FINANCIAL FORECASTING USING NEURAL NETWORKS

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Problem Statement

- Prediction of prices of instruments of speculation
  - Stocks
  - Commodity futures
  - Exchange Rates
  - Interest Rates
- Problem : Non linear and non stationary data

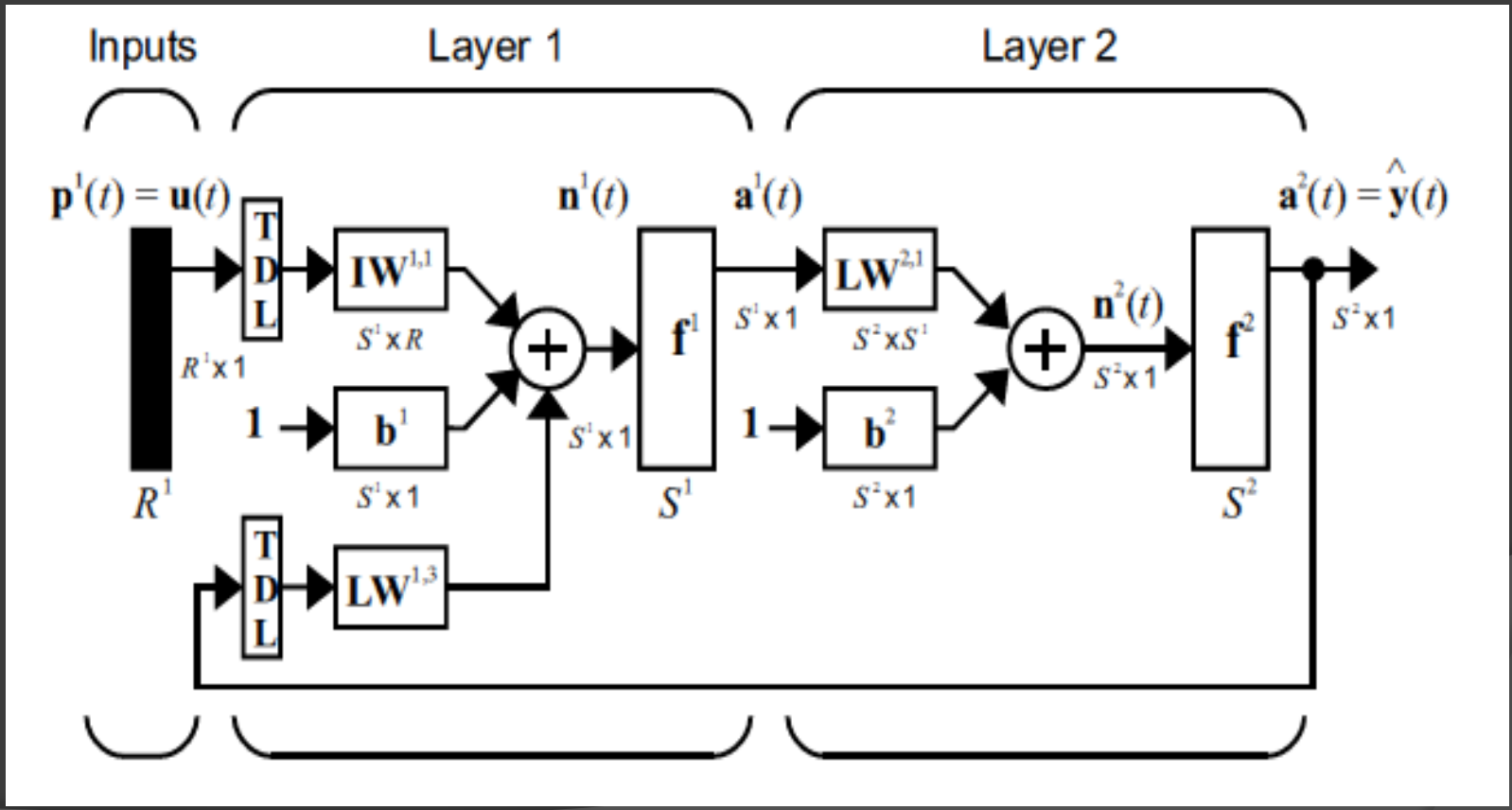
Why use NEURAL NETWORKS ?

- They derive *non-linear models* that can be trained to map past and future values of the input output relationship .It extracts relationships governing the data that was not obvious using other analytical tools.
- *Capability to recognize pattern* and the speed of techniques to accurately solve complex processes, exploited exhaustively in financial forecasting.
- Trained *without the restriction of a model* to derive parameters and discover relationships, driven and shaped solely by the nature of the data.

NARX MODEL

The defining equation for the NARX model is

$$y(t) = f(y(t-1), y(t-2), \ldots, y(t-n_y), u(t-1), u(t-2), \ldots, u(t-n_u))$$

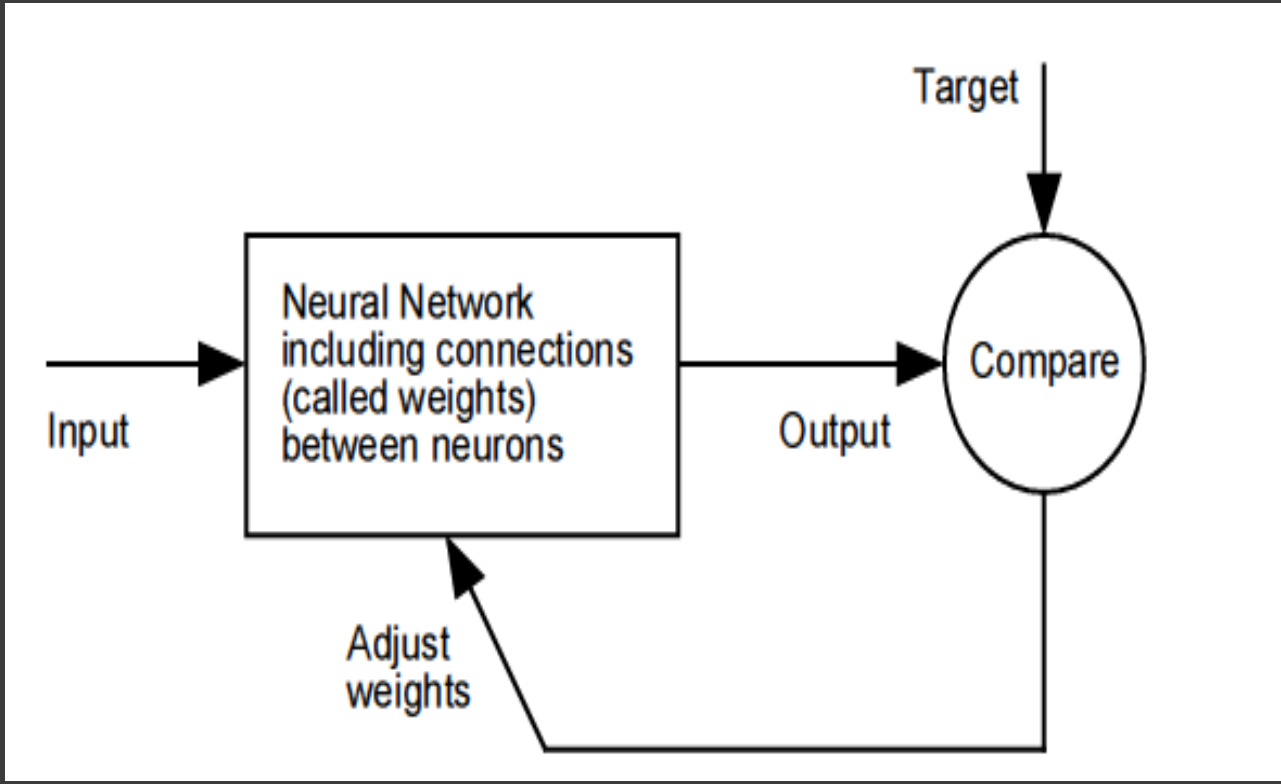


TRAINING ALGORITHMS

- trainlm : fastest and better for non-linear cases , default for feed-forwardnet .

Function	Algorithm
trainlm	Levenberg-Marquardt
trainbr	Bayesian Regularization
trainbfg	BFGS Quasi-Newton
trainrp	Resilient Backpropagation
trainscg	Scaled Conjugate Gradient
traincgb	Conjugate Gradient with Powell/Beale Restarts
traincgf	Fletcher-Powell Conjugate Gradient
traincgp	Polak-Ribiére Conjugate Gradient
trainoss	One Step Secant
traingdx	Variable Learning Rate Gradient Descent

BACK-PROPOGATION



- Numerous such input/target pairs are used to train the Neural Network.

Types Of Data Worked Upon

- **Interest Rates** (RBI 91 day Govt. Of India Treasury Bills)
- **Sensex Data** (2005-2010)
- **Exchange Rates** (Daily Exchange Rates of INR-Dollars 2004-2011)

1	Date	Time	Open	High	Low	Close
2	20090105	1001	13702	13702	13680	13680
3	20090105	1002	13644.22	13689.15	13644.22	13689.15
4	20090105	1003	13650.31	13688.13	13648.28	13681.02
5	20090105	1004	13643.21	13680	13631.04	13665.77
6	20090105	1005	13630.03	13672.89	13630.03	13671.87
7	20090105	1006	13635.1	13676.95	13633.07	13676.95
8	20090105	1007	13638.14	13680	13635.1	13680
9	20090105	1008	13643.21	13680	13636.12	13673.9
10	20090105	1009	13638.14	13685.08	13637.13	13682.03

DIFFICULTIES

- Limited quantity of data .
- Noise in data – It obscures the underlying pattern of the data .
- Non-stationarity - data that do not have the same statistical properties (e.g., mean and variance) at each point in time
- Appropriate Forecasting Technique Selection .

Preprocessing of Training Data

- Reason: Need to understand underlying patterns.
- Tools:
  - Fast Fourier Transform (FFT)
  - Hilbert Huang Transform (HHT)

Comparative study

	Fourier	Hilbert
Basis	*a priori*	adaptive
Frequency	convolution: global uncertainty	differentiation: local, certainty
Nonlinear	no	yes
Nonstationary	no	yes
Theoretical base	theory complete	empirical

Types Of Preprocessing

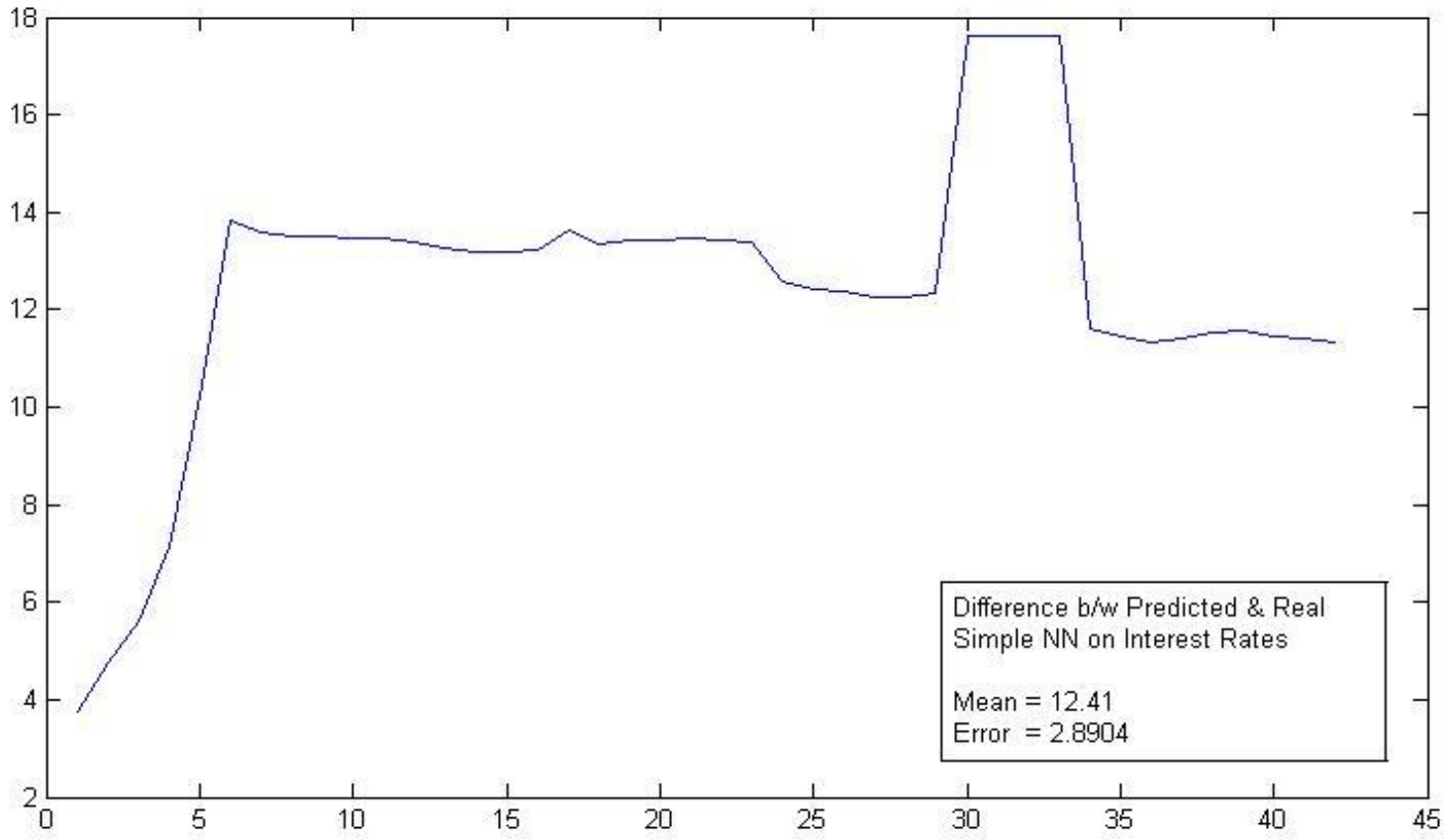
- **No Pre-Processing** (Simple NN)
- **Using FFT** (FFT NN)
- **Using HHT** (HHT NN)

All the types of data are used on all the types of preprocessing techniques , therefore generating 9 cases.

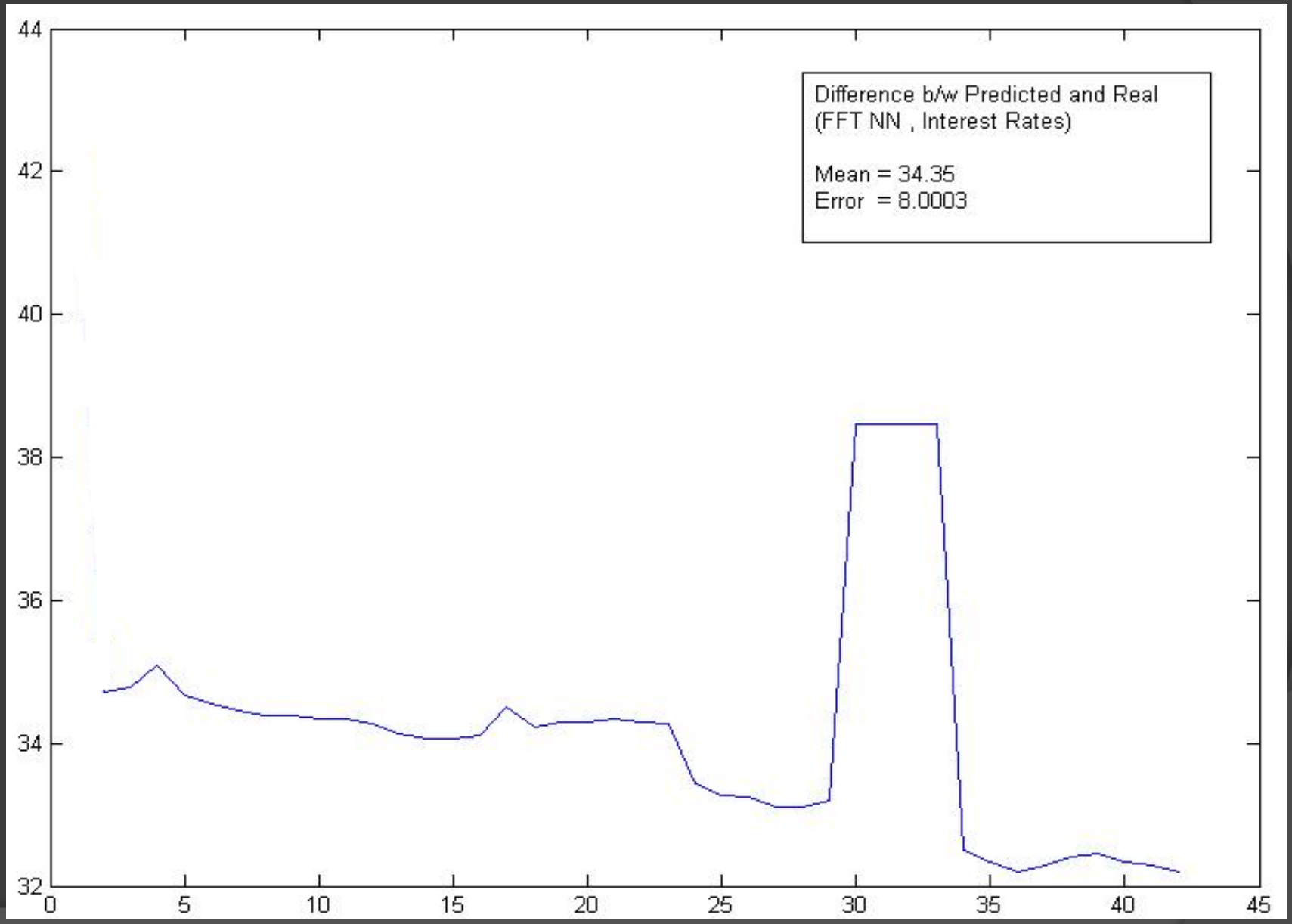
Now, we Compare all of them Data-Wise.

1. Interest Rates

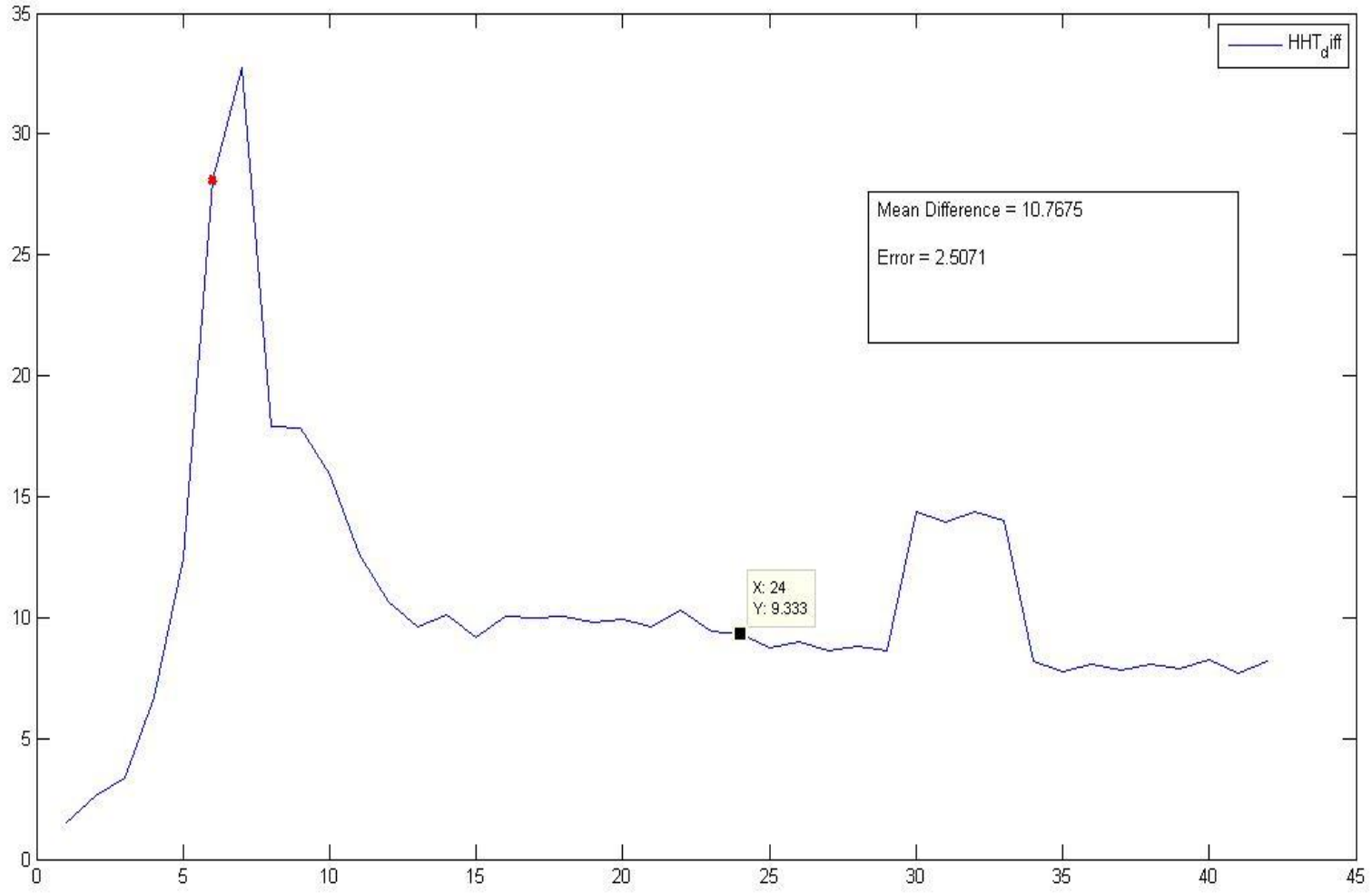
- The interest rate data is applied on all three kinds of preprocessing. The Error Graphs are as:
- Simple NN



FFT NN

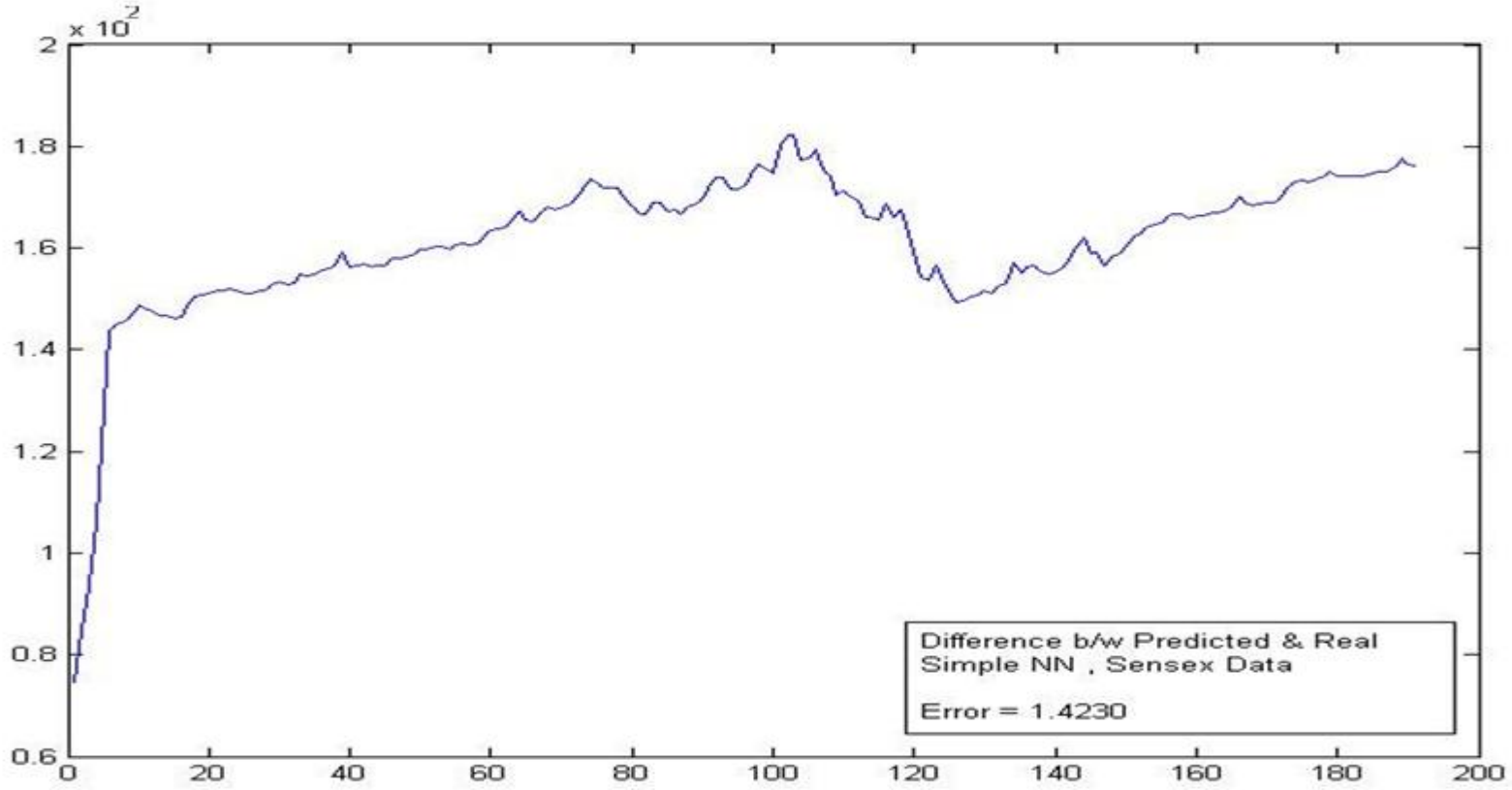

Difference b/w Predicted and Real
(FFT NN , Interest Rates)
Mean = 34.35
Error = 8.0003
44
42
40
38
36
34
32
0
5
10
15
20
25
30
35
40
45

HHT NN

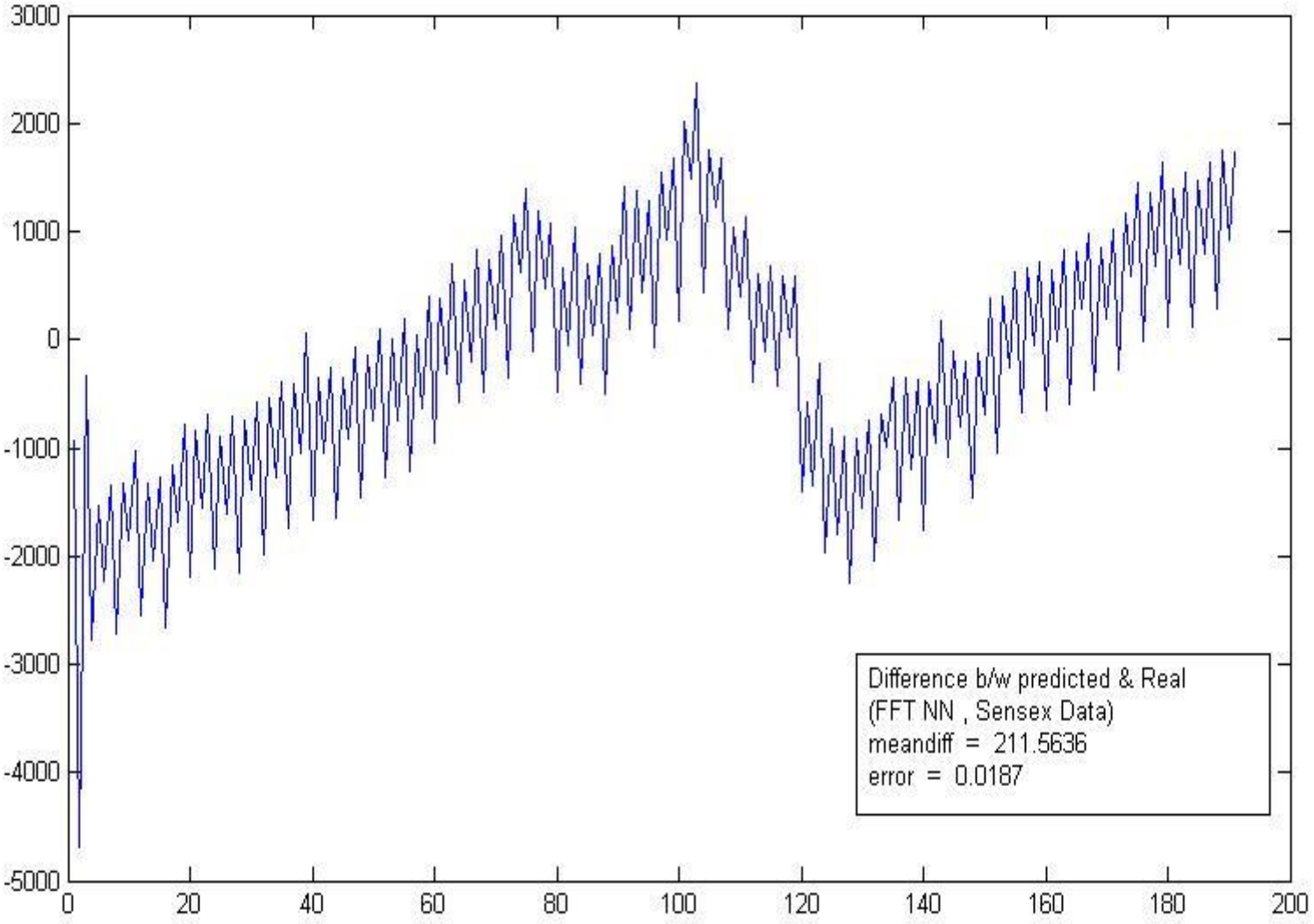

HHT_diff
Mean Difference = 10.7675
Error = 2.5071
X: 24
Y: 9.333
0
5
10
15
20
25
30
35
40
45

2. Sensex Data

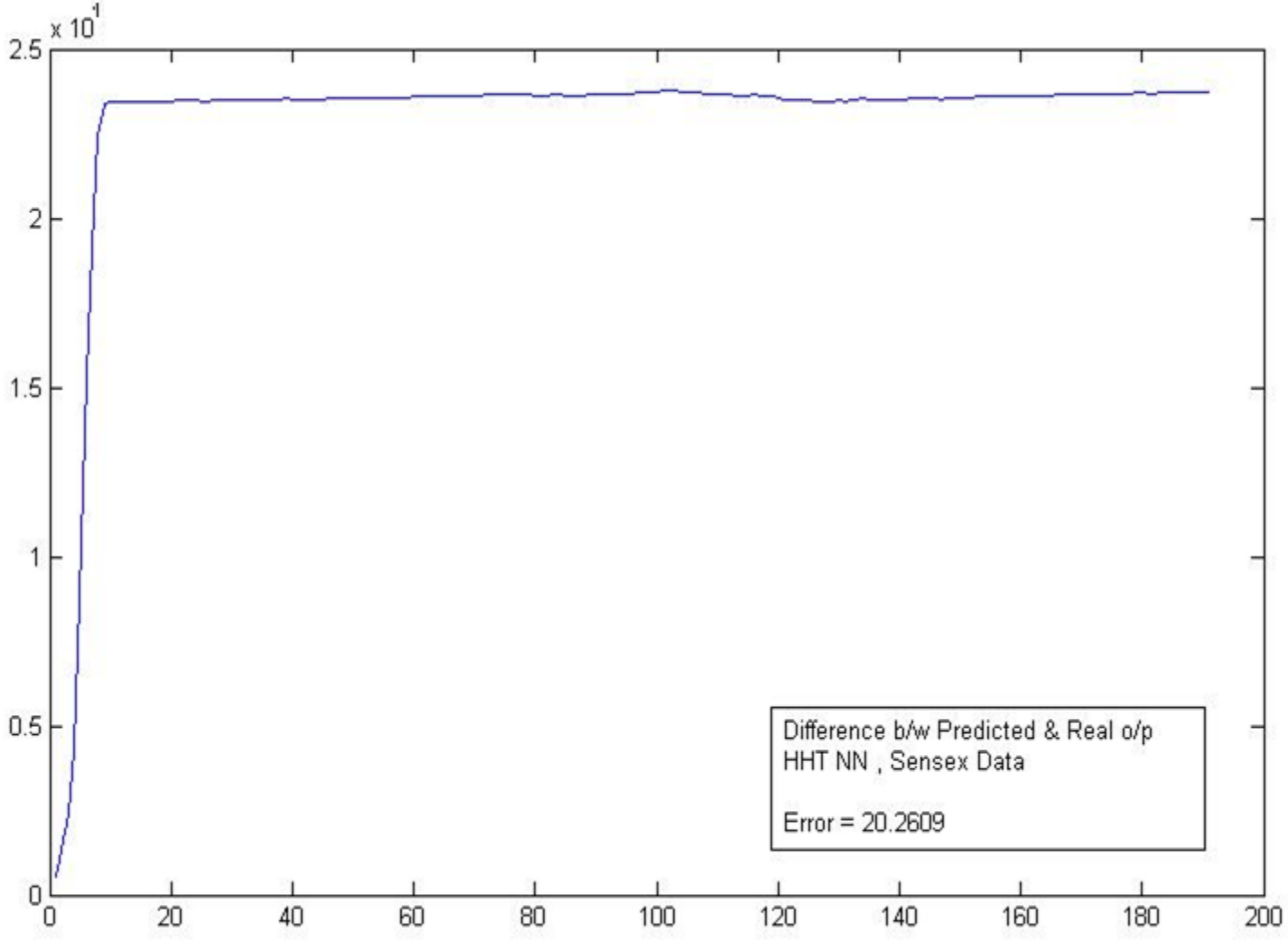
- The sensex data is applied on all three kinds of preprocessing. The Error Graphs are as:



FFT NN

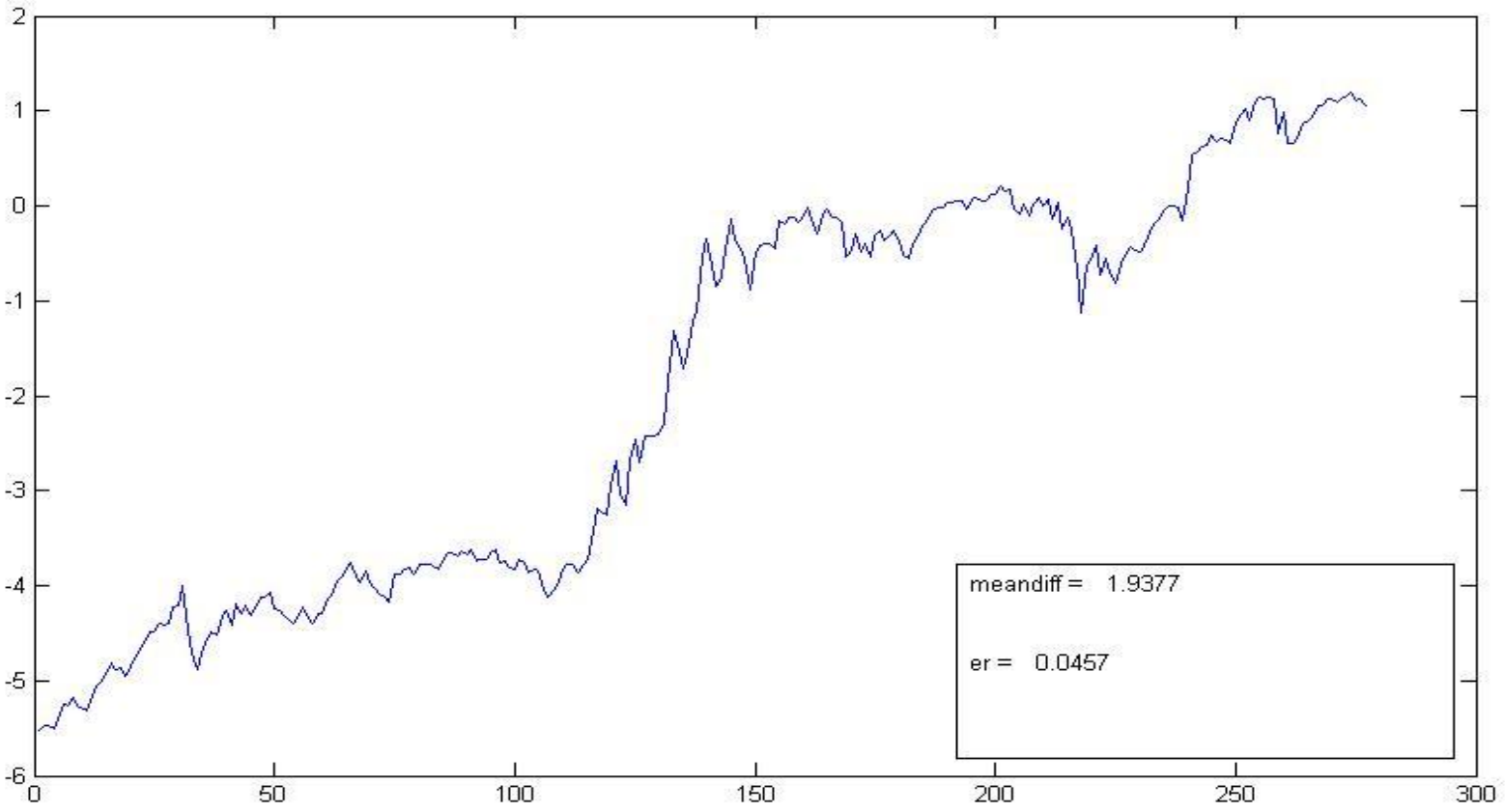

3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
0
20
40
60
80
100
120
140
160
180
200
Difference b/w predicted & Real
(FFT NN , Sensex Data)
meandiff = 211.5636
error = 0.0187

HHT NN

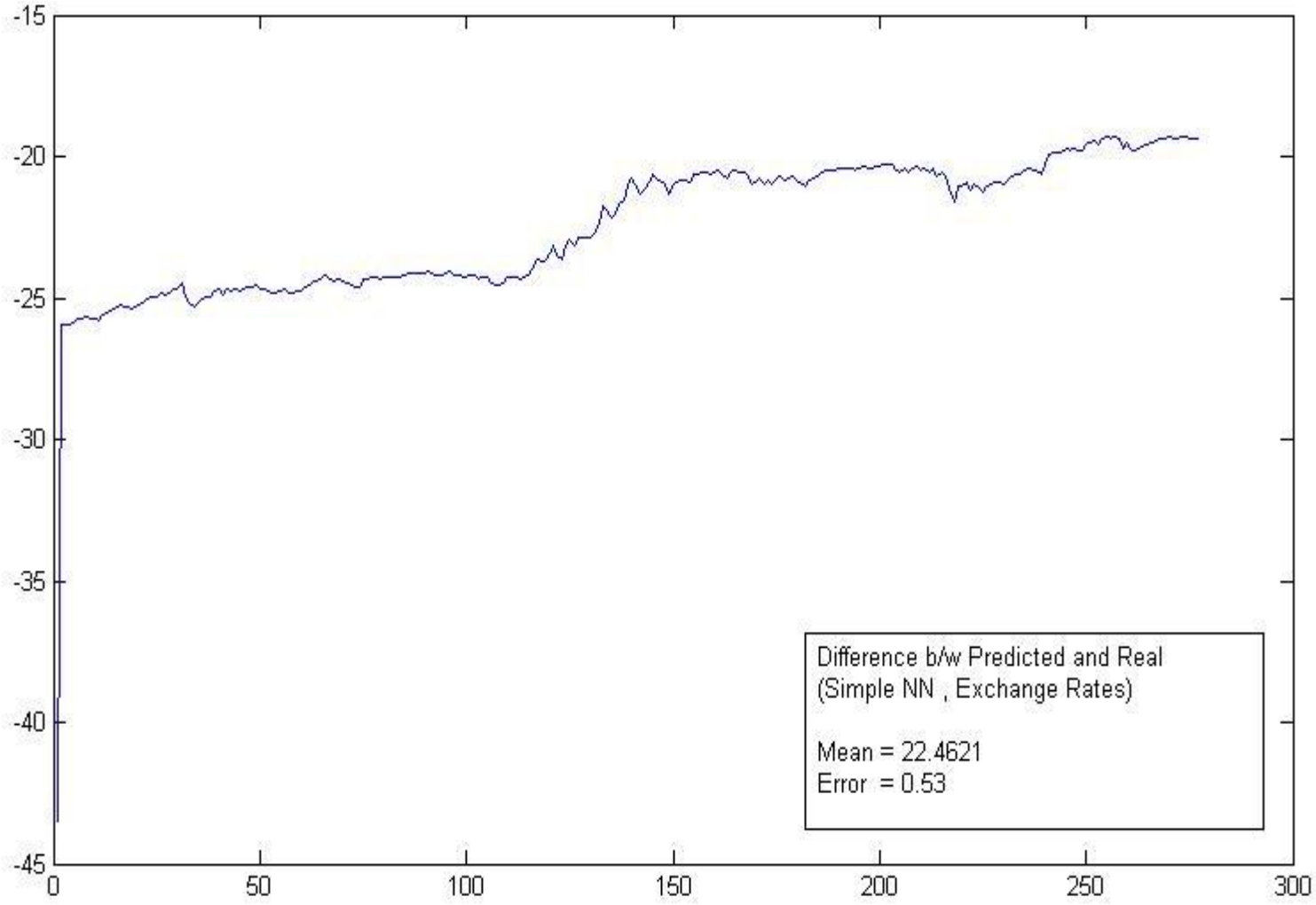

x 10^-1
2.5
2
1.5
1
0.5
0
0
20
40
60
80
100
120
140
160
180
200
Difference b/w Predicted & Real o/p
HHT NN , Sensex Data
Error = 20.2609

3. Exchange Rates

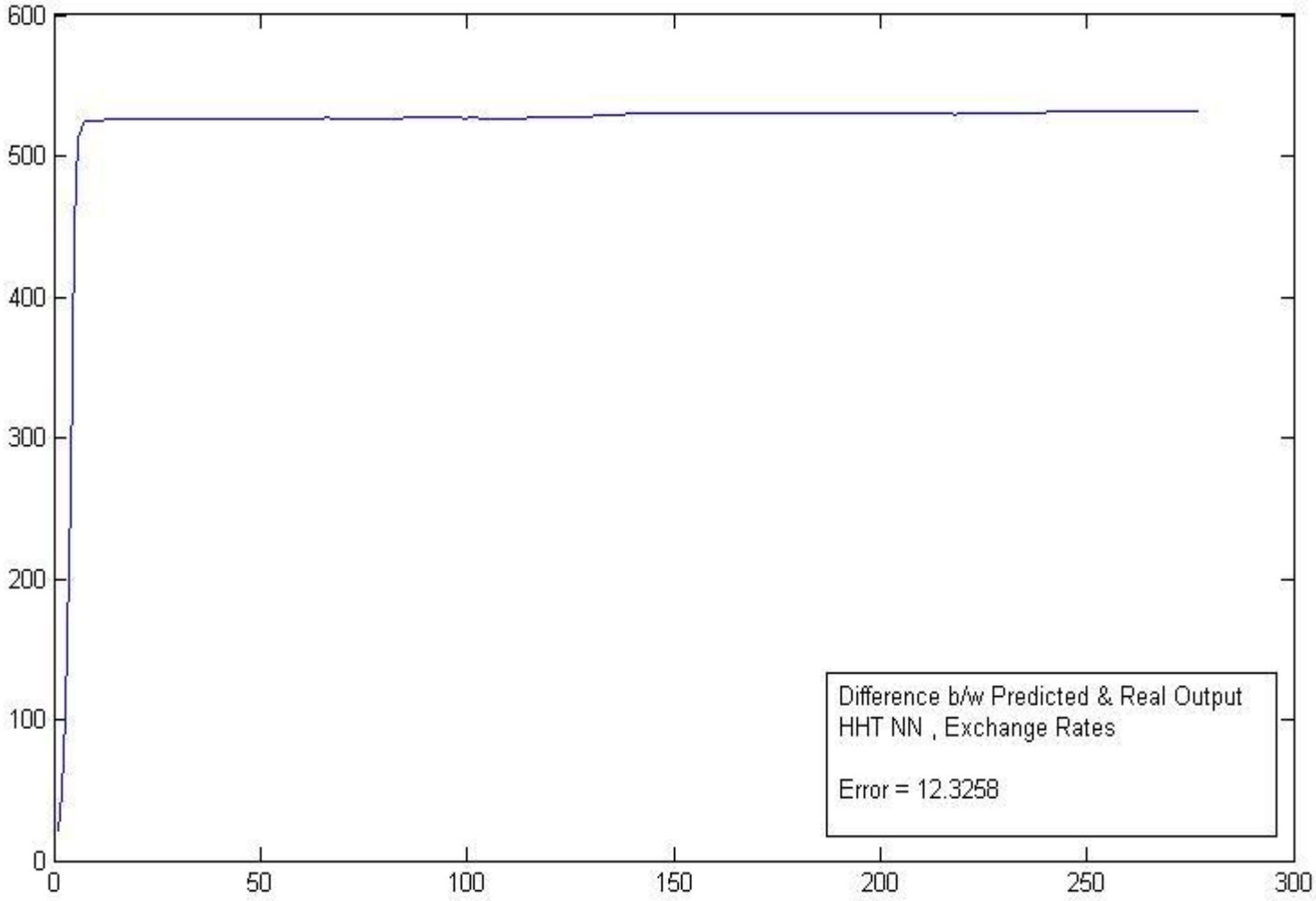
- The Exchange Rate data is applied on all three kinds of preprocessing. The Error Graphs are as:
- Simple NN



FFT NN


-15
-20
-25
-30
-35
-40
-45
0
50
100
150
200
250
300
Difference b/w Predicted and Real
(Simple NN , Exchange Rates)
Mean = 22.4621
Error = 0.53

HHT NN


600
500
400
300
200
100
0
0
50
100
150
200
250
300
Difference b/w Predicted & Real Output
HHT NN , Exchange Rates
Error = 12.3258

Conclusion from Results

- Pre-processing can boost the Neural Network Performance
- The performance of Neural Network also depends on the nature of the data series
- Pre-processing using HHT is better than FFT.

Thank You