357
F1_Score:0.526
Batch 35:LogReg
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 35:RF
Accuracy :0.688
Recall: 1.0
Precision:0.5
F1_Score:0.667
Batch 35:KNN
Accuracy :0.469
Recall: 1.0
Precision:0.37
F1_Score:0.541
Batch 35:SVM
Accuracy :0.312
Recall: 1.0
Precision:0.312
F1_Score:0.476
Batch 35:GNB
Accuracy :0.688
Recall: 0.2
```

```
Precision:0.5
F1_Score:0.286
Batch 35:XGB
Accuracy :0.438
Recall: 1.0
Precision:0.357
F1_Score:0.526
Batch 35:DT
Accuracy :0.719
Recall: 1.0
Precision:0.526
F1_Score:0.69
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 :0.75
Recall: 0.933
Precision:0.667
F1_Score:0.778
Batch 36:KNN
Accuracy :0.719
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 36:SVM
Accuracy :0.562
Recall: 1.0
Precision:0.517
F1_Score:0.682
Batch 36:GNB
Accuracy :0.656
Recall: 0.533
Precision:0.667
F1_Score:0.593
Batch 36:XGB
Accuracy :0.625
Recall: 1.0
Precision:0.556
F1_Score:0.714
Batch 36:DT
Accuracy :0.562
Recall: 0.733
Precision:0.524
F1_Score:0.611
Batch 36:MLP
Accuracy :0.562
Recall: 1.0
Precision:0.517
F1_Score:0.682
Batch 37:LogReg
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
```

```
Batch 37:RF
Accuracy :0.75
Recall: 0.95
Precision:0.731
F1_Score:0.826
Batch 37:KNN
Accuracy :0.656
Recall: 0.95
Precision:0.655
F1_Score:0.776
Batch 37:SVM
Accuracy :0.656
Recall: 1.0
Precision:0.645
F1_Score:0.784
Batch 37:GNB
Accuracy :0.688
Recall: 1.0
Precision:0.667
F1_Score:0.8
Batch 37:XGB
Accuracy :0.719
Recall: 1.0
Precision:0.69
F1_Score:0.816
Batch 37:DT
Accuracy :0.812
Recall: 0.9
Precision:0.818
F1_Score:0.857
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 :0.688
Recall: 0.652
Precision:0.882
F1_Score:0.75
Batch 38:KNN
Accuracy :0.719
Recall: 0.913
Precision:0.75
F1_Score:0.824
Batch 38:SVM
Accuracy :0.75
Recall: 0.957
Precision:0.759
F1_Score:0.846
Batch 38:GNB
Accuracy :0.719
Recall: 1.0
Precision:0.719
F1_Score:0.836
Batch 38:XGB
Accuracy :0.719
```

```
Recall: 0.739
Precision:0.85
F1_Score:0.791
Batch 38:DT
Accuracy :0.656
Recall: 0.565
Precision:0.929
F1_Score:0.703
Batch 38:MLP
Accuracy :0.75
Recall: 1.0
Precision:0.742
F1_Score:0.852
Batch 39:LogReg
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 39:RF
Accuracy :0.469
Recall: 0.2
Precision:0.8
F1_Score:0.32
Batch 39:KNN
Accuracy :0.531
Recall: 0.5
Precision:0.667
F1_Score:0.571
Batch 39:SVM
Accuracy :0.594
Recall: 0.75
Precision:0.652
F1_Score:0.698
Batch 39:GNB
Accuracy :0.625
Recall: 1.0
Precision:0.625
F1_Score:0.769
Batch 39:XGB
Accuracy :0.625
Recall: 0.4
Precision:1.0
F1_Score:0.571
Batch 39:DT
Accuracy :0.5
Recall: 0.2
Precision:1.0
F1_Score:0.333
Batch 39:MLP
Accuracy :0.594
Recall: 0.9
Precision:0.621
F1_Score:0.735
Batch 40:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:RF
Accuracy :0.688
Recall: 0.286
Precision:1.0
```

```
F1_Score:0.444
Batch 40:KNN
Accuracy :0.656
Recall: 0.571
Precision:0.615
F1_Score:0.593
Batch 40:SVM
Accuracy :0.75
Recall: 0.929
Precision:0.65
F1_Score:0.765
Batch 40:GNB
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:XGB
Accuracy :0.719
Recall: 0.571
Precision:0.727
F1_Score:0.64
Batch 40:DT
Accuracy :0.531
Recall: 0.357
Precision:0.455
F1_Score:0.4
Batch 40:MLP
Accuracy :0.625
Recall: 1.0
Precision:0.538
F1_Score:0.7
Batch 41:LogReg
Accuracy :0.25
Recall: 1.0
Precision:0.25
F1_Score:0.4
Batch 41:RF
Accuracy :0.781
Recall: 0.25
Precision:0.667
F1_Score:0.364
Batch 41:KNN
Accuracy :0.719
Recall: 0.5
Precision:0.444
F1_Score:0.471
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 :0.781
Recall: 0.625
Precision:0.556
F1_Score:0.588
Batch 41:DT
```

```
Accuracy :0.688
Recall: 0.375
Precision:0.375
F1_Score:0.375
Batch 41:MLP
Accuracy :0.625
Recall: 0.875
Precision:0.389
F1_Score:0.538
Batch 42:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 42:RF
Accuracy :0.531
Recall: 0.571
Precision:0.471
F1_Score:0.516
Batch 42:KNN
Accuracy :0.531
Recall: 0.643
Precision:0.474
F1_Score:0.545
Batch 42:SVM
Accuracy :0.562
Recall: 0.857
Precision:0.5
F1_Score:0.632
Batch 42:GNB
Accuracy :0.469
Recall: 1.0
Precision:0.452
F1_Score:0.622
Batch 42:XGB
Accuracy :0.562
Recall: 0.643
Precision:0.5
F1_Score:0.563
Batch 42:DT
Accuracy :0.531
Recall: 0.357
Precision:0.455
F1_Score:0.4
Batch 42:MLP
Accuracy :0.5
Recall: 1.0
Precision:0.467
F1_Score:0.636
Batch 43:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 43:RF
Accuracy :0.531
Recall: 0.929
Precision:0.481
F1_Score:0.634
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 :0.594
Recall: 0.786
Precision:0.524
F1_Score:0.629
Batch 43:XGB
Accuracy :0.562
Recall: 1.0
Precision:0.5
F1_Score:0.667
Batch 43:DT
Accuracy :0.5
Recall: 0.857
Precision:0.462
F1_Score:0.6
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 :0.438
Recall: 0.667
Precision:0.105
F1_Score:0.182
Batch 44:KNN
Accuracy :0.25
Recall: 1.0
Precision:0.111
F1_Score:0.2
Batch 44:SVM
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 44:GNB
Accuracy :0.656
Recall: 1.0
Precision:0.214
F1_Score:0.353
Batch 44:XGB
Accuracy :0.281
Recall: 0.667
Precision:0.083
F1_Score:0.148
Batch 44:DT
Accuracy :0.531
Recall: 1.0
Precision:0.167
F1_Score:0.286
```

```
Batch 44:MLP
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 45:LogReg
Accuracy :0.188
Recall: 1.0
Precision:0.133
F1_Score:0.235
Batch 45:RF
Accuracy :0.812
Recall: 0.75
Precision:0.375
F1_Score:0.5
Batch 45:KNN
Accuracy :0.469
Recall: 1.0
Precision:0.19
F1_Score:0.32
Batch 45:SVM
Accuracy :0.344
Recall: 1.0
Precision:0.16
F1_Score:0.276
Batch 45:GNB
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 45:XGB
Accuracy :0.25
Recall: 1.0
Precision:0.143
F1_Score:0.25
Batch 45:DT
Accuracy :0.656
Recall: 1.0
Precision:0.267
F1_Score:0.421
Batch 45:MLP
Accuracy :0.375
Recall: 1.0
Precision:0.167
F1_Score:0.286
Batch 46:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 46:RF
Accuracy :0.625
Recall: 1.0
Precision:0.478
F1_Score:0.647
Batch 46:KNN
Accuracy :0.438
Recall: 1.0
Precision:0.379
F1_Score:0.55
Batch 46:SVM
Accuracy :0.344
```

```
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 46:GNB
Accuracy :0.656
Recall: 0.364
Precision:0.5
F1_Score:0.421
Batch 46:XGB
Accuracy :0.438
Recall: 1.0
Precision:0.379
F1_Score:0.55
Batch 46:DT
Accuracy :0.531
Recall: 0.455
Precision:0.357
F1_Score:0.4
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 :0.531
Recall: 0.8
Precision:0.222
F1_Score:0.348
Batch 47:KNN
Accuracy :0.219
Recall: 1.0
Precision:0.167
F1_Score:0.286
Batch 47:SVM
Accuracy :0.156
Recall: 1.0
Precision:0.156
F1_Score:0.27
Batch 47:GNB
Accuracy :0.688
Recall: 0.4
Precision:0.222
F1_Score:0.286
Batch 47:XGB
Accuracy :0.219
Recall: 1.0
Precision:0.167
F1_Score:0.286
Batch 47:DT
Accuracy :0.625
Recall: 0.6
Precision:0.231
F1_Score:0.333
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 :0.75
Recall: 1.0
Precision:0.704
F1_Score:0.826
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 :0.656
Recall: 1.0
Precision:0.633
F1_Score:0.776
Batch 48:XGB
Accuracy :0.688
Recall: 1.0
Precision:0.655
F1_Score:0.792
Batch 48:DT
Accuracy :0.656
Recall: 0.842
Precision:0.667
F1_Score:0.744
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 :0.75
Recall: 0.895
Precision:0.739
F1_Score:0.81
Batch 49:KNN
Accuracy :0.75
Recall: 1.0
Precision:0.704
F1_Score:0.826
Batch 49:SVM
Accuracy :0.688
Recall: 1.0
Precision:0.655
F1_Score:0.792
Batch 49:GNB
```

```
Accuracy :0.594
Recall: 1.0
Precision:0.594
F1_Score:0.745
Batch 49:XGB
Accuracy :0.75
Recall: 0.947
Precision:0.72
F1_Score:0.818
Batch 49:DT
Accuracy :0.625
Recall: 0.526
Precision:0.769
F1_Score:0.625
Batch 49:MLP
Accuracy :0.625
Recall: 1.0
Precision:0.613
F1_Score:0.76
Batch 50:LogReg
Accuracy :0.531
Recall: 1.0
Precision:0.531
F1_Score:0.694
Batch 50:RF
Accuracy :0.688
Recall: 0.706
Precision:0.706
F1_Score:0.706
Batch 50:KNN
Accuracy :0.688
Recall: 0.824
Precision:0.667
F1_Score:0.737
Batch 50:SVM
Accuracy :0.625
Recall: 1.0
Precision:0.586
F1_Score:0.739
Batch 50:GNB
Accuracy :0.531
Recall: 1.0
Precision:0.531
F1_Score:0.694
Batch 50:XGB
Accuracy :0.688
Recall: 0.824
Precision:0.667
F1_Score:0.737
Batch 50:DT
Accuracy :0.531
Recall: 0.294
Precision:0.625
F1_Score:0.4
Batch 50:MLP
Accuracy :0.562
Recall: 1.0
Precision:0.548
F1_Score:0.708
Batch 51:LogReg
Accuracy :0.406
Recall: 1.0
```

```
Precision:0.406
F1_Score:0.578
Batch 51:RF
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 51:KNN
Accuracy :0.594
Recall: 0.231
Precision:0.5
F1_Score:0.316
Batch 51:SVM
Accuracy :0.594
Recall: 0.538
Precision:0.5
F1_Score:0.519
Batch 51:GNB
Accuracy :0.406
Recall: 1.0
Precision:0.406
F1_Score:0.578
Batch 51:XGB
Accuracy :0.562
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 51:DT
Accuracy :0.562
Recall: 0.385
Precision:0.455
F1_Score:0.417
Batch 51:MLP
Accuracy :0.594
Recall: 0.769
Precision:0.5
F1_Score:0.606
Batch 52:LogReg
Accuracy :0.281
Recall: 1.0
Precision:0.281
F1_Score:0.439
Batch 52:RF
Accuracy :0.719
Recall: 0.222
Precision:0.5
F1_Score:0.308
Batch 52:KNN
Accuracy :0.594
Recall: 0.444
Precision:0.333
F1_Score:0.381
Batch 52:SVM
Accuracy :0.531
Recall: 0.889
Precision:0.364
F1_Score:0.516
Batch 52:GNB
Accuracy :0.281
Recall: 1.0
Precision:0.281
F1_Score:0.439
```

```
Batch 52:XGB
Accuracy :0.594
Recall: 0.222
Precision:0.25
F1_Score:0.235
Batch 52:DT
Accuracy :0.688
Recall: 0.111
Precision:0.333
F1_Score:0.167
Batch 52:MLP
Accuracy :0.438
Recall: 1.0
Precision:0.333
F1_Score:0.5
Batch 53:LogReg
Accuracy :0.344
Recall: 1.0
Precision:0.344
F1_Score:0.512
Batch 53:RF
Accuracy :0.781
Recall: 0.818
Precision:0.643
F1_Score:0.72
Batch 53:KNN
Accuracy :0.531
Recall: 0.818
Precision:0.409
F1_Score:0.545
Batch 53:SVM
Accuracy :0.5
Recall: 1.0
Precision:0.407
F1_Score:0.579
Batch 53:GNB
Accuracy :0.375
Recall: 1.0
Precision:0.355
F1_Score:0.524
Batch 53:XGB
Accuracy :0.688
Recall: 0.909
Precision:0.526
F1_Score:0.667
Batch 53:DT
Accuracy :0.812
Recall: 0.636
Precision:0.778
F1_Score:0.7
Batch 53:MLP
Accuracy :0.406
Recall: 1.0
Precision:0.367
F1_Score:0.537
Batch 54:LogReg
Accuracy :0.094
Recall: 1.0
Precision:0.094
F1_Score:0.171
Batch 54:RF
Accuracy :0.531
```

```
Recall: 1.0
Precision:0.167
F1_Score:0.286
Batch 54:KNN
Accuracy :0.25
Recall: 1.0
Precision:0.111
F1_Score:0.2
Batch 54:SVM
Accuracy :0.125
Recall: 1.0
Precision:0.097
F1_Score:0.176
Batch 54:GNB
Accuracy :0.25
Recall: 0.667
Precision:0.08
F1_Score:0.143
Batch 54:XGB
Accuracy :0.438
Recall: 1.0
Precision:0.143
F1_Score:0.25
Batch 54:DT
Accuracy :0.625
Recall: 0.667
Precision:0.154
F1_Score:0.25
Batch 54:MLP
Accuracy :0.125
Recall: 1.0
Precision:0.097
F1_Score:0.176
Batch 55:LogReg
Accuracy :0.188
Recall: 1.0
Precision:0.188
F1_Score:0.316
Batch 55:RF
Accuracy :0.562
Recall: 1.0
Precision:0.3
F1_Score:0.462
Batch 55:KNN
Accuracy :0.312
Recall: 1.0
Precision:0.214
F1_Score:0.353
Batch 55:SVM
Accuracy :0.25
Recall: 1.0
Precision:0.2
F1_Score:0.333
Batch 55:GNB
Accuracy :0.469
Recall: 0.667
Precision:0.211
F1_Score:0.32
Batch 55:XGB
Accuracy :0.375
Recall: 1.0
Precision:0.231
```

```
F1_Score:0.375
Batch 55:DT
Accuracy :0.625
Recall: 1.0
Precision:0.333
F1_Score:0.5
Batch 55:MLP
Accuracy :0.219
Recall: 1.0
Precision:0.194
F1_Score:0.324
Batch 56:LogReg
Accuracy :0.083
Recall: 1.0
Precision:0.083
F1_Score:0.154
Batch 56:RF
Accuracy :0.667
Recall: 1.0
Precision:0.2
F1_Score:0.333
Batch 56:KNN
Accuracy :0.333
Recall: 1.0
Precision:0.111
F1_Score:0.2
Batch 56:SVM
Accuracy :0.083
Recall: 1.0
Precision:0.083
F1_Score:0.154
Batch 56:GNB
Accuracy :0.875
Recall: 0.0
Precision:0.0
F1_Score:0.0
Batch 56:XGB
Accuracy :0.333
Recall: 1.0
Precision:0.111
F1_Score:0.2
Batch 56:DT
Accuracy :0.667
Recall: 0.5
Precision:0.125
F1_Score:0.2
Batch 56:MLP
Accuracy :0.125
Recall: 1.0
Precision:0.087
F1_Score:0.16
```

In [108…

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

0.8

## Gradual Drift Bottom 25 %

In [109…

```
batches_d=make_batches(df_drifted_bottom25_all)

all_excede_list_d,exceed_count_L2_instThresh_d ,exceed_count_L2_countThresh_d,avg_ms
```

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

Batch Number : 0

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 17, 18,
19]

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, 30]

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, 26, 27]

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, 17, 18, 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 : [9, 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 : []

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, 8, 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 : [6]

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 : [1, 10, 11, 12, 17, 18, 2
2]

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, 5, 7, 13, 20, 21
, 29]

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 : [24, 25]

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 : [3, 4, 9, 10, 11, 12, 20,
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, 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, 4, 5, 6, 7, 8, 9, 1
0, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29]

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, 11, 12, 14, 20,
21, 22, 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 : 19

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

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, 26]

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 : [3, 4, 8, 10, 11, 29, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [3, 4, 12]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3


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

Batch Number : 22

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 4, 17, 18, 21, 22, 26, 27]

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 : [0, 1, 20, 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 : [10, 26, 30, 31]

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, 14, 15, 16, 17, 21, 22, 23]

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, 2, 9, 11, 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 : [1, 2, 3, 4, 5, 21, 26, 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, 16, 17, 25, 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, 16, 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 : [0, 1, 2, 5, 6, 11, 12, 17, 18, 19, 20, 26, 27, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [6, 23, 24]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3


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

Batch Number : 31

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 14, 15, 26, 27, 28, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 5, 9, 10, 13, 14, 15, 27, 28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 9

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

Batch Number : 32

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 2, 3, 4, 7, 8, 10, 22,
23, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [2, 3, 4, 16]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 4


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

Batch Number : 33

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 3, 7, 8, 9, 21, 22, 23
, 24, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [3, 4, 9, 27, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 5


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

Batch Number : 34

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 4, 6, 7, 13, 14, 18, 1
9, 20, 21, 24, 25, 30, 31]

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

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


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

Batch Number : 35

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 7, 11, 14, 15, 17, 22,
26]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [8, 22, 24, 25, 26, 27, 28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 7


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

Batch Number : 36

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 10, 11, 23, 25,
26, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 2, 7, 12, 13, 20, 22
, 23, 25, 31]
```

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 11


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

Batch Number : 37

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 3, 4, 7, 8, 16, 17, 18
, 21, 22, 23, 27, 28, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 3, 4, 5, 7, 8, 12, 1
7, 18, 19, 24]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 12


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

Batch Number : 38

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 4, 5, 7, 8, 9, 10, 11,
12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 29, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 4, 5, 7, 8, 10, 19, 21,
24, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 10


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

Batch Number : 39

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 3, 4, 6, 7, 9, 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, 6, 7, 8, 12, 13, 14, 15
, 16, 17, 19, 24, 26]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 13


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

Batch Number : 40

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8
, 9, 13, 14, 15, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 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, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 29, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [2, 3, 7]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 3


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

Batch Number : 42

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 3, 4, 5, 9, 10, 11, 13, 14, 15, 17, 18, 19, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [10, 11, 19, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 5


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

Batch Number : 43

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 9, 10, 11, 12, 15, 16, 17, 21, 22, 23, 24, 25, 27, 28, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 12, 16, 23, 24, 25]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 6


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

Batch Number : 44

Data Points Exceeding Layer 1 Encoder Instance Threshold : [10, 11, 14, 15, 16, 17, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 11, 28, 30, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 6


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

Batch Number : 45

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 8, 9, 13, 14, 15, 17, 22, 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, 1, 2, 10, 12, 13, 18, 19, 20, 21, 25, 27, 28, 29, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 5, 11, 12, 13, 14, 18, 19, 20, 21, 22, 25, 31]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 14


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

Batch Number : 47

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 2, 4, 7, 13, 22, 25, 27, 28, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 4, 7, 8, 9, 10, 11, 12, 13, 14, 22, 23]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 12


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

Batch Number : 48

Data Points Exceeding Layer 1 Encoder Instance Threshold : [3, 4, 5, 7, 9, 10, 12, 14, 15, 18, 19, 20, 21, 24, 25, 26, 30, 31]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 1, 3, 4, 5, 6, 9, 10, 12, 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 : [0, 5, 6, 7, 8, 9, 11, 12, 16, 17, 18, 19, 22, 23, 24, 25, 30]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 4, 5, 6, 7, 8, 9, 11, 12, 13, 16, 18, 19, 21, 22, 23, 25]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 17


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

Batch Number : 50

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8

, 9, 10, 11, 12, 13, 14, 16, 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, 19, 20, 21, 22, 23, 24, 26, 28, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 20

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

Batch Number : 51

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 5, 6, 7, 8, 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: [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 : [0, 1, 2, 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: [5, 10, 11, 13, 14, 16, 21, 28, 29, 30]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 10

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

Batch Number : 53

Data Points Exceeding Layer 1 Encoder Instance Threshold : [0, 1, 2, 3, 4, 8, 16, 20, 21, 22, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [0, 4, 5, 9, 10, 22, 23, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 8

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

Batch Number : 54

Data Points Exceeding Layer 1 Encoder Instance Threshold : [1, 2, 11, 16, 17, 22, 24, 27, 28]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 2, 7, 8, 10, 11, 12, 16, 17, 25, 27, 28]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 12


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

Batch Number : 55

Data Points Exceeding Layer 1 Encoder Instance Threshold : [2, 5, 6, 7, 13, 17, 27, 28, 29]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [4, 12, 13, 17, 24, 25, 28, 29]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 8


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

Batch Number : 56

Data Points Exceeding Layer 1 Encoder Instance Threshold : [7, 10, 11, 19]

Data Points Exceeding Layer 2 Encoder Instance Threshold: [1, 7, 11, 12, 16, 18, 19, 20]

Number of Data Points Exceeding Layer 2 Encoder Instance thresholds: 8

 Drift Detection at Batch Level

 Threshold exceeds at batch : 22
[22]
Warning Level at Batch 22
 Threshold exceeds at batch : 31
[31]
Warning Level at Batch 31
 Threshold exceeds at batch : 32
[31, 32]
Warning Level at Batch 32
 Threshold exceeds at batch : 35
[35]
Warning Level at Batch 35
 Threshold exceeds at batch : 36
[35, 36]
Warning Level at Batch 36
 Threshold exceeds at batch : 37
[35, 36, 37]
 Drift Confirmed at Batch No :  35
 Threshold exceeds at batch : 38
[35, 36, 37, 38]
 Drift Confirmed at Batch No :  36
 Threshold exceeds at batch : 39
[35, 36, 37, 38, 39]
 Drift Confirmed at Batch No :  37
 Threshold exceeds at batch : 40
[35, 36, 37, 38, 39, 40]
 Drift Confirmed at Batch No :  38
 Threshold exceeds at batch : 41
[35, 36, 37, 38, 39, 40, 41]
 Drift Confirmed at Batch No :  39
 Threshold exceeds at batch : 42

```
[35, 36, 37, 38, 39, 40, 41, 42]
 Drift Confirmed at Batch No :  40
 Threshold exceeds at batch : 43
[35, 36, 37, 38, 39, 40, 41, 42, 43]
 Drift Confirmed at Batch No :  41
 Threshold exceeds at batch : 44
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44]
 Drift Confirmed at Batch No :  42
 Threshold exceeds at batch : 45
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45]
 Drift Confirmed at Batch No :  43
 Threshold exceeds at batch : 46
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46]
 Drift Confirmed at Batch No :  44
 Threshold exceeds at batch : 47
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47]
 Drift Confirmed at Batch No :  45
 Threshold exceeds at batch : 48
[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
[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 : 50
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50]
 Drift Confirmed at Batch No :  48
 Threshold exceeds at batch : 51
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51]
 Drift Confirmed at Batch No :  49
 Threshold exceeds at batch : 52
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52]
 Drift Confirmed at Batch No :  50
 Threshold exceeds at batch : 53
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53]
 Drift Confirmed at Batch No :  51
 Threshold exceeds at batch : 54
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54]
 Drift Confirmed at Batch No :  52
 Threshold exceeds at batch : 55
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55]
 Drift Confirmed at Batch No :  53
 Threshold exceeds at batch : 56
[35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55,
56]
 Drift Confirmed at Batch No :  54
```

In [110…

```
perform_t_test()
```

```
Layer 1 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 1.288094
p-value for two tailed test is 0.200368
Accept H0: There is no drift in the dataset

Layer 1 Exceed Count   Values for Normal and Drifted Data
Test statistic is -0.896247
p-value for two tailed test is 0.372043
Accept H0: There is no drift in the dataset

Layer 2 Reconstruction Error  Values for Normal and Drifted Data
Test statistic is 4.362005
p-value for two tailed test is 0.000029
```

Conclusion :
Since p-value(=0.000029) < 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 5.757505
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 [111…

```
df_plotting=visual_analysis()
```
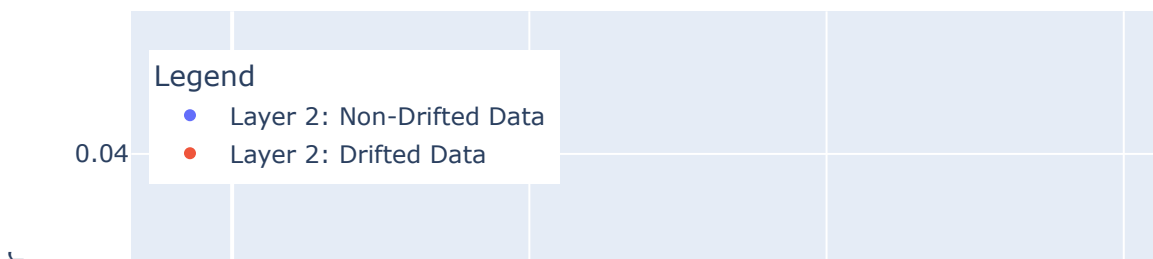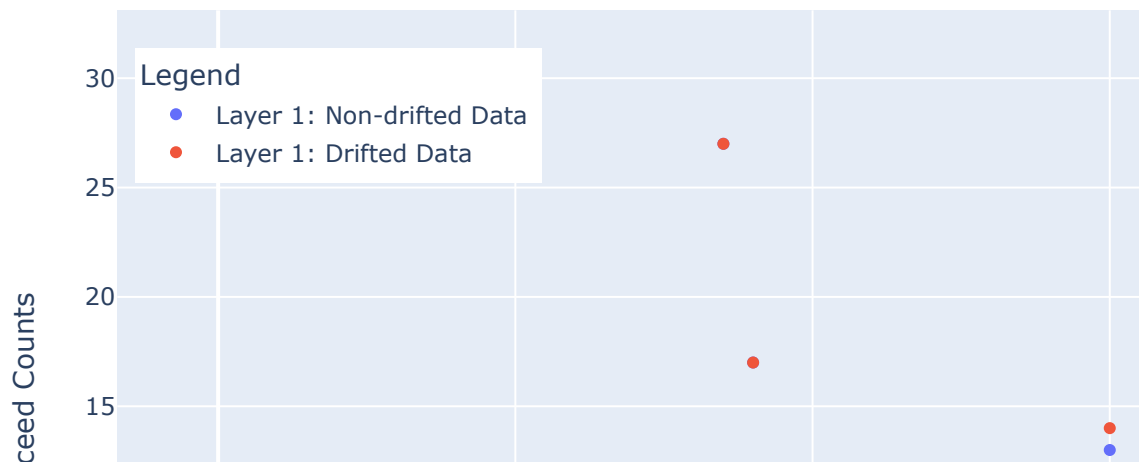
In [112...

```
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 :0.906
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 :0.781
Recall: 0.636
Precision:0.7
F1_Score:0.667
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 :0.875
Recall: 0.8
Precision:0.923
F1_Score:0.857
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 :0.719
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 :0.781
Recall: 0.857
```

```
Precision:0.818
F1_Score:0.837
Batch 3:MLP
Accuracy :0.938
Recall: 0.905
Precision:1.0
F1_Score:0.95
Batch 4:LogReg
Accuracy :0.719
Recall: 0.65
Precision:0.867
F1_Score:0.743
Batch 4:RF
Accuracy :0.781
Recall: 0.65
Precision:1.0
F1_Score:0.788
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 :0.625
Recall: 0.5
Precision:0.833
F1_Score:0.625
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 :0.719
Recall: 0.538
Precision:0.7
F1_Score:0.609
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 :0.719
Recall: 0.538
Precision:0.7
F1_Score:0.609
Batch 5:MLP
Accuracy :0.781
Recall: 0.538
Precision:0.875
F1_Score:0.667
Batch 6:LogReg
Accuracy :0.5
Recall: 0.667
Precision:0.316
F1_Score:0.429
Batch 6:RF
Accuracy :0.719
Recall: 0.222
Precision:0.5
F1_Score:0.308
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 :0.75
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 :0.719
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 :0.812
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 :0.844
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 :0.688
Recall: 0.625
Precision:0.417
F1_Score:0.5
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: 0.5
Precision:0.571
F1_Score:0.533
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 :0.812
Recall: 0.571
Precision:0.571
F1_Score:0.571
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 :0.75
Recall: 0.429
Precision:0.429
F1_Score:0.429
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 :0.75
Recall: 0.571
Precision:0.444
F1_Score:0.5
Batch 12:MLP
Accuracy :0.875
Recall: 0.571
Precision:0.8
F1_Score:0.667
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 :0.844
Recall: 0.4
Precision:0.5
F1_Score:0.444
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 :0.781
Recall: 0.533
Precision:1.0
F1_Score:0.696
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 :0.75
Recall: 0.6
Precision:0.818
F1_Score:0.692
Batch 14:MLP
Accuracy :0.656
Recall: 0.267
Precision:1.0
F1_Score:0.421
Batch 15:LogReg
Accuracy :0.688
Recall: 0.72
Precision:0.857
F1_Score:0.783
Batch 15:RF
Accuracy :0.844
Recall: 0.92
Precision:0.885
F1_Score:0.902
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 :0.75
Recall: 0.72
Precision:0.947
F1_Score:0.818
Batch 15:MLP
Accuracy :0.812
Recall: 0.88
Precision:0.88
F1_Score:0.88
Batch 16:LogReg
Accuracy :0.719
Recall: 0.923
Precision:0.6
F1_Score:0.727
Batch 16:RF
Accuracy :0.719
Recall: 0.615
Precision:0.667
```

```
F1_Score:0.64
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 :0.75
Recall: 0.615
Precision:0.727
F1_Score:0.667
Batch 16:MLP
Accuracy :0.75
Recall: 0.769
Precision:0.667
F1_Score:0.714
Batch 17:LogReg
Accuracy :0.531
Recall: 0.929
Precision:0.481
F1_Score:0.634
Batch 17:RF
Accuracy :0.625
Recall: 0.643
Precision:0.562
F1_Score:0.6
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 :0.469
Recall: 0.357
Precision:0.385
F1_Score:0.37
Batch 17:MLP
Accuracy :0.625
Recall: 0.786
Precision:0.55
F1_Score:0.647
Batch 18:LogReg
Accuracy :0.406
Recall: 0.909
Precision:0.357
F1_Score:0.513
Batch 18:RF
Accuracy :0.531
Recall: 0.818
Precision:0.409
F1_Score:0.545
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 :0.531
Recall: 0.818
Precision:0.409
F1_Score:0.545
Batch 19:LogReg
Accuracy :0.812
Recall: 0.625
Precision:0.625
F1_Score:0.625
Batch 19:RF
Accuracy :0.812
Recall: 0.75
Precision:0.6
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 :0.688
Recall: 0.875
Precision:0.438
F1_Score:0.583
Batch 19:MLP
Accuracy :0.688
Recall: 0.875
Precision:0.438
F1_Score:0.583
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 :0.625
Recall: 0.75
Precision:0.375
F1_Score:0.5
```

```
Batch 20:MLP
Accuracy :0.812
Recall: 0.875
Precision:0.583
F1_Score:0.7
Batch 21:LogReg
Accuracy :0.906
Recall: 1.0
Precision:0.8
F1_Score:0.889
Batch 21:RF
Accuracy :0.75
Recall: 0.667
Precision:0.667
F1_Score:0.667
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 :0.656
Recall: 0.5
Precision:0.545
F1_Score:0.522
Batch 21:MLP
Accuracy :0.781
Recall: 0.75
Precision:0.692
F1_Score:0.72
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 :0.812
Recall: 0.5
Precision:0.5
F1_Score:0.5
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 :0.938
Recall: 0.75
Precision:0.75
F1_Score:0.75
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 :0.781
Recall: 0.75
Precision:0.333
F1_Score:0.462
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 :0.844
Recall: 0.75
Precision:0.667
F1_Score:0.706
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 :0.719
Recall: 0.625
Precision:0.455
F1_Score:0.526
Batch 24:MLP
Accuracy :0.812
Recall: 0.75
Precision:0.6
F1_Score:0.667
Batch 25:LogReg
Accuracy :0.625
Recall: 0.6
Precision:0.429
F1_Score:0.5
Batch 25:RF
Accuracy :0.656
Recall: 0.7
Precision:0.467
F1_Score:0.56
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 :0.625
Recall: 0.7
Precision:0.438
F1_Score:0.538
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: 0.571
Precision:0.667
F1_Score:0.615
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 :0.625
Recall: 0.643
Precision:0.562
F1_Score:0.6
Batch 26:MLP
Accuracy :0.75
Recall: 0.571
Precision:0.8
F1_Score:0.667
Batch 27:LogReg
Accuracy :0.812
Recall: 0.857
```

```
Precision:0.75
F1_Score:0.8
Batch 27:RF
Accuracy :0.812
Recall: 0.786
Precision:0.786
F1_Score:0.786
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 :0.781
Recall: 0.714
Precision:0.769
F1_Score:0.741
Batch 27:MLP
Accuracy :0.812
Recall: 0.786
Precision:0.786
F1_Score:0.786
Batch 28:LogReg
Accuracy :0.438
Recall: 0.917
Precision:0.393
F1_Score:0.55
Batch 28:RF
Accuracy :0.75
Recall: 0.583
Precision:0.7
F1_Score:0.636
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: 0.667
Precision:0.571
F1_Score:0.615
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 :0.688
Recall: 0.455
Precision:0.556
F1_Score:0.5
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 :0.625
Recall: 0.455
Precision:0.455
F1_Score:0.455
Batch 29:MLP
Accuracy :0.75
Recall: 0.818
Precision:0.6
F1_Score:0.692
Batch 30:LogReg
Accuracy :0.531
Recall: 0.909
Precision:0.417
F1_Score:0.571
Batch 30:RF
Accuracy :0.5
```

```
Recall: 0.455
Precision:0.333
F1_Score:0.385
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 :0.594
Recall: 0.636
Precision:0.438
F1_Score:0.519
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 :0.625
Recall: 0.583
Precision:0.5
F1_Score:0.538
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 :0.562
Recall: 0.75
Precision:0.45
F1_Score:0.563
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 :0.625
Recall: 0.818
Precision:0.474
F1_Score:0.6
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 :0.594
Recall: 0.818
Precision:0.45
F1_Score:0.581
Batch 33:LogReg
Accuracy :0.562
Recall: 0.833
Precision:0.278
F1_Score:0.417
Batch 33:RF
Accuracy :0.688
Recall: 0.667
Precision:0.333
F1_Score:0.444
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 :0.625
Recall: 0.833
Precision:0.312
F1_Score:0.455
Batch 33:MLP
Accuracy :0.594
Recall: 0.667
Precision:0.267
F1_Score:0.381
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: 0.9
```

```
Precision:0.6
F1_Score:0.72
Batch 34:MLP
Accuracy :0.688
Recall: 0.6
Precision:0.5
F1_Score:0.545
Batch 35:LogReg
Accuracy :0.781
Recall: 1.0
Precision:0.588
F1_Score:0.741
Batch 35:RF
Accuracy :0.719
Recall: 1.0
Precision:0.526
F1_Score:0.69
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 :0.625
Recall: 1.0
Precision:0.455
F1_Score:0.625
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 :0.875
Recall: 0.8
Precision:0.923
F1_Score:0.857
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: 0.95
Precision:0.826
F1_Score:0.884
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 :0.719
Recall: 0.85
Precision:0.739
F1_Score:0.791
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 :0.781
Recall: 0.957
Precision:0.786
F1_Score:0.863
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 :0.719
Recall: 0.87
Precision:0.769
F1_Score:0.816
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: 0.4
Precision:0.615
F1_Score:0.485
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 :0.469
Recall: 0.35
Precision:0.636
F1_Score:0.452
Batch 39:MLP
Accuracy :0.688
Recall: 0.85
Precision:0.708
F1_Score:0.773
Batch 40:LogReg
Accuracy :0.438
Recall: 1.0
Precision:0.438
F1_Score:0.609
Batch 40:RF
Accuracy :0.844
Recall: 0.786
Precision:0.846
F1_Score:0.815
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 :0.719
Recall: 1.0
Precision:0.609
F1_Score:0.757
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 :0.75
Recall: 0.5
Precision:0.5
F1_Score:0.5
Batch 41:MLP
Accuracy :0.781
Recall: 0.875
Precision:0.538
F1_Score:0.667
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 :0.688
Recall: 0.929
Precision:0.591
F1_Score:0.722
Batch 42:MLP
Accuracy :0.625
Recall: 0.857
Precision:0.545
F1_Score:0.667
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 :0.531
Recall: 0.857
Precision:0.48
F1_Score:0.615
Batch 43:MLP
Accuracy :0.531
Recall: 1.0
Precision:0.483
F1_Score:0.651
Batch 44:LogReg
Accuracy :0.562
Recall: 1.0
Precision:0.176
F1_Score:0.3
```

```
Batch 44:RF
Accuracy :0.469
Recall: 1.0
Precision:0.15
F1_Score:0.261
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 :0.562
Recall: 1.0
Precision:0.176
F1_Score:0.3
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 :0.781
Recall: 0.5
Precision:0.286
F1_Score:0.364
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 :0.719
Recall: 0.5
Precision:0.222
F1_Score:0.308
Batch 45:MLP
Accuracy :0.844
Recall: 0.5
Precision:0.4
F1_Score:0.444
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 :0.719
Recall: 1.0
Precision:0.357
```

```
F1_Score:0.526
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 :0.406
Recall: 0.8
Precision:0.182
F1_Score:0.296
Batch 47:MLP
Accuracy :0.781
Recall: 1.0
Precision:0.417
F1_Score:0.588
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 :0.812
Recall: 1.0
Precision:0.76
F1_Score:0.864
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 :0.719
Recall: 0.842
Precision:0.727
F1_Score:0.78
Batch 49:MLP
Accuracy :0.812
Recall: 0.947
Precision:0.783
F1_Score:0.857
Batch 50:LogReg
Accuracy :0.562
Recall: 0.941
Precision:0.552
F1_Score:0.696
Batch 50:RF
Accuracy :0.625
Recall: 0.882
Precision:0.6
F1_Score:0.714
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 :0.531
Recall: 0.647
Precision:0.55
F1_Score:0.595
Batch 50:MLP
Accuracy :0.562
Recall: 0.941
Precision:0.552
F1_Score:0.696
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 :0.688
Recall: 0.923
Precision:0.571
F1_Score:0.706
Batch 52:LogReg
Accuracy :0.312
Recall: 1.0
Precision:0.29
F1_Score:0.45
Batch 52:RF
Accuracy :0.406
Recall: 0.667
Precision:0.273
F1_Score:0.387
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 :0.562
Recall: 0.667
Precision:0.353
F1_Score:0.462
Batch 52:MLP
Accuracy :0.5
Recall: 0.889
Precision:0.348
F1_Score:0.5
Batch 53:LogReg
Accuracy :0.781
Recall: 1.0
Precision:0.611
F1_Score:0.759
Batch 53:RF
Accuracy :0.688
Recall: 1.0
Precision:0.524
F1_Score:0.688
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 :0.5
Recall: 0.909
Precision:0.4
F1_Score:0.556
Batch 53:MLP
Accuracy :0.75
Recall: 0.909
Precision:0.588
F1_Score:0.714
Batch 54:LogReg
Accuracy :0.719
Recall: 0.333
Precision:0.125
F1_Score:0.182
Batch 54:RF
Accuracy :0.594
Recall: 0.333
Precision:0.083
F1_Score:0.133
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 :0.281
Recall: 0.667
Precision:0.083
F1_Score:0.148
Batch 54:MLP
Accuracy :0.688
Recall: 0.333
Precision:0.111
```

```
F1_Score:0.167
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 :0.406
Recall: 1.0
Precision:0.24
F1_Score:0.387
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 :0.792
Recall: 0.5
Precision:0.2
F1_Score:0.286
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
```
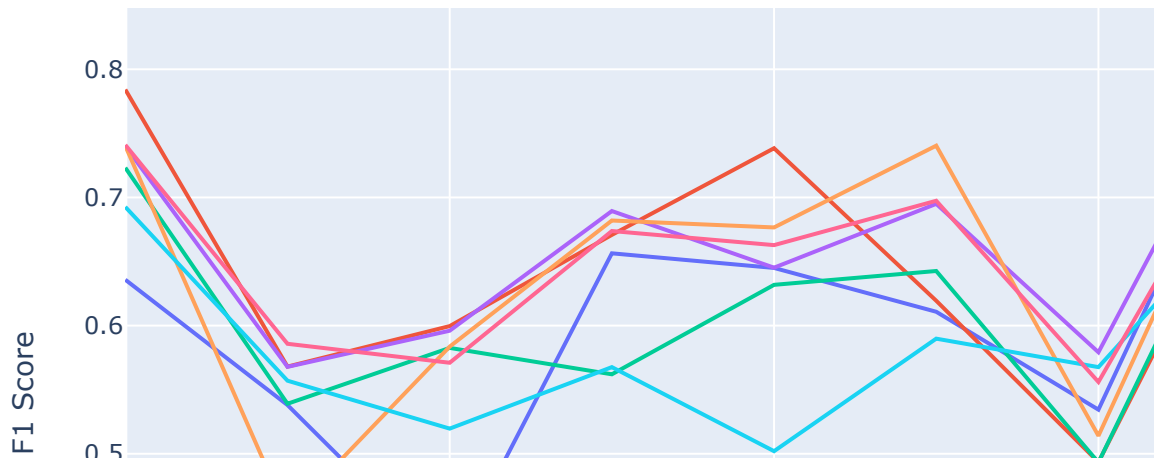
```
Accuracy :0.833
Recall: 1.0
Precision:0.333
F1_Score:0.5
Batch 56:XGB
Accuracy :0.583
Recall: 0.5
Precision:0.1
F1_Score:0.167
Batch 56:DT
Accuracy :0.625
Recall: 0.5
Precision:0.111
F1_Score:0.182
Batch 56:MLP
Accuracy :0.75
Recall: 0.5
Precision:0.167
F1_Score:0.25
```

In [113…    `plt_classification_results(df,df2)`



In [ ]:

In [ ]:

In [ ]: