Training for CA_4
Single window of past history : (100, 4)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 120ms/step - loss: 0.7354 - val_loss: 1.0536
Epoch 2/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7229 - val_loss: 1.0162
Epoch 3/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6974 - val_loss: 0.9723
Epoch 4/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6286 - val_loss: 0.9001
Epoch 5/100
50/50 [==============================] - 6s 124ms/step - loss: 0.5707 - val_loss: 0.7880
Epoch 6/100
50/50 [==============================] - 6s 115ms/step - loss: 0.5416 - val_loss: 0.6903
Epoch 7/100
50/50 [==============================] - 5s 110ms/step - loss: 0.5277 - val_loss: 0.6477
Epoch 8/100
50/50 [==============================] - 5s 107ms/step - loss: 0.5189 - val_loss: 0.6271
Epoch 9/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5145 - val_loss: 0.6095
Epoch 10/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5136 - val_loss: 0.6000
Epoch 11/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5115 - val_loss: 0.5904
Epoch 12/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5118 - val_loss: 0.5877
Epoch 13/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5102 - val_loss: 0.5808
Epoch 14/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5090 - val_loss: 0.5818
Epoch 15/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5089 - val_loss: 0.5778
Epoch 16/100
50/50 [==============================] - 5s 101ms/step - loss: 0.5081 - val_loss: 0.5783
Epoch 17/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5077 - val_loss: 0.5747
Epoch 18/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5068 - val_loss: 0.5733
Epoch 19/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5062 - val_loss: 0.5750
Epoch 20/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5056 - val_loss: 0.5725
Epoch 21/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5045 - val_loss: 0.5731

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Epoch 22/100
50/50 [==============================] - 5s 99ms/step - loss: 0.5038 - val_loss: 0.5726
Epoch 23/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5029 - val_loss: 0.5702
Epoch 24/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5023 - val_loss: 0.5710
Epoch 25/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5015 - val_loss: 0.5697
Epoch 26/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4998 - val_loss: 0.5693
Epoch 27/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4982 - val_loss: 0.5682
Epoch 28/100
50/50 [==============================] - 6s 111ms/step - loss: 0.4974 - val_loss: 0.5677
Epoch 29/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4950 - val_loss: 0.5665
Epoch 30/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4936 - val_loss: 0.5655
Epoch 31/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4902 - val_loss: 0.5651
Epoch 32/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4864 - val_loss: 0.5689
Epoch 33/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4804 - val_loss: 0.5665
Epoch 34/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4670 - val_loss: 0.5196
Epoch 35/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4452 - val_loss: 0.4780
Epoch 36/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4217 - val_loss: 0.4309
Epoch 37/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4029 - val_loss: 0.4055
Epoch 38/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3849 - val_loss: 0.4038
Epoch 39/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3755 - val_loss: 0.3863
Epoch 40/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3684 - val_loss: 0.3992
Epoch 41/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3639 - val_loss: 0.3909
Epoch 42/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3597 - val_loss: 0.3731
Epoch 43/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3571 - val_loss: 0.3864
Epoch 44/100
```

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50/50 [==============================] - 5s 104ms/step - loss: 0.3540 - val_loss: 0.3724
Epoch 45/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3549 - val_loss: 0.3705
Epoch 46/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3534 - val_loss: 0.3772
Epoch 47/100
50/50 [==============================] - 5s 99ms/step - loss: 0.3508 - val_loss: 0.3637
Epoch 48/100
50/50 [==============================] - 5s 98ms/step - loss: 0.3496 - val_loss: 0.3902
Epoch 49/100
50/50 [==============================] - 5s 98ms/step - loss: 0.3479 - val_loss: 0.3670
Epoch 50/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3474 - val_loss: 0.3751
Epoch 51/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3468 - val_loss: 0.3687
Epoch 52/100
50/50 [==============================] - 5s 99ms/step - loss: 0.3460 - val_loss: 0.3792
Epoch 53/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3447 - val_loss: 0.3768
Epoch 54/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3444 - val_loss: 0.3888
Epoch 55/100
50/50 [==============================] - 5s 99ms/step - loss: 0.3434 - val_loss: 0.3679
Epoch 56/100
50/50 [==============================] - 5s 99ms/step - loss: 0.3443 - val_loss: 0.3762
Epoch 57/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3417 - val_loss: 0.3684
Epoch 58/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3412 - val_loss: 0.3797
Epoch 59/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3419 - val_loss: 0.3754
Epoch 60/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3398 - val_loss: 0.3641
Epoch 61/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3390 - val_loss: 0.3769
Epoch 62/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3406 - val_loss: 0.3691
Epoch 63/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3372 - val_loss: 0.3584
Epoch 64/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3379 - val_loss: 0.3634
Epoch 65/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3376 - val_loss: 0.3586
Epoch 66/100
50/50 [==============================] - 6s 118ms/step - loss: 0.3353 - val_loss: 0.3669
```

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Epoch 67/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3359 - val_loss: 0.3610
Epoch 68/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3356 - val_loss: 0.3735
Epoch 69/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3320 - val_loss: 0.3841
Epoch 70/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3327 - val_loss: 0.3642
Epoch 71/100
50/50 [==============================] - 5s 99ms/step - loss: 0.3311 - val_loss: 0.3591
Epoch 72/100
50/50 [==============================] - 5s 97ms/step - loss: 0.3312 - val_loss: 0.3719
Epoch 73/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3294 - val_loss: 0.3686
Epoch 74/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3295 - val_loss: 0.3668
Epoch 75/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3274 - val_loss: 0.3562
Epoch 76/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3287 - val_loss: 0.3642
Epoch 77/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3273 - val_loss: 0.3543
Epoch 78/100
50/50 [==============================] - 5s 97ms/step - loss: 0.3243 - val_loss: 0.3449
Epoch 79/100
50/50 [==============================] - 5s 96ms/step - loss: 0.3260 - val_loss: 0.3610
Epoch 80/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3247 - val_loss: 0.3503
Epoch 81/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3244 - val_loss: 0.3470
Epoch 82/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3221 - val_loss: 0.3619
Epoch 83/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3227 - val_loss: 0.3644
Epoch 84/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3223 - val_loss: 0.3585
Epoch 85/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3216 - val_loss: 0.3439
Epoch 86/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3214 - val_loss: 0.3513
Epoch 87/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3205 - val_loss: 0.3552
Epoch 88/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3188 - val_loss: 0.3581
Epoch 89/100
```

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50/50 [==============================] - 5s 104ms/step - loss: 0.3205 - val_loss: 0.3715
Epoch 90/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3193 - val_loss: 0.3462
Epoch 91/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3187 - val_loss: 0.3466
Epoch 92/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3177 - val_loss: 0.3578
Epoch 93/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3174 - val_loss: 0.3465
Epoch 94/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3169 - val_loss: 0.3477
Epoch 95/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3166 - val_loss: 0.3496
Epoch 96/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3151 - val_loss: 0.3483
Epoch 97/100
50/50 [==============================] - 7s 133ms/step - loss: 0.3152 - val_loss: 0.3470
Epoch 98/100
50/50 [==============================] - 7s 133ms/step - loss: 0.3145 - val_loss: 0.3536
Epoch 99/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3149 - val_loss: 0.3498
Epoch 100/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3142 - val_loss: 0.3515
```


Multi-Step Training and validation loss for CA_4

Multi_step LSTM for CA_4

Tail of Multi_step LSTM for CA_4
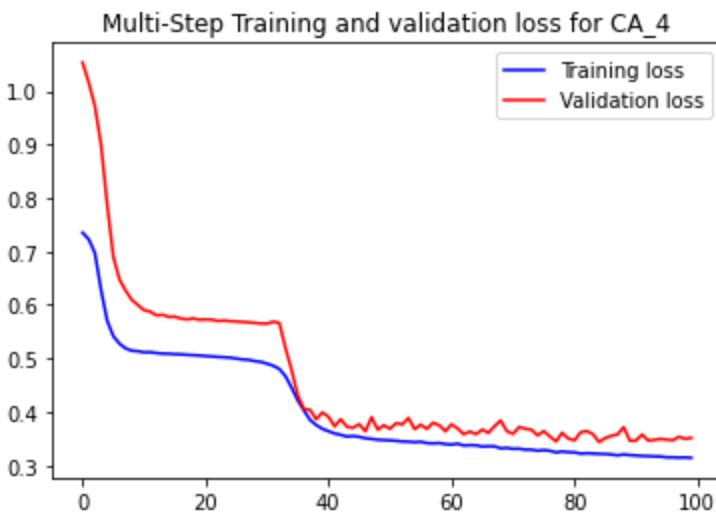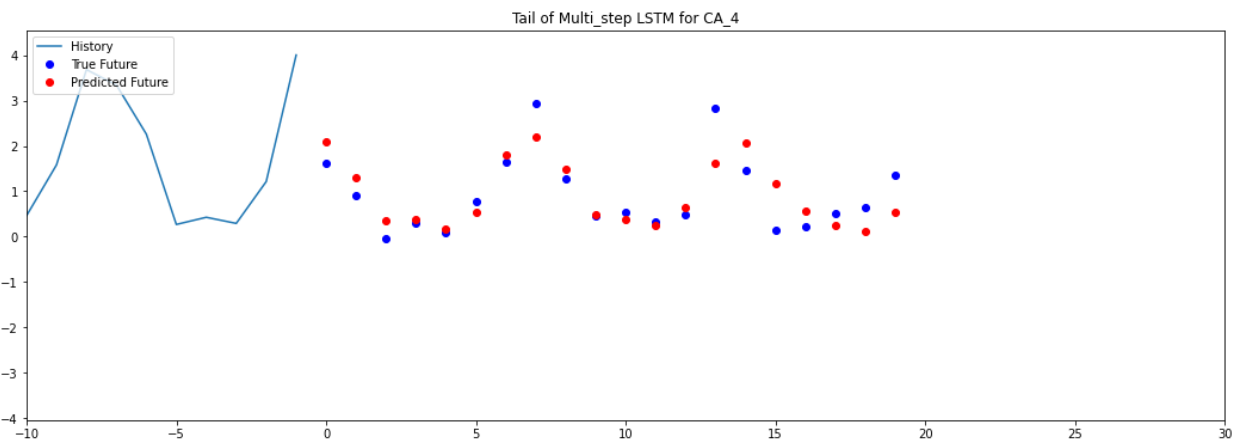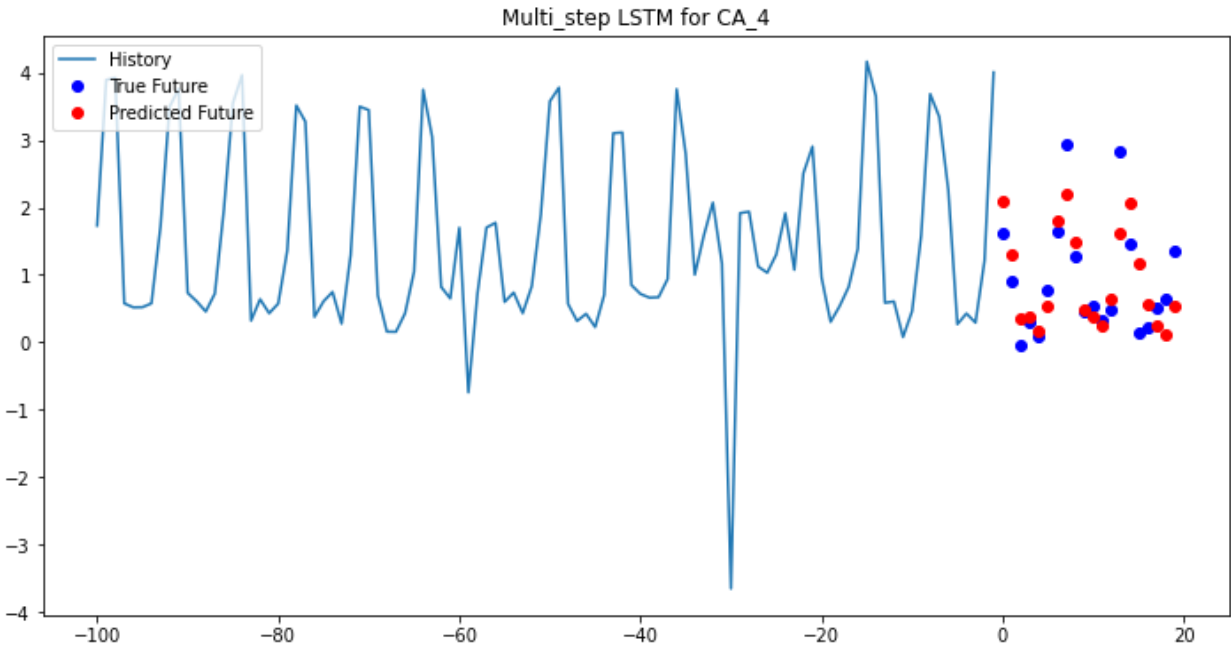
CA_4 - True Future: [2787. 2487. 2088. 2239. 2153. 2432. 2806. 3343. 2643. 2299. 2335. 2244. 2316. 3301. 2727. 2166. 2207. 2323. 2383. 2677.]

CA_4 - Model Prediction: [2991.581 2652.53 2264.3958 2273.7778 2178.2842 2334.4495 2866.5415
3037.1248 2732.1611 2318.185 2273.8752 2211.188 2375.9446 2786.106
2982.4365 2606.9016 2342.437 2209.5112 2153.7825 2340.8428]

CA_4 - Model Percentage Error: [7.34054735 6.65581139 8.44807241 1.55327521 1.1743697 4.01112406
2.1575732 9.14972313 3.37348213 0.83449581 2.61776256 1.46221086
2.58828066 15.59812308 9.36694255 20.35556839 6.13670194 4.88543993
9.61886401 12.5572367]%

CA_4 - Model Mean Percentage Error: 6.494280253981239%

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Training for CA_2

Single window of past history : (100, 4)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 122ms/step - loss: 0.7860 - val_loss: 1.8145
Epoch 2/100
50/50 [==============================] - 5s 110ms/step - loss: 0.7713 - val_loss: 1.8068
Epoch 3/100
50/50 [==============================] - 5s 110ms/step - loss: 0.7611 - val_loss: 1.7551
Epoch 4/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7448 - val_loss: 1.5472
Epoch 5/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7222 - val_loss: 1.4193
Epoch 6/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7055 - val_loss: 1.3000
Epoch 7/100
50/50 [==============================] - 5s 101ms/step - loss: 0.6915 - val_loss: 1.2193
Epoch 8/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6797 - val_loss: 1.1722
Epoch 9/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6738 - val_loss: 1.1370
Epoch 10/100
50/50 [==============================] - 5s 101ms/step - loss: 0.6698 - val_loss: 1.1245
Epoch 11/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6657 - val_loss: 1.1336
Epoch 12/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6638 - val_loss: 1.1194
Epoch 13/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6591 - val_loss: 1.1155
Epoch 14/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6552 - val_loss: 1.1191
Epoch 15/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6509 - val_loss: 1.1151
Epoch 16/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6427 - val_loss: 1.1056
Epoch 17/100
50/50 [==============================] - 6s 116ms/step - loss: 0.6278 - val_loss: 1.1215
Epoch 18/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6401 - val_loss: 1.1044
Epoch 19/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6035 - val_loss: 1.0533
Epoch 20/100
50/50 [==============================] - 5s 108ms/step - loss: 0.5578 - val_loss: 0.9983
Epoch 21/100
50/50 [==============================] - 6s 115ms/step - loss: 0.4991 - val_loss: 0.9126
Epoch 22/100

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50/50 [==============================] - 6s 114ms/step - loss: 0.4414 - val_loss: 3.8737
Epoch 23/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4045 - val_loss: 0.7972
Epoch 24/100
50/50 [==============================] - 6s 115ms/step - loss: 0.4054 - val_loss: 0.7459
Epoch 25/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3788 - val_loss: 0.7456
Epoch 26/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3731 - val_loss: 0.7453
Epoch 27/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3698 - val_loss: 0.6991
Epoch 28/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3684 - val_loss: 0.6950
Epoch 29/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3642 - val_loss: 0.7145
Epoch 30/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3594 - val_loss: 0.6734
Epoch 31/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3442 - val_loss: 0.6387
Epoch 32/100
50/50 [==============================] - 6s 116ms/step - loss: 0.3374 - val_loss: 0.6533
Epoch 33/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3297 - val_loss: 0.6403
Epoch 34/100
50/50 [==============================] - 6s 118ms/step - loss: 0.3138 - val_loss: 0.6038
Epoch 35/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3120 - val_loss: 0.6444
Epoch 36/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2973 - val_loss: 0.6798
Epoch 37/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2967 - val_loss: 0.6377
Epoch 38/100
50/50 [==============================] - 6s 110ms/step - loss: 0.2859 - val_loss: 0.5910
Epoch 39/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2915 - val_loss: 0.5901
Epoch 40/100
50/50 [==============================] - 6s 112ms/step - loss: 0.2791 - val_loss: 0.5760
Epoch 41/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4912 - val_loss: 1.5383
Epoch 42/100
50/50 [==============================] - 5s 110ms/step - loss: 0.6494 - val_loss: 1.0980
Epoch 43/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6235 - val_loss: 1.0721
Epoch 44/100
50/50 [==============================] - 5s 108ms/step - loss: 0.5628 - val_loss: 1.0481
```

```
Epoch 45/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4375 - val_loss: 0.9263
Epoch 46/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3371 - val_loss: 0.7216
Epoch 47/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3003 - val_loss: 0.6531
Epoch 48/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2859 - val_loss: 0.6082
Epoch 49/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2805 - val_loss: 0.5733
Epoch 50/100
50/50 [==============================] - 6s 113ms/step - loss: 0.2752 - val_loss: 0.5442
Epoch 51/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2726 - val_loss: 0.5477
Epoch 52/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2704 - val_loss: 0.5432
Epoch 53/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2701 - val_loss: 0.5425
Epoch 54/100
50/50 [==============================] - 5s 101ms/step - loss: 0.2678 - val_loss: 0.5336
Epoch 55/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2673 - val_loss: 0.5435
Epoch 56/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2638 - val_loss: 0.5381
Epoch 57/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2653 - val_loss: 0.5713
Epoch 58/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2637 - val_loss: 0.5356
Epoch 59/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2620 - val_loss: 0.5160
Epoch 60/100
50/50 [==============================] - 5s 103ms/step - loss: nan - val_loss: nan
Epoch 61/100
50/50 [==============================] - 5s 103ms/step - loss: nan - val_loss: nan
Epoch 62/100
50/50 [==============================] - 5s 102ms/step - loss: nan - val_loss: nan
Epoch 63/100
50/50 [==============================] - 5s 103ms/step - loss: nan - val_loss: nan
Epoch 64/100
50/50 [==============================] - 5s 102ms/step - loss: nan - val_loss: nan
Epoch 65/100
50/50 [==============================] - 5s 102ms/step - loss: nan - val_loss: nan
Epoch 66/100
50/50 [==============================] - 5s 105ms/step - loss: nan - val_loss: nan
Epoch 67/100
```

```
50/50 [==============================] - 5s 105ms/step - loss: nan - val_loss: nan
Epoch 68/100
50/50 [==============================] - 5s 105ms/step - loss: nan - val_loss: nan
Epoch 69/100
50/50 [==============================] - 5s 102ms/step - loss: nan - val_loss: nan
Epoch 70/100
50/50 [==============================] - 5s 102ms/step - loss: nan - val_loss: nan
Epoch 71/100
50/50 [==============================] - 5s 103ms/step - loss: nan - val_loss: nan
Epoch 72/100
50/50 [==============================] - 5s 101ms/step - loss: nan - val_loss: nan
Epoch 73/100
50/50 [==============================] - 5s 100ms/step - loss: nan - val_loss: nan
Epoch 74/100
50/50 [==============================] - 5s 104ms/step - loss: nan - val_loss: nan
Epoch 75/100
50/50 [==============================] - 5s 104ms/step - loss: nan - val_loss: nan
Epoch 76/100
50/50 [==============================] - 5s 102ms/step - loss: nan - val_loss: nan
Epoch 77/100
50/50 [==============================] - 6s 110ms/step - loss: nan - val_loss: nan
Epoch 78/100
50/50 [==============================] - 6s 122ms/step - loss: nan - val_loss: nan
Epoch 79/100
50/50 [==============================] - 5s 105ms/step - loss: nan - val_loss: nan
Epoch 80/100
50/50 [==============================] - 5s 102ms/step - loss: nan - val_loss: nan
Epoch 81/100
50/50 [==============================] - 5s 105ms/step - loss: nan - val_loss: nan
Epoch 82/100
50/50 [==============================] - 5s 107ms/step - loss: nan - val_loss: nan
Epoch 83/100
50/50 [==============================] - 5s 104ms/step - loss: nan - val_loss: nan
Epoch 84/100
50/50 [==============================] - 5s 102ms/step - loss: nan - val_loss: nan
Epoch 85/100
50/50 [==============================] - 5s 103ms/step - loss: nan - val_loss: nan
Epoch 86/100
50/50 [==============================] - 5s 102ms/step - loss: nan - val_loss: nan
Epoch 87/100
50/50 [==============================] - 5s 100ms/step - loss: nan - val_loss: nan
Epoch 88/100
50/50 [==============================] - 5s 103ms/step - loss: nan - val_loss: nan
Epoch 89/100
50/50 [==============================] - 5s 103ms/step - loss: nan - val_loss: nan
```

```
Epoch 90/100
50/50 [==============================] - 5s 106ms/step - loss: nan - val_loss: nan
Epoch 91/100
50/50 [==============================] - 5s 104ms/step - loss: nan - val_loss: nan
Epoch 92/100
50/50 [==============================] - 5s 103ms/step - loss: nan - val_loss: nan
Epoch 93/100
50/50 [==============================] - 5s 104ms/step - loss: nan - val_loss: nan
Epoch 94/100
50/50 [==============================] - 5s 104ms/step - loss: nan - val_loss: nan
Epoch 95/100
50/50 [==============================] - 5s 100ms/step - loss: nan - val_loss: nan
Epoch 96/100
50/50 [==============================] - 5s 101ms/step - loss: nan - val_loss: nan
Epoch 97/100
50/50 [==============================] - 5s 99ms/step - loss: nan - val_loss: nan
Epoch 98/100
50/50 [==============================] - 5s 98ms/step - loss: nan - val_loss: nan
Epoch 99/100
50/50 [==============================] - 5s 101ms/step - loss: nan - val_loss: nan
Epoch 100/100
50/50 [==============================] - 5s 100ms/step - loss: nan - val_loss: nan
```


Multi-Step Training and validation loss for CA_2

Multi_step LSTM for CA_2

Tail of Multi_step LSTM for CA_2

CA_2 - True Future: [5647. 3240. 3294. 3189. 3211. 3964. 5873. 6037. 3454. 3360. 3314. 3333. 4276. 6150. 4251. 3537. 3549. 3586. 4026. 4140.]

CA_2 - Model Prediction: [nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan]

CA_2 - Model Percentage Error: [nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan]%

CA_2 - Model Mean Percentage Error: nan%

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Training for CA_3

Single window of past history : (100, 4)

(72, 20)

Epoch 1/100

```
50/50 [==============================] - 6s 111ms/step - loss: 0.7220 - val_loss: 0.6579
Epoch 2/100
50/50 [==============================] - 5s 100ms/step - loss: 0.6884 - val_loss: 0.6524
Epoch 3/100
50/50 [==============================] - 5s 101ms/step - loss: 0.6590 - val_loss: 0.6482
Epoch 4/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6378 - val_loss: 0.6448
Epoch 5/100
50/50 [==============================] - 5s 102ms/step - loss: 0.6293 - val_loss: 0.6429
Epoch 6/100
50/50 [==============================] - 5s 102ms/step - loss: 0.6242 - val_loss: 0.6434
Epoch 7/100
50/50 [==============================] - 5s 101ms/step - loss: 0.6207 - val_loss: 0.6442
Epoch 8/100
50/50 [==============================] - 7s 145ms/step - loss: 0.6185 - val_loss: 0.6462
Epoch 9/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6162 - val_loss: 0.6477
Epoch 10/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6145 - val_loss: 0.6488
Epoch 11/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6124 - val_loss: 0.6488
Epoch 12/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6113 - val_loss: 0.6497
Epoch 13/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6102 - val_loss: 0.6495
Epoch 14/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6080 - val_loss: 0.6501
Epoch 15/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6063 - val_loss: 0.6520
Epoch 16/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6032 - val_loss: 0.6489
Epoch 17/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6010 - val_loss: 0.6496
Epoch 18/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5967 - val_loss: 0.6515
Epoch 19/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5926 - val_loss: 0.6558
Epoch 20/100
50/50 [==============================] - 5s 101ms/step - loss: 0.5841 - val_loss: 0.6573
Epoch 21/100
50/50 [==============================] - 5s 101ms/step - loss: 0.5904 - val_loss: 0.6468
Epoch 22/100
50/50 [==============================] - 5s 101ms/step - loss: 0.5685 - val_loss: 0.6637
Epoch 23/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5286 - val_loss: 0.5550
```

```
Epoch 24/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4878 - val_loss: 0.4715
Epoch 25/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4574 - val_loss: 0.4434
Epoch 26/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4401 - val_loss: 0.4085
Epoch 27/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4257 - val_loss: 0.3931
Epoch 28/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4156 - val_loss: 0.4152
Epoch 29/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4062 - val_loss: 0.4025
Epoch 30/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3977 - val_loss: 0.3782
Epoch 31/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3922 - val_loss: 0.3938
Epoch 32/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3876 - val_loss: 0.3987
Epoch 33/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3807 - val_loss: 0.3822
Epoch 34/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3776 - val_loss: 0.3951
Epoch 35/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3743 - val_loss: 0.3963
Epoch 36/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3716 - val_loss: 0.4001
Epoch 37/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3679 - val_loss: 0.3872
Epoch 38/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3669 - val_loss: 0.3992
Epoch 39/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3628 - val_loss: 0.3892
Epoch 40/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3625 - val_loss: 0.3702
Epoch 41/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3597 - val_loss: 0.3921
Epoch 42/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3600 - val_loss: 0.3755
Epoch 43/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3588 - val_loss: 0.3790
Epoch 44/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3554 - val_loss: 0.3797
Epoch 45/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3542 - val_loss: 0.3692
Epoch 46/100
```

```
50/50 [==============================] - 5s 106ms/step - loss: 0.3546 - val_loss: 0.3618
Epoch 47/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3505 - val_loss: 0.3712
Epoch 48/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3507 - val_loss: 0.3719
Epoch 49/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3473 - val_loss: 0.3790
Epoch 50/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3451 - val_loss: 0.3583
Epoch 51/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3459 - val_loss: 0.3510
Epoch 52/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3448 - val_loss: 0.3626
Epoch 53/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3422 - val_loss: 0.3807
Epoch 54/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3377 - val_loss: 0.3598
Epoch 55/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3383 - val_loss: 0.3598
Epoch 56/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3340 - val_loss: 0.3587
Epoch 57/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3334 - val_loss: 0.3467
Epoch 58/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3295 - val_loss: 0.3597
Epoch 59/100
50/50 [==============================] - 8s 167ms/step - loss: 0.3270 - val_loss: 0.3556
Epoch 60/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3251 - val_loss: 0.3392
Epoch 61/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3224 - val_loss: 0.3533
Epoch 62/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3197 - val_loss: 0.3767
Epoch 63/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3184 - val_loss: 0.3485
Epoch 64/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3139 - val_loss: 0.3530
Epoch 65/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3128 - val_loss: 0.3521
Epoch 66/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3124 - val_loss: 0.3697
Epoch 67/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3096 - val_loss: 0.3495
Epoch 68/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3080 - val_loss: 0.3533
```

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Epoch 69/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3083 - val_loss: 0.3592
Epoch 70/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3072 - val_loss: 0.3736
Epoch 71/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3029 - val_loss: 0.3620
Epoch 72/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3049 - val_loss: 0.3633
Epoch 73/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3013 - val_loss: 0.3784
Epoch 74/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3004 - val_loss: 0.3878
Epoch 75/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3013 - val_loss: 0.3635
Epoch 76/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2972 - val_loss: 0.3658
Epoch 77/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2989 - val_loss: 0.3612
Epoch 78/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2982 - val_loss: 0.3515
Epoch 79/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2957 - val_loss: 0.4050
Epoch 80/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2960 - val_loss: 0.3870
Epoch 81/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2928 - val_loss: 0.3772
Epoch 82/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2955 - val_loss: 0.3799
Epoch 83/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2926 - val_loss: 0.3881
Epoch 84/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2924 - val_loss: 0.3900
Epoch 85/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2919 - val_loss: 0.4059
Epoch 86/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2898 - val_loss: 0.4010
Epoch 87/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2925 - val_loss: 0.3811
Epoch 88/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2869 - val_loss: 0.3845
Epoch 89/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2888 - val_loss: 0.4017
Epoch 90/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2872 - val_loss: 0.3945
Epoch 91/100
```

```
50/50 [==============================] - 5s 106ms/step - loss: 0.2863 - val_loss: 0.4277
Epoch 92/100
50/50 [==============================] - 6s 112ms/step - loss: 0.2862 - val_loss: 0.3918
Epoch 93/100
50/50 [==============================] - 6s 115ms/step - loss: 0.2866 - val_loss: 0.3877
Epoch 94/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2845 - val_loss: 0.3995
Epoch 95/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2844 - val_loss: 0.3939
Epoch 96/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2827 - val_loss: 0.4026
Epoch 97/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2827 - val_loss: 0.4042
Epoch 98/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2829 - val_loss: 0.4122
Epoch 99/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2818 - val_loss: 0.3981
Epoch 100/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2806 - val_loss: 0.4023
```


Multi-Step Training and validation loss for CA_3

Multi_step LSTM for CA_3

Tail of Multi_step LSTM for CA_3
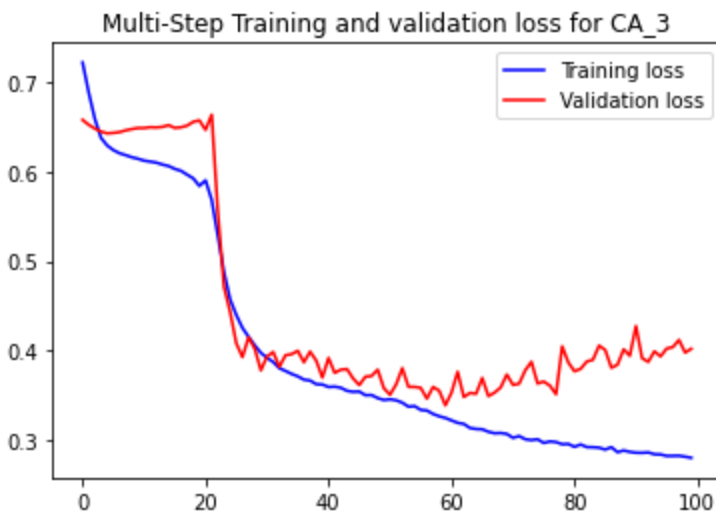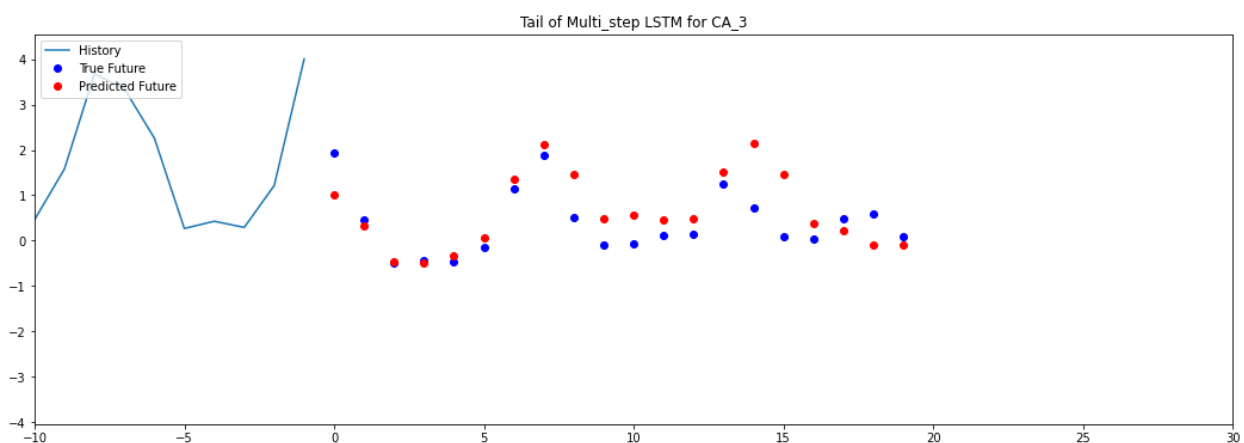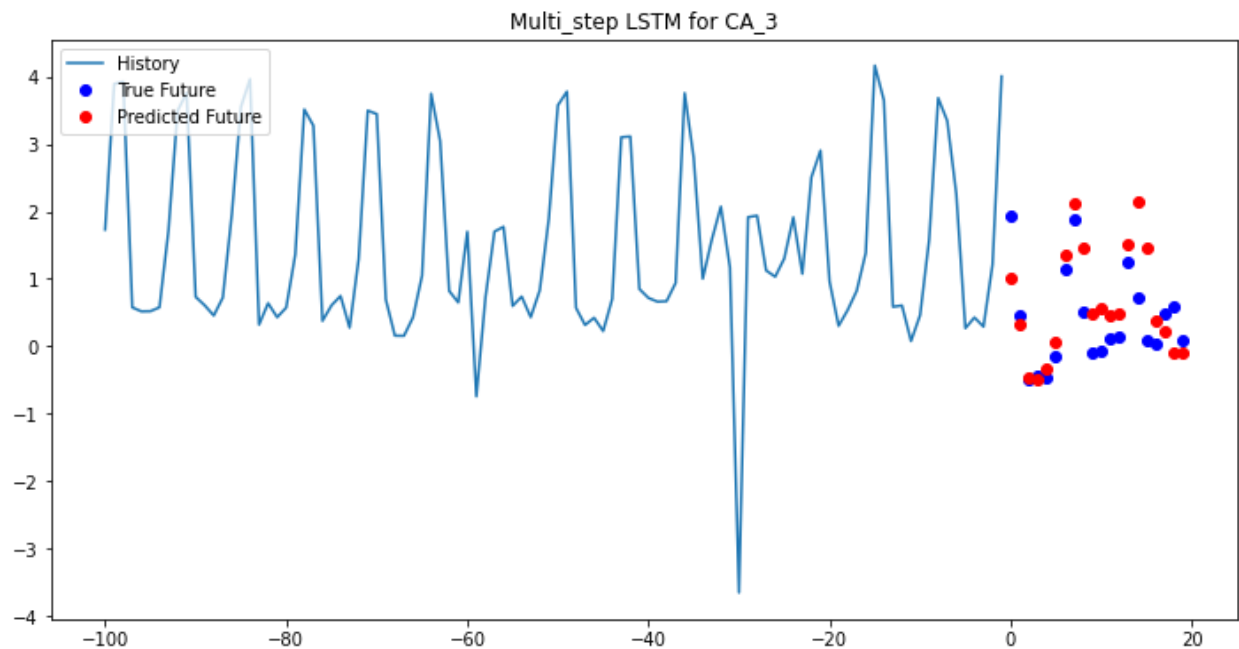
CA_3 - True Future: [8164. 6371. 5244. 5309. 5261. 5637. 7217. 8094. 6446. 5722. 5740. 5951.
 5986. 7347. 6696. 5930. 5882. 6421. 6547. 5928.]

CA_3 - Model Prediction: [7061.2437 6216.9653 5252.6787 5244.457 5426.7715 5898.7515
7458.7715
 8396.346 7602.304 6415.473 6514.0615 6370.0874 6411.142 7665.0376
 8419.49   7605.7847 6284.454 6097.2114 5712.1963 5714.674]

CA_3 - Model Percentage Error: [13.50754958 2.4177471   0.16549792 1.21572742 3.15095009
4.64345334
 3.3500275   3.73542999 17.93832143 12.11941881 13.48539239 7.04230217
 7.10227347 4.32880901 25.73910147 28.25943791 6.84213025 5.04265028
 12.75093495 3.59861963]%

CA_3 - Model Mean Percentage Error: 8.821788735583793%

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Training for CA_1

```
Single window of past history : (100, 4)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 114ms/step - loss: 0.7800 - val_loss: 0.7292
Epoch 2/100
50/50 [==============================] - 5s 102ms/step - loss: 0.7755 - val_loss: 0.7266
Epoch 3/100
50/50 [==============================] - 5s 108ms/step - loss: 0.7705 - val_loss: 0.7261
Epoch 4/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7656 - val_loss: 0.7257
Epoch 5/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7533 - val_loss: 0.7244
Epoch 6/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7388 - val_loss: 0.7224
Epoch 7/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7234 - val_loss: 0.7207
Epoch 8/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7119 - val_loss: 0.7195
Epoch 9/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7054 - val_loss: 0.7192
Epoch 10/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6998 - val_loss: 0.7191
Epoch 11/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6992 - val_loss: 0.7193
Epoch 12/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6966 - val_loss: 0.7189
Epoch 13/100
50/50 [==============================] - 5s 100ms/step - loss: 0.6957 - val_loss: 0.7191
Epoch 14/100
50/50 [==============================] - 5s 102ms/step - loss: 0.6943 - val_loss: 0.7201
Epoch 15/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6930 - val_loss: 0.7213
Epoch 16/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6924 - val_loss: 0.7236
Epoch 17/100
50/50 [==============================] - 5s 101ms/step - loss: 0.6905 - val_loss: 0.7252
Epoch 18/100
50/50 [==============================] - 5s 102ms/step - loss: 0.6905 - val_loss: 0.7243
Epoch 19/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6882 - val_loss: 0.7262
Epoch 20/100
50/50 [==============================] - 7s 149ms/step - loss: 0.6869 - val_loss: 0.7273
Epoch 21/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6852 - val_loss: 0.7977
Epoch 22/100
```

```
50/50 [==============================] - 5s 107ms/step - loss: 0.6836 - val_loss: 5.1449
Epoch 23/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6812 - val_loss: 7.0277
Epoch 24/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6788 - val_loss: 14.3094
Epoch 25/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6754 - val_loss: 20.2151
Epoch 26/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6718 - val_loss: 1.2520
Epoch 27/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6624 - val_loss: 0.7508
Epoch 28/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6358 - val_loss: 0.6449
Epoch 29/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5494 - val_loss: 0.5306
Epoch 30/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4773 - val_loss: 0.4771
Epoch 31/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4281 - val_loss: 0.4260
Epoch 32/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4075 - val_loss: 0.4273
Epoch 33/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3940 - val_loss: 0.4229
Epoch 34/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3910 - val_loss: 0.3994
Epoch 35/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3833 - val_loss: 0.4011
Epoch 36/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3832 - val_loss: 0.4790
Epoch 37/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3793 - val_loss: 0.4022
Epoch 38/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3768 - val_loss: 0.3835
Epoch 39/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3710 - val_loss: 0.3915
Epoch 40/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3694 - val_loss: 0.3976
Epoch 41/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3617 - val_loss: 0.4673
Epoch 42/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3587 - val_loss: 0.3857
Epoch 43/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3532 - val_loss: 0.3792
Epoch 44/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3485 - val_loss: 0.3653
```

```
Epoch 45/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3437 - val_loss: 0.3926
Epoch 46/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3410 - val_loss: 0.3619
Epoch 47/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3345 - val_loss: 0.3402
Epoch 48/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3352 - val_loss: 0.3373
Epoch 49/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3299 - val_loss: 0.3402
Epoch 50/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3281 - val_loss: 0.3376
Epoch 51/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3253 - val_loss: 0.3374
Epoch 52/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3226 - val_loss: 0.3378
Epoch 53/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3221 - val_loss: 0.3423
Epoch 54/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3225 - val_loss: 0.5060
Epoch 55/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3240 - val_loss: 0.3564
Epoch 56/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3164 - val_loss: 0.3341
Epoch 57/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3175 - val_loss: 0.5094
Epoch 58/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3223 - val_loss: 0.3537
Epoch 59/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3096 - val_loss: 0.3485
Epoch 60/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3226 - val_loss: 0.3456
Epoch 61/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3093 - val_loss: 0.3798
Epoch 62/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3056 - val_loss: 0.3708
Epoch 63/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3150 - val_loss: 0.3740
Epoch 64/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3039 - val_loss: 0.4306
Epoch 65/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3066 - val_loss: 0.4346
Epoch 66/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3015 - val_loss: 0.6819
Epoch 67/100
```

```
50/50 [==============================] - 5s 105ms/step - loss: 0.3130 - val_loss: 0.4802
Epoch 68/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2993 - val_loss: 0.5135
Epoch 69/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3020 - val_loss: 0.4999
Epoch 70/100
50/50 [==============================] - 6s 115ms/step - loss: 0.2987 - val_loss: 0.4967
Epoch 71/100
50/50 [==============================] - 6s 116ms/step - loss: 0.2991 - val_loss: 0.5116
Epoch 72/100
50/50 [==============================] - 6s 116ms/step - loss: 0.2954 - val_loss: 0.5872
Epoch 73/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3103 - val_loss: 0.5800
Epoch 74/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2948 - val_loss: 0.6237
Epoch 75/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2945 - val_loss: 0.6105
Epoch 76/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2924 - val_loss: 0.6216
Epoch 77/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3124 - val_loss: 0.5579
Epoch 78/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2914 - val_loss: 0.5552
Epoch 79/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3002 - val_loss: 0.7676
Epoch 80/100
50/50 [==============================] - 6s 117ms/step - loss: 0.3119 - val_loss: 0.5480
Epoch 81/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2902 - val_loss: 0.5952
Epoch 82/100
50/50 [==============================] - 6s 112ms/step - loss: 0.2892 - val_loss: 0.5976
Epoch 83/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2886 - val_loss: 0.6129
Epoch 84/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3098 - val_loss: 0.5297
Epoch 85/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2878 - val_loss: 0.5641
Epoch 86/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2857 - val_loss: 0.5901
Epoch 87/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4141 - val_loss: 0.7330
Epoch 88/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4064 - val_loss: 0.4424
Epoch 89/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2937 - val_loss: 0.4938
```

```
Epoch 90/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2887 - val_loss: 0.5491
Epoch 91/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2851 - val_loss: 0.5258
Epoch 92/100
50/50 [==============================] - 6s 120ms/step - loss: 0.2843 - val_loss: 0.5497
Epoch 93/100
50/50 [==============================] - 6s 115ms/step - loss: 0.2819 - val_loss: 0.5601
Epoch 94/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2843 - val_loss: 0.5665
Epoch 95/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2826 - val_loss: 0.5140
Epoch 96/100
50/50 [==============================] - 6s 112ms/step - loss: 0.2804 - val_loss: 0.5194
Epoch 97/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3119 - val_loss: 0.5102
Epoch 98/100
50/50 [==============================] - 6s 114ms/step - loss: 0.2798 - val_loss: 0.5305
Epoch 99/100
50/50 [==============================] - 6s 116ms/step - loss: 0.2791 - val_loss: 0.4920
Epoch 100/100
50/50 [==============================] - 6s 123ms/step - loss: 0.2797 - val_loss: 0.5059
```


Multi-Step Training and validation loss for CA_1

Multi_step LSTM for CA_1

Tail of Multi_step LSTM for CA_1
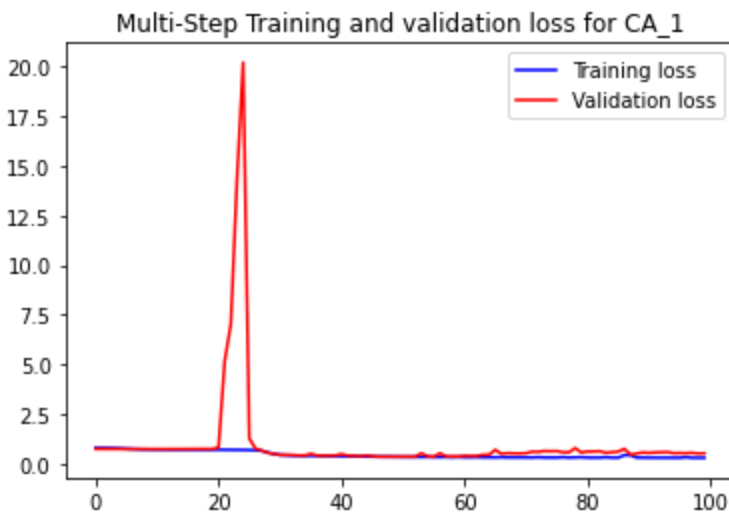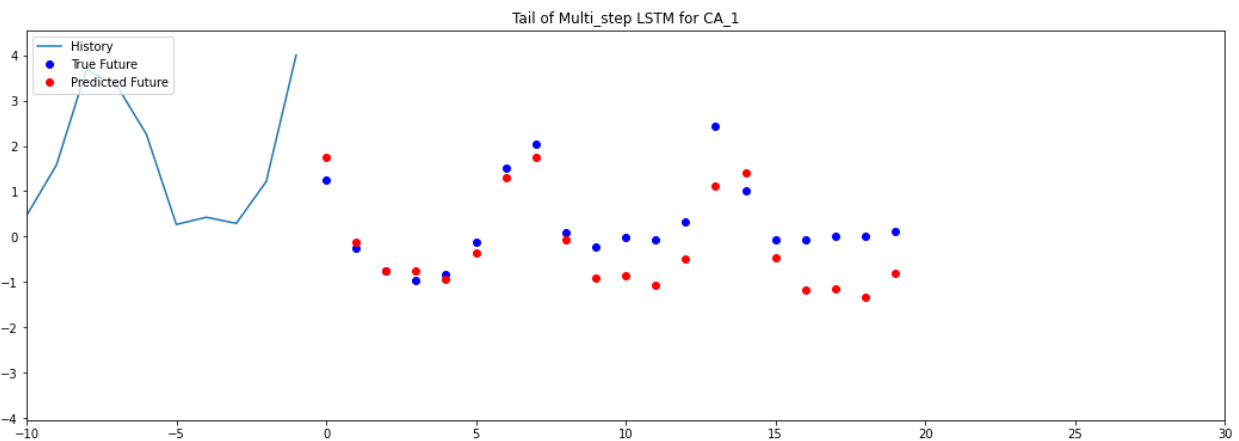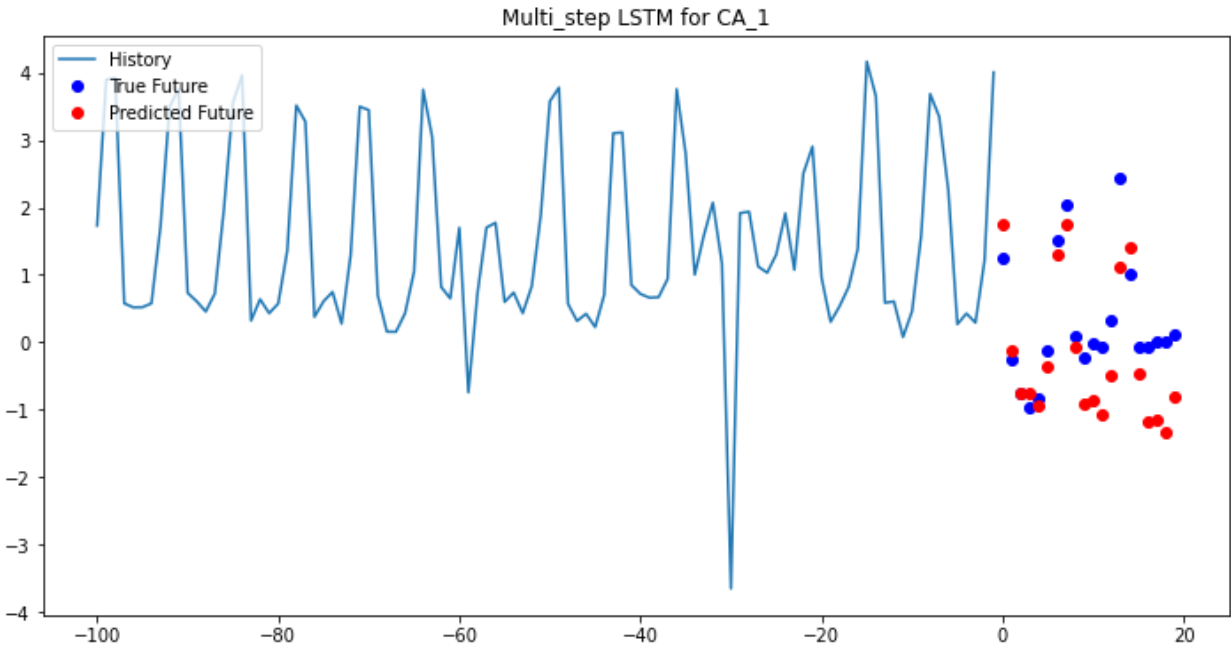
CA_1 - True Future: [5247. 3741. 3246. 3031. 3173. 3871. 5498. 6032. 4075. 3765. 3983. 3928.
 4327. 6412. 4986. 3933. 3936. 3995. 4007. 4111.]
CA_1 - Model Prediction: [5743.6836 3860.3545 3247.6084 3249.1914 3057.3975 3644.8633
5297.1147
 5739.1895 3931.5454 3092.3455 3129.805 2940.4893 3506.1394 5099.228
 5385.168 3541.8032 2831.6245 2854.3677 2663.442 3202.1328]
CA_1 - Model Percentage Error: [9.46604905 3.19044352 0.04955017 7.19866071 3.64331986
5.84181655
 3.65378781 4.85428625 3.52035803 17.86599047 21.4209156 25.14029384
 18.97066318 20.47367393 8.00577555 9.94652371 28.05832033 28.55149748
 33.53027466 22.10817775]%
CA_1 - Model Mean Percentage Error: 13.774518922980633%
====================================
====================================
Training for TX_1

```
Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 128ms/step - loss: 0.7577 - val_loss: 0.7662
Epoch 2/100
50/50 [==============================] - 6s 114ms/step - loss: 0.7525 - val_loss: 0.7701
Epoch 3/100
50/50 [==============================] - 7s 138ms/step - loss: 0.7473 - val_loss: 0.7723
Epoch 4/100
50/50 [==============================] - 6s 127ms/step - loss: 0.7421 - val_loss: 0.7724
Epoch 5/100
50/50 [==============================] - 6s 113ms/step - loss: 0.7376 - val_loss: 0.7701
Epoch 6/100
50/50 [==============================] - 6s 119ms/step - loss: 0.7312 - val_loss: 0.7662
Epoch 7/100
50/50 [==============================] - 6s 117ms/step - loss: 0.7243 - val_loss: 0.7608
Epoch 8/100
50/50 [==============================] - 6s 117ms/step - loss: 0.7181 - val_loss: 0.7545
Epoch 9/100
50/50 [==============================] - 6s 115ms/step - loss: 0.7117 - val_loss: 0.7478
Epoch 10/100
50/50 [==============================] - 6s 115ms/step - loss: 0.7094 - val_loss: 0.7416
Epoch 11/100
50/50 [==============================] - 6s 115ms/step - loss: 0.7066 - val_loss: 0.7368
Epoch 12/100
50/50 [==============================] - 6s 123ms/step - loss: 0.7052 - val_loss: 0.7323
Epoch 13/100
50/50 [==============================] - 6s 123ms/step - loss: 0.7037 - val_loss: 0.7287
Epoch 14/100
50/50 [==============================] - 6s 118ms/step - loss: 0.7029 - val_loss: 0.7259
Epoch 15/100
50/50 [==============================] - 6s 128ms/step - loss: 0.7011 - val_loss: 0.7234
Epoch 16/100
50/50 [==============================] - 6s 119ms/step - loss: 0.7004 - val_loss: 0.7214
Epoch 17/100
50/50 [==============================] - 6s 116ms/step - loss: 0.7004 - val_loss: 0.7196
Epoch 18/100
50/50 [==============================] - 6s 114ms/step - loss: 0.6995 - val_loss: 0.7180
Epoch 19/100
50/50 [==============================] - 6s 118ms/step - loss: 0.6981 - val_loss: 0.7167
Epoch 20/100
50/50 [==============================] - 6s 118ms/step - loss: 0.6973 - val_loss: 0.7158
Epoch 21/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6962 - val_loss: 0.7151
Epoch 22/100
```

```
50/50 [==============================] - 6s 112ms/step - loss: 0.6955 - val_loss: 0.7167
Epoch 23/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6935 - val_loss: 0.7156
Epoch 24/100
50/50 [==============================] - 6s 117ms/step - loss: 0.6927 - val_loss: 0.7182
Epoch 25/100
50/50 [==============================] - 6s 114ms/step - loss: 0.6908 - val_loss: 0.7204
Epoch 26/100
50/50 [==============================] - 8s 153ms/step - loss: 0.6896 - val_loss: 0.7208
Epoch 27/100
50/50 [==============================] - 7s 145ms/step - loss: 0.6877 - val_loss: 0.7258
Epoch 28/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6861 - val_loss: 0.7207
Epoch 29/100
50/50 [==============================] - 6s 110ms/step - loss: 0.6826 - val_loss: 0.7187
Epoch 30/100
50/50 [==============================] - 5s 110ms/step - loss: 0.6814 - val_loss: 0.7240
Epoch 31/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6784 - val_loss: 0.7231
Epoch 32/100
50/50 [==============================] - 6s 110ms/step - loss: 0.6741 - val_loss: 0.7296
Epoch 33/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6701 - val_loss: 0.7233
Epoch 34/100
50/50 [==============================] - 6s 114ms/step - loss: 0.6655 - val_loss: 0.7364
Epoch 35/100
50/50 [==============================] - 7s 138ms/step - loss: 0.6581 - val_loss: 0.7474
Epoch 36/100
50/50 [==============================] - 7s 135ms/step - loss: 0.6497 - val_loss: 0.7656
Epoch 37/100
50/50 [==============================] - 6s 117ms/step - loss: 0.6376 - val_loss: 0.7383
Epoch 38/100
50/50 [==============================] - 6s 114ms/step - loss: 0.6190 - val_loss: 0.7055
Epoch 39/100
50/50 [==============================] - 7s 141ms/step - loss: 0.5896 - val_loss: 0.6292
Epoch 40/100
50/50 [==============================] - 6s 121ms/step - loss: 0.5528 - val_loss: 0.5958
Epoch 41/100
50/50 [==============================] - 6s 115ms/step - loss: 0.5213 - val_loss: 0.5657
Epoch 42/100
50/50 [==============================] - 6s 111ms/step - loss: 0.4999 - val_loss: 0.5643
Epoch 43/100
50/50 [==============================] - 6s 113ms/step - loss: 0.4876 - val_loss: 0.5484
Epoch 44/100
50/50 [==============================] - 6s 111ms/step - loss: 0.4832 - val_loss: 0.5608
```

```
Epoch 45/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4854 - val_loss: 0.5398
Epoch 46/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4752 - val_loss: 0.5451
Epoch 47/100
50/50 [==============================] - 6s 111ms/step - loss: 0.5672 - val_loss: 0.6981
Epoch 48/100
50/50 [==============================] - 6s 120ms/step - loss: 0.6119 - val_loss: 0.6681
Epoch 49/100
50/50 [==============================] - 6s 119ms/step - loss: 0.5017 - val_loss: 0.6238
Epoch 50/100
50/50 [==============================] - 6s 125ms/step - loss: 0.4833 - val_loss: 0.5796
Epoch 51/100
50/50 [==============================] - 6s 117ms/step - loss: 0.4741 - val_loss: 0.5790
Epoch 52/100
50/50 [==============================] - 6s 118ms/step - loss: 0.4698 - val_loss: 0.5471
Epoch 53/100
50/50 [==============================] - 6s 116ms/step - loss: 0.4650 - val_loss: 0.5545
Epoch 54/100
50/50 [==============================] - 6s 118ms/step - loss: 0.4592 - val_loss: 0.6099
Epoch 55/100
50/50 [==============================] - 6s 122ms/step - loss: 0.4556 - val_loss: 0.4986
Epoch 56/100
50/50 [==============================] - 6s 115ms/step - loss: 0.4502 - val_loss: 0.5160
Epoch 57/100
50/50 [==============================] - 6s 114ms/step - loss: 0.5819 - val_loss: 0.7347
Epoch 58/100
50/50 [==============================] - 6s 118ms/step - loss: 0.6594 - val_loss: 0.6961
Epoch 59/100
50/50 [==============================] - 6s 120ms/step - loss: 0.5959 - val_loss: 0.5594
Epoch 60/100
50/50 [==============================] - 6s 115ms/step - loss: 0.4843 - val_loss: 0.5215
Epoch 61/100
50/50 [==============================] - 6s 114ms/step - loss: 0.4515 - val_loss: 0.5160
Epoch 62/100
50/50 [==============================] - 6s 114ms/step - loss: 0.4403 - val_loss: 0.4797
Epoch 63/100
50/50 [==============================] - 6s 114ms/step - loss: 0.4291 - val_loss: 0.5115
Epoch 64/100
50/50 [==============================] - 6s 119ms/step - loss: 0.4202 - val_loss: 0.4393
Epoch 65/100
50/50 [==============================] - 6s 114ms/step - loss: 0.4133 - val_loss: 0.4193
Epoch 66/100
50/50 [==============================] - 6s 115ms/step - loss: 0.4541 - val_loss: 0.6439
Epoch 67/100
```

```
50/50 [==============================] - 6s 118ms/step - loss: 0.4538 - val_loss: 0.4142
Epoch 68/100
50/50 [==============================] - 6s 116ms/step - loss: 0.4010 - val_loss: 0.4191
Epoch 69/100
50/50 [==============================] - 6s 117ms/step - loss: 0.3938 - val_loss: 0.4013
Epoch 70/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3875 - val_loss: 0.3689
Epoch 71/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3826 - val_loss: 0.3818
Epoch 72/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3793 - val_loss: 0.3800
Epoch 73/100
50/50 [==============================] - 6s 118ms/step - loss: 0.5993 - val_loss: 0.6861
Epoch 74/100
50/50 [==============================] - 6s 117ms/step - loss: 0.6419 - val_loss: 0.6601
Epoch 75/100
50/50 [==============================] - 6s 118ms/step - loss: 0.6085 - val_loss: 0.6226
Epoch 76/100
50/50 [==============================] - 6s 119ms/step - loss: 0.5552 - val_loss: 0.5417
Epoch 77/100
50/50 [==============================] - 6s 115ms/step - loss: 0.4787 - val_loss: 0.4624
Epoch 78/100
50/50 [==============================] - 6s 114ms/step - loss: 0.4266 - val_loss: 0.4294
Epoch 79/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3969 - val_loss: 0.4041
Epoch 80/100
50/50 [==============================] - 6s 116ms/step - loss: 0.3848 - val_loss: 0.4047
Epoch 81/100
50/50 [==============================] - 6s 120ms/step - loss: 0.3769 - val_loss: 0.4014
Epoch 82/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3724 - val_loss: 0.4039
Epoch 83/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3685 - val_loss: 0.3830
Epoch 84/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3657 - val_loss: 0.3882
Epoch 85/100
50/50 [==============================] - 6s 116ms/step - loss: 0.3643 - val_loss: 0.3859
Epoch 86/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3611 - val_loss: 0.3845
Epoch 87/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3595 - val_loss: 0.3750
Epoch 88/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3587 - val_loss: 0.3677
Epoch 89/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3579 - val_loss: 0.3691
```

```
Epoch 90/100
50/50 [==============================] - 6s 117ms/step - loss: 0.3542 - val_loss: 0.3774
Epoch 91/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3544 - val_loss: 0.3578
Epoch 92/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3527 - val_loss: 0.3692
Epoch 93/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3500 - val_loss: 0.3708
Epoch 94/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3616 - val_loss: 0.4479
Epoch 95/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3550 - val_loss: 0.3862
Epoch 96/100
50/50 [==============================] - 6s 117ms/step - loss: 0.3473 - val_loss: 0.3784
Epoch 97/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3541 - val_loss: 0.3870
Epoch 98/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3453 - val_loss: 0.3558
Epoch 99/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3431 - val_loss: 0.3762
Epoch 100/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3420 - val_loss: 0.3784
```


Multi-Step Training and validation loss for TX_1

Multi_step LSTM for TX_1

Tail of Multi_step LSTM for TX_1
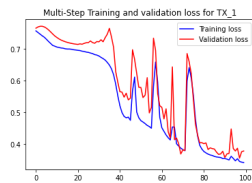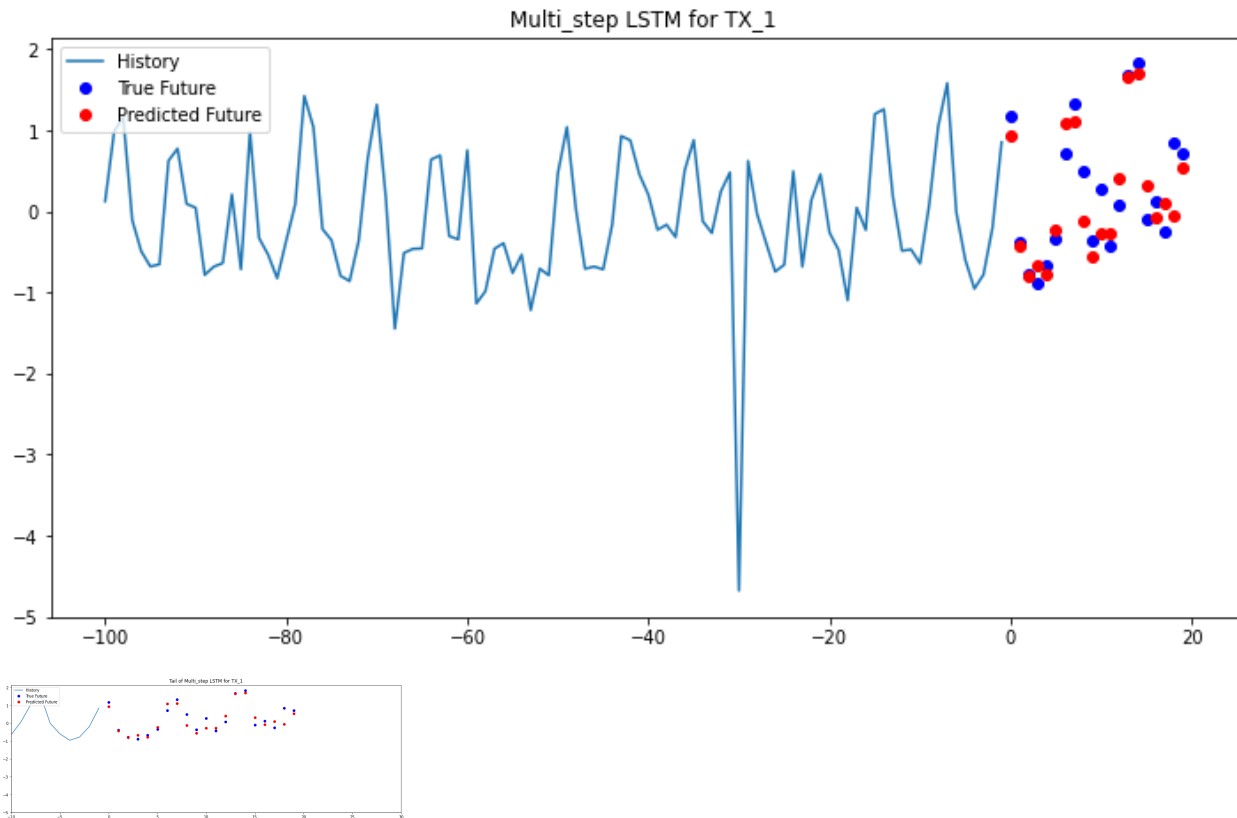
TX_1 - True Future: [3639. 2666. 2426. 2357. 2497. 2693. 3347. 3727. 3213. 2681. 3081. 2645.
 2949. 3939. 4034. 2845. 2978. 2745. 3431. 3343.]

TX_1 - Model Prediction: [3490.4136 2642.9766 2412.0452 2487.293 2426.9084 2763.6072
3572.9072
 3595.0627 2832.261 2561.4255 2738.5112 2742.6023 3164.3484 3934.66
 3953.9712 3111.0298 2856.7869 2974.2454 2869.7847 3238.1143]

TX_1 - Model Percentage Error: [4.08316641 0.8635948   0.57521987 5.52791552 2.80703055
2.62187812
  6.74954367 3.54003906 11.84995374 4.46006948 11.1161561   3.69006786
  7.30242078 0.11018248 1.98385743 9.35078331 4.07028659 8.35137928
 16.35719417 3.13747359]%

TX_1 - Model Mean Percentage Error: 5.4274106410178735%
===================================
===================================
Training for TX_3
Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 121ms/step - loss: 0.7527 - val_loss: 1.0669
Epoch 2/100
50/50 [==============================] - 6s 112ms/step - loss: 0.7335 - val_loss: 1.0103
Epoch 3/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7124 - val_loss: 0.9116

```
Epoch 4/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6846 - val_loss: 0.8017
Epoch 5/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6617 - val_loss: 0.7270
Epoch 6/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6470 - val_loss: 0.6826
Epoch 7/100
50/50 [==============================] - 6s 116ms/step - loss: 0.6380 - val_loss: 0.6768
Epoch 8/100
50/50 [==============================] - 6s 116ms/step - loss: 0.6333 - val_loss: 0.6696
Epoch 9/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6307 - val_loss: 0.6776
Epoch 10/100
50/50 [==============================] - 6s 116ms/step - loss: 0.6296 - val_loss: 0.6911
Epoch 11/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6288 - val_loss: 0.6904
Epoch 12/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6281 - val_loss: 0.7061
Epoch 13/100
50/50 [==============================] - 5s 110ms/step - loss: 0.6272 - val_loss: 0.7399
Epoch 14/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6287 - val_loss: 0.6771
Epoch 15/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6262 - val_loss: 0.7061
Epoch 16/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6257 - val_loss: 0.7202
Epoch 17/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6247 - val_loss: 0.7148
Epoch 18/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6244 - val_loss: 0.7228
Epoch 19/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6237 - val_loss: 0.7232
Epoch 20/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6235 - val_loss: 0.7246
Epoch 21/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6237 - val_loss: 0.7178
Epoch 22/100
50/50 [==============================] - 5s 110ms/step - loss: 0.6217 - val_loss: 0.7305
Epoch 23/100
50/50 [==============================] - 6s 117ms/step - loss: 0.6209 - val_loss: 0.7390
Epoch 24/100
50/50 [==============================] - 6s 121ms/step - loss: 0.6212 - val_loss: 0.7400
Epoch 25/100
50/50 [==============================] - 6s 114ms/step - loss: 0.6192 - val_loss: 0.7362
Epoch 26/100
```

```
50/50 [==============================] - 5s 110ms/step - loss: 0.6209 - val_loss: 0.7319
Epoch 27/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6187 - val_loss: 0.7447
Epoch 28/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6164 - val_loss: 0.7482
Epoch 29/100
50/50 [==============================] - 8s 166ms/step - loss: 0.6161 - val_loss: 0.7350
Epoch 30/100
50/50 [==============================] - 6s 115ms/step - loss: 0.6144 - val_loss: 0.7502
Epoch 31/100
50/50 [==============================] - 6s 115ms/step - loss: 0.6125 - val_loss: 0.7438
Epoch 32/100
50/50 [==============================] - 6s 117ms/step - loss: 0.6116 - val_loss: 0.7192
Epoch 33/100
50/50 [==============================] - 6s 120ms/step - loss: 0.6090 - val_loss: 0.7355
Epoch 34/100
50/50 [==============================] - 6s 115ms/step - loss: 0.6082 - val_loss: 0.6948
Epoch 35/100
50/50 [==============================] - 6s 114ms/step - loss: 0.6070 - val_loss: 0.7448
Epoch 36/100
50/50 [==============================] - 6s 117ms/step - loss: 0.5997 - val_loss: 0.7219
Epoch 37/100
50/50 [==============================] - 6s 115ms/step - loss: 0.5877 - val_loss: 0.7342
Epoch 38/100
50/50 [==============================] - 6s 111ms/step - loss: 0.5677 - val_loss: 0.6479
Epoch 39/100
50/50 [==============================] - 5s 108ms/step - loss: 0.5201 - val_loss: 0.5733
Epoch 40/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4734 - val_loss: 0.5910
Epoch 41/100
50/50 [==============================] - 6s 113ms/step - loss: 0.4481 - val_loss: 0.5779
Epoch 42/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4361 - val_loss: 0.5365
Epoch 43/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4278 - val_loss: 0.5626
Epoch 44/100
50/50 [==============================] - 6s 118ms/step - loss: 0.4254 - val_loss: 0.5163
Epoch 45/100
50/50 [==============================] - 6s 114ms/step - loss: 0.4229 - val_loss: 0.5409
Epoch 46/100
50/50 [==============================] - 6s 111ms/step - loss: 0.4192 - val_loss: 0.5272
Epoch 47/100
50/50 [==============================] - 6s 111ms/step - loss: 0.4155 - val_loss: 0.5101
Epoch 48/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4169 - val_loss: 0.5117
```

```
Epoch 49/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4158 - val_loss: 0.5114
Epoch 50/100
50/50 [==============================] - 5s 110ms/step - loss: 0.4090 - val_loss: 0.5037
Epoch 51/100
50/50 [==============================] - 6s 113ms/step - loss: 0.4701 - val_loss: 0.5225
Epoch 52/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4096 - val_loss: 0.5276
Epoch 53/100
50/50 [==============================] - 6s 113ms/step - loss: 0.4032 - val_loss: 0.4908
Epoch 54/100
50/50 [==============================] - 6s 115ms/step - loss: 0.4007 - val_loss: 0.5049
Epoch 55/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3971 - val_loss: 0.4892
Epoch 56/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4613 - val_loss: 0.5216
Epoch 57/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4003 - val_loss: 0.5299
Epoch 58/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3914 - val_loss: 0.4988
Epoch 59/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3877 - val_loss: 0.5029
Epoch 60/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3892 - val_loss: 0.5132
Epoch 61/100
50/50 [==============================] - 6s 122ms/step - loss: 0.3811 - val_loss: 0.5369
Epoch 62/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3801 - val_loss: 0.5236
Epoch 63/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3924 - val_loss: 0.5302
Epoch 64/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3824 - val_loss: 0.4967
Epoch 65/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3741 - val_loss: 0.4972
Epoch 66/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3747 - val_loss: 0.5087
Epoch 67/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3712 - val_loss: 0.4919
Epoch 68/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4093 - val_loss: 0.6255
Epoch 69/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4411 - val_loss: 0.5005
Epoch 70/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3694 - val_loss: 0.5094
Epoch 71/100
```

```
50/50 [==============================] - 5s 108ms/step - loss: 0.3667 - val_loss: 0.5018
Epoch 72/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3635 - val_loss: 0.5008
Epoch 73/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3756 - val_loss: 0.5258
Epoch 74/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3630 - val_loss: 0.4937
Epoch 75/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3583 - val_loss: 0.4703
Epoch 76/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3586 - val_loss: 0.4636
Epoch 77/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3727 - val_loss: 0.4768
Epoch 78/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3549 - val_loss: 0.4793
Epoch 79/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3528 - val_loss: 0.4561
Epoch 80/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3937 - val_loss: 0.5008
Epoch 81/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3646 - val_loss: 0.4583
Epoch 82/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3494 - val_loss: 0.4350
Epoch 83/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3472 - val_loss: 0.4173
Epoch 84/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3448 - val_loss: 0.4092
Epoch 85/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3606 - val_loss: 0.4179
Epoch 86/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3462 - val_loss: 0.4160
Epoch 87/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3375 - val_loss: 0.3941
Epoch 88/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3359 - val_loss: 0.4049
Epoch 89/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3341 - val_loss: 0.4174
Epoch 90/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3414 - val_loss: 0.4451
Epoch 91/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3305 - val_loss: 0.4119
Epoch 92/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3291 - val_loss: 0.4075
Epoch 93/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3260 - val_loss: 0.4177
```

Epoch 94/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3462 - val_loss: 0.4020
Epoch 95/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3235 - val_loss: 0.4126
Epoch 96/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3199 - val_loss: 0.4127
Epoch 97/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3448 - val_loss: 0.4349
Epoch 98/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3215 - val_loss: 0.4089
Epoch 99/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3179 - val_loss: 0.4221
Epoch 100/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3176 - val_loss: 0.4260

Multi-Step Training and validation loss for TX_3
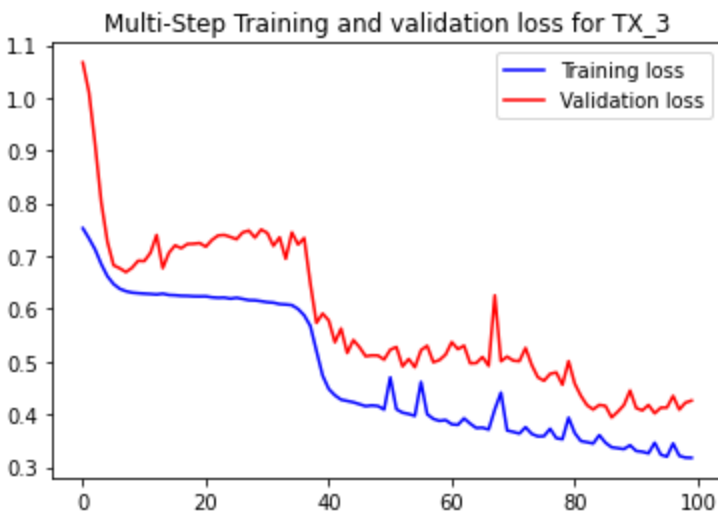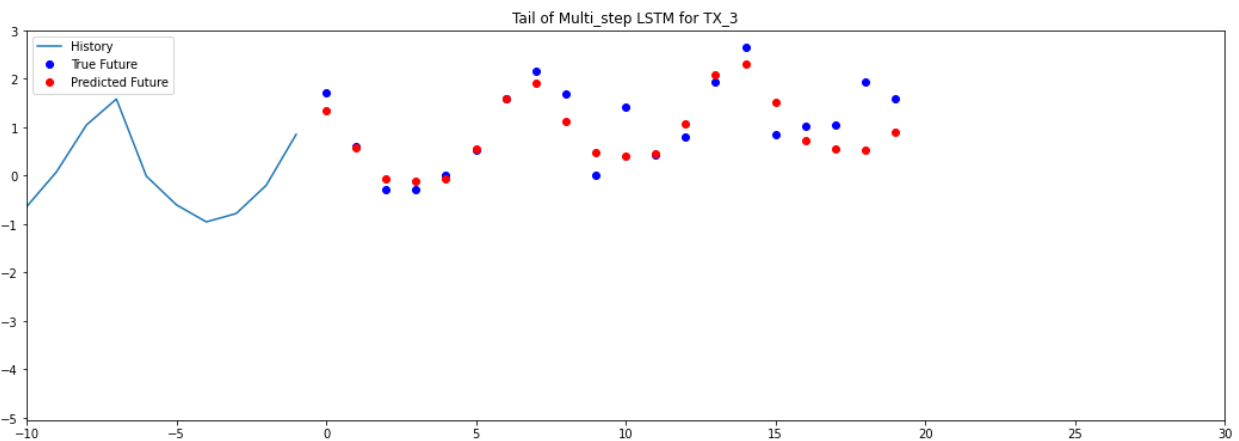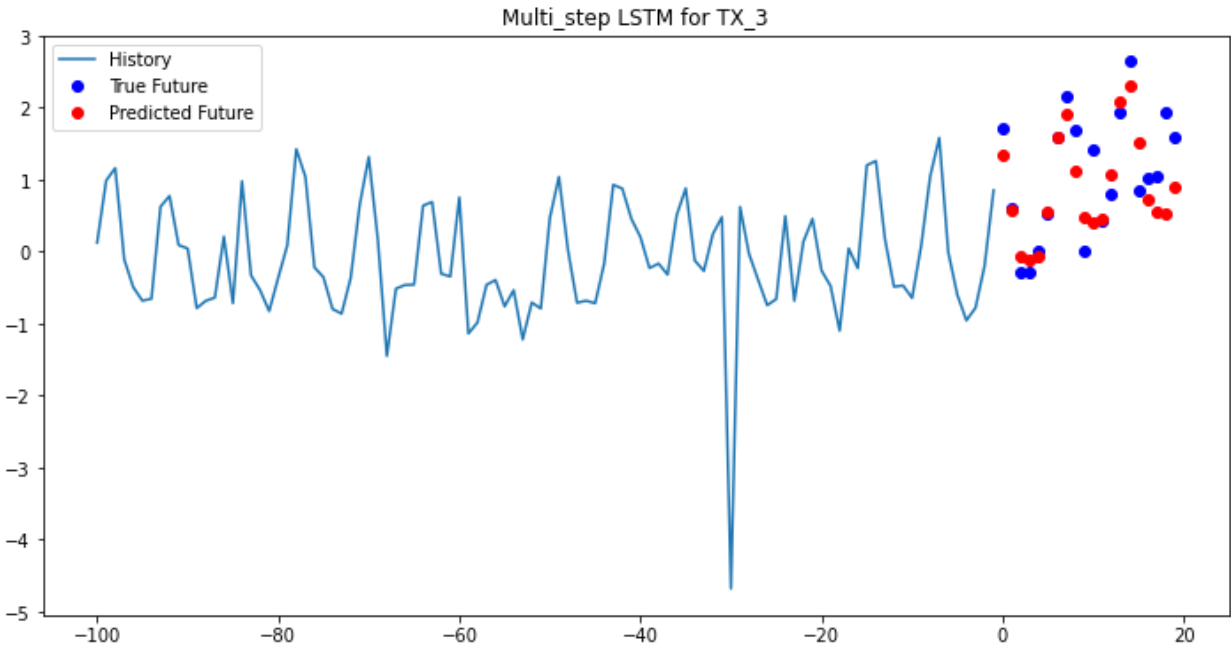
TX_3 - True Future: [4286. 3538. 2934. 2939. 3135. 3486. 4202. 4575. 4262. 3141. 4091. 3421.
 3664. 4432. 4905. 3707. 3825. 3831. 4438. 4198.]

TX_3 - Model Prediction: [4038.5352 3522.4575 3081.2695 3054.8635 3092.9692 3499.6624
4190.981
 4406.7725 3889.4077 3451.143 3405.876 3439.9802 3852.0964 4528.0317
 4680.5845 4146.9307 3617.2227 3495.9934 3485.5789 3733.9114]

TX_3 - Model Percentage Error: [5.77379477 0.43930131 5.01941143 3.94227715 1.34069415
0.39192064
 0.26223329 3.67710468 8.74219346 9.87402313 16.74710397 0.5548151
 5.13363634 2.1667811   4.57524011 11.8675658   5.43208742 8.74462521
 21.46059357 11.0549934]%

TX_3 - Model Mean Percentage Error: 6.360019801105814%

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Training for TX_2

```
Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 120ms/step - loss: 0.7708 - val_loss: 0.6865
Epoch 2/100
50/50 [==============================] - 6s 112ms/step - loss: 0.7650 - val_loss: 0.6955
Epoch 3/100
50/50 [==============================] - 6s 113ms/step - loss: 0.7605 - val_loss: 0.7031
Epoch 4/100
50/50 [==============================] - 6s 116ms/step - loss: 0.7496 - val_loss: 0.7079
Epoch 5/100
50/50 [==============================] - 6s 114ms/step - loss: 0.7345 - val_loss: 0.7083
Epoch 6/100
50/50 [==============================] - 6s 114ms/step - loss: 0.7215 - val_loss: 0.7208
Epoch 7/100
50/50 [==============================] - 6s 118ms/step - loss: 0.7116 - val_loss: 0.7231
Epoch 8/100
50/50 [==============================] - 6s 114ms/step - loss: 0.7060 - val_loss: 0.7228
Epoch 9/100
50/50 [==============================] - 6s 113ms/step - loss: 0.7010 - val_loss: 0.7297
Epoch 10/100
50/50 [==============================] - 6s 116ms/step - loss: 0.6971 - val_loss: 0.7338
Epoch 11/100
50/50 [==============================] - 6s 117ms/step - loss: 0.6951 - val_loss: 0.7418
Epoch 12/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6935 - val_loss: 0.7483
Epoch 13/100
50/50 [==============================] - 6s 114ms/step - loss: 0.6911 - val_loss: 0.7544
Epoch 14/100
50/50 [==============================] - 7s 136ms/step - loss: 0.6902 - val_loss: 0.7579
Epoch 15/100
50/50 [==============================] - 6s 128ms/step - loss: 0.6896 - val_loss: 0.7545
Epoch 16/100
50/50 [==============================] - 6s 116ms/step - loss: 0.6879 - val_loss: 0.7572
Epoch 17/100
50/50 [==============================] - 6s 116ms/step - loss: 0.6877 - val_loss: 0.7530
Epoch 18/100
50/50 [==============================] - 6s 120ms/step - loss: 0.6859 - val_loss: 0.7564
Epoch 19/100
50/50 [==============================] - 6s 115ms/step - loss: 0.6874 - val_loss: 0.7571
Epoch 20/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6851 - val_loss: 0.7565
Epoch 21/100
50/50 [==============================] - 6s 110ms/step - loss: 0.6851 - val_loss: 0.7774
Epoch 22/100
```

```
50/50 [==============================] - 5s 108ms/step - loss: 0.6840 - val_loss: 0.7600
Epoch 23/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6839 - val_loss: 0.7536
Epoch 24/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6815 - val_loss: 0.7658
Epoch 25/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6828 - val_loss: 0.7626
Epoch 26/100
50/50 [==============================] - 6s 117ms/step - loss: 0.6803 - val_loss: 0.7562
Epoch 27/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6804 - val_loss: 0.7746
Epoch 28/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6771 - val_loss: 0.7582
Epoch 29/100
50/50 [==============================] - 6s 116ms/step - loss: 0.6759 - val_loss: 0.7523
Epoch 30/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6770 - val_loss: 0.7516
Epoch 31/100
50/50 [==============================] - 6s 110ms/step - loss: 0.6748 - val_loss: 0.7247
Epoch 32/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6751 - val_loss: 0.7479
Epoch 33/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6646 - val_loss: 0.7386
Epoch 34/100
50/50 [==============================] - 8s 159ms/step - loss: 0.6556 - val_loss: 0.7241
Epoch 35/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6266 - val_loss: 0.6508
Epoch 36/100
50/50 [==============================] - 6s 113ms/step - loss: 0.5644 - val_loss: 0.5296
Epoch 37/100
50/50 [==============================] - 5s 108ms/step - loss: 0.5082 - val_loss: 0.5067
Epoch 38/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4809 - val_loss: 0.5389
Epoch 39/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4643 - val_loss: 0.5929
Epoch 40/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4583 - val_loss: 0.5270
Epoch 41/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4494 - val_loss: 0.5045
Epoch 42/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4476 - val_loss: 0.5270
Epoch 43/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4424 - val_loss: 0.5116
Epoch 44/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4346 - val_loss: 0.5488
```

```
Epoch 45/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4390 - val_loss: 0.4932
Epoch 46/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4328 - val_loss: 0.5038
Epoch 47/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4254 - val_loss: 0.5293
Epoch 48/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4287 - val_loss: 0.5280
Epoch 49/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4195 - val_loss: 0.4859
Epoch 50/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4177 - val_loss: 0.4661
Epoch 51/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4160 - val_loss: 0.5107
Epoch 52/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4091 - val_loss: 0.4699
Epoch 53/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4005 - val_loss: 0.5034
Epoch 54/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4081 - val_loss: 0.4986
Epoch 55/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4473 - val_loss: 0.5840
Epoch 56/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4082 - val_loss: 0.4870
Epoch 57/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3878 - val_loss: 0.4875
Epoch 58/100
50/50 [==============================] - 5s 100ms/step - loss: 0.4115 - val_loss: 0.4985
Epoch 59/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3838 - val_loss: 0.4630
Epoch 60/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3820 - val_loss: 0.4589
Epoch 61/100
50/50 [==============================] - 6s 110ms/step - loss: 0.5382 - val_loss: 0.5260
Epoch 62/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3941 - val_loss: 0.4687
Epoch 63/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3819 - val_loss: 0.4872
Epoch 64/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3762 - val_loss: 0.4724
Epoch 65/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3765 - val_loss: 0.4948
Epoch 66/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3874 - val_loss: 0.5063
Epoch 67/100
```

```
50/50 [==============================] - 5s 109ms/step - loss: 0.3753 - val_loss: 0.5348
Epoch 68/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3839 - val_loss: 0.7125
Epoch 69/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6502 - val_loss: 0.6766
Epoch 70/100
50/50 [==============================] - 6s 119ms/step - loss: 0.4636 - val_loss: 0.4819
Epoch 71/100
50/50 [==============================] - 6s 118ms/step - loss: 0.3797 - val_loss: 0.4620
Epoch 72/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3735 - val_loss: 0.4977
Epoch 73/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3709 - val_loss: 0.4648
Epoch 74/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3692 - val_loss: 0.4701
Epoch 75/100
50/50 [==============================] - 5s 107ms/step - loss: 0.5947 - val_loss: 0.7114
Epoch 76/100
50/50 [==============================] - 5s 109ms/step - loss: 0.5106 - val_loss: 0.4908
Epoch 77/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4059 - val_loss: 0.4760
Epoch 78/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3825 - val_loss: 0.4936
Epoch 79/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3738 - val_loss: 0.4874
Epoch 80/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3699 - val_loss: 0.5223
Epoch 81/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3675 - val_loss: 0.4875
Epoch 82/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6178 - val_loss: 0.6968
Epoch 83/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4989 - val_loss: 0.4840
Epoch 84/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3800 - val_loss: 0.4981
Epoch 85/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3700 - val_loss: 0.5084
Epoch 86/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3651 - val_loss: 0.4657
Epoch 87/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3635 - val_loss: 0.4750
Epoch 88/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3612 - val_loss: 0.4833
Epoch 89/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3581 - val_loss: 0.4761
```

```
Epoch 90/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3581 - val_loss: 0.4819
Epoch 91/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3566 - val_loss: 0.4698
Epoch 92/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3550 - val_loss: 0.4933
Epoch 93/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3528 - val_loss: 0.4910
Epoch 94/100
50/50 [==============================] - 6s 111ms/step - loss: 0.5089 - val_loss: 0.7292
Epoch 95/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6591 - val_loss: 0.7187
Epoch 96/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6242 - val_loss: 0.6832
Epoch 97/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4756 - val_loss: 0.4652
Epoch 98/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3741 - val_loss: 0.4805
Epoch 99/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3620 - val_loss: 0.4707
Epoch 100/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3565 - val_loss: 0.4736
```


Multi-Step Training and validation loss for TX_2

Multi_step LSTM for TX_2

Tail of Multi_step LSTM for TX_2
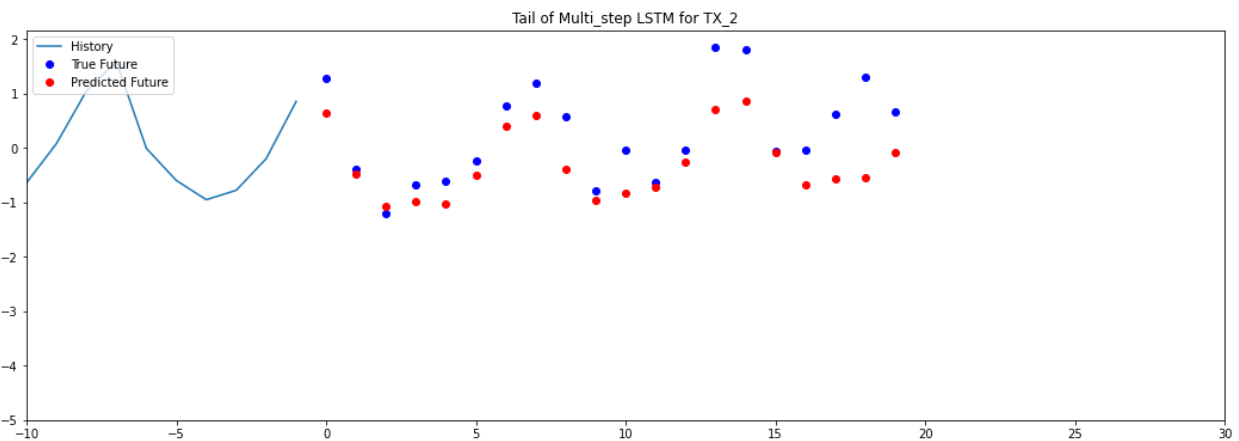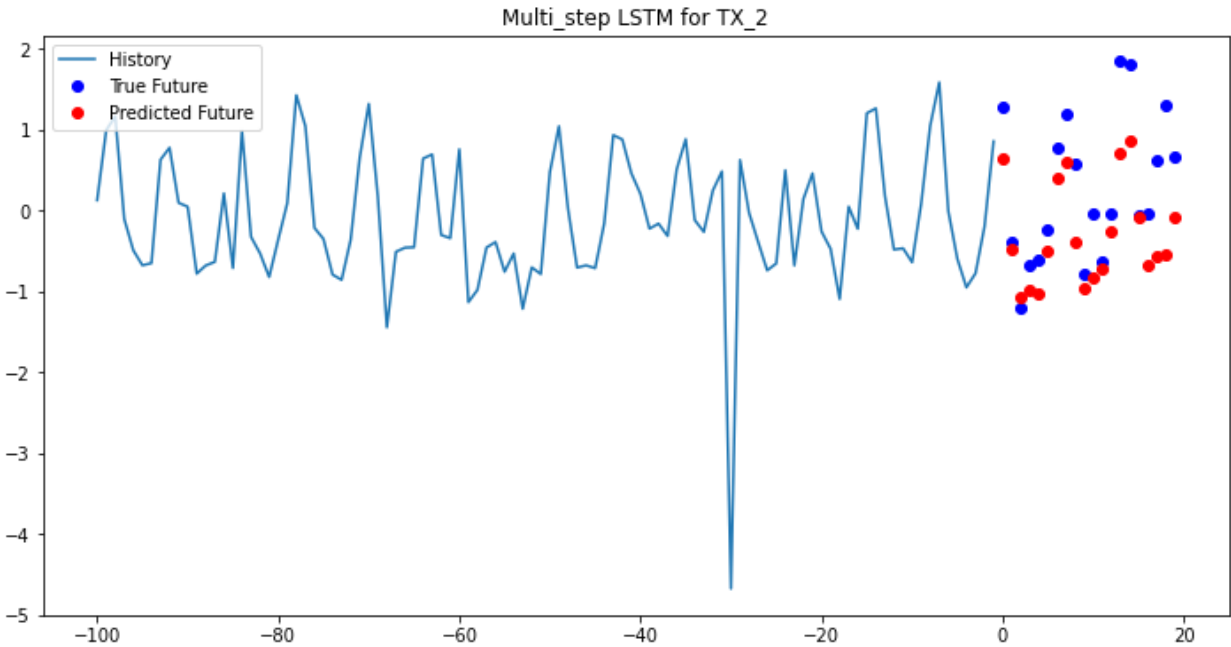
TX_2 - True Future: [4794. 3441. 2798. 3216. 3264. 3562. 4384. 4712. 4225. 3121. 3722. 3245.
 3737. 5240. 5210. 3714. 3737. 4259. 4799. 4295.]
TX_2 - Model Prediction: [4278.8413 3372.8423 2902.7373 2966.6855 2938.9307 3360.028
4074.5159
 4244.667 3449.7993 2982.8933 3093.4998 3177.1511 3544.396 4321.5664
 4447.213 3699.363 3221.828 3311.6897 3313.1733 3690.143]
TX_2 - Model Percentage Error: [10.74590512 1.98075312 3.7432918   7.75231508 9.95923211
5.67018315
 7.0594008   9.9179331 18.34794517 4.42507816 16.88608931 2.09087448
 5.15397388 17.52735866 14.64082744 0.39410239 13.78571365 22.24255231
 30.96117233 14.08281568]%
TX_2 - Model Mean Percentage Error: 10.868375887585179%
===================================
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Training for WI_1

```
Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 5s 108ms/step - loss: 0.7698 - val_loss: 1.1858
Epoch 2/100
50/50 [==============================] - 6s 118ms/step - loss: 0.6758 - val_loss: 0.9842
Epoch 3/100
50/50 [==============================] - 9s 178ms/step - loss: 0.5787 - val_loss: 0.8671
Epoch 4/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5292 - val_loss: 0.8331
Epoch 5/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5074 - val_loss: 0.8545
Epoch 6/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4986 - val_loss: 0.8466
Epoch 7/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4963 - val_loss: 0.8501
Epoch 8/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4973 - val_loss: 0.8413
Epoch 9/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4939 - val_loss: 0.8465
Epoch 10/100
50/50 [==============================] - 6s 110ms/step - loss: 0.4956 - val_loss: 0.8504
Epoch 11/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4947 - val_loss: 0.8527
Epoch 12/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4943 - val_loss: 0.8449
Epoch 13/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4935 - val_loss: 0.8458
Epoch 14/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4939 - val_loss: 0.8379
Epoch 15/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4921 - val_loss: 0.8473
Epoch 16/100
50/50 [==============================] - 6s 111ms/step - loss: 0.4923 - val_loss: 0.8454
Epoch 17/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4939 - val_loss: 0.8531
Epoch 18/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4915 - val_loss: 0.8580
Epoch 19/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4920 - val_loss: 0.8431
Epoch 20/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4914 - val_loss: 0.8356
Epoch 21/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4913 - val_loss: 0.8368
Epoch 22/100
```

```
50/50 [==============================] - 5s 102ms/step - loss: 0.4917 - val_loss: 0.8402
Epoch 23/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4902 - val_loss: 0.8476
Epoch 24/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4898 - val_loss: 0.8324
Epoch 25/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4879 - val_loss: 0.8352
Epoch 26/100
50/50 [==============================] - 6s 111ms/step - loss: 0.4907 - val_loss: 0.8260
Epoch 27/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4881 - val_loss: 0.8280
Epoch 28/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4876 - val_loss: 0.8230
Epoch 29/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4882 - val_loss: 0.8384
Epoch 30/100
50/50 [==============================] - 5s 99ms/step - loss: 0.4870 - val_loss: 0.8264
Epoch 31/100
50/50 [==============================] - 5s 100ms/step - loss: 0.4865 - val_loss: 0.8250
Epoch 32/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4836 - val_loss: 0.8216
Epoch 33/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4843 - val_loss: 0.8260
Epoch 34/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4804 - val_loss: 0.8073
Epoch 35/100
50/50 [==============================] - 6s 110ms/step - loss: 0.4771 - val_loss: 0.8023
Epoch 36/100
50/50 [==============================] - 9s 184ms/step - loss: 0.4484 - val_loss: 0.7695
Epoch 37/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4051 - val_loss: 0.6680
Epoch 38/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3690 - val_loss: 0.6031
Epoch 39/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3481 - val_loss: 0.5942
Epoch 40/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3331 - val_loss: 0.5512
Epoch 41/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3300 - val_loss: 0.5559
Epoch 42/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3250 - val_loss: 0.5302
Epoch 43/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3228 - val_loss: 0.5293
Epoch 44/100
50/50 [==============================] - 7s 144ms/step - loss: 0.3194 - val_loss: 0.5313
```

```
Epoch 45/100
50/50 [==============================] - 6s 121ms/step - loss: 0.3202 - val_loss: 0.5173
Epoch 46/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3149 - val_loss: 0.5091
Epoch 47/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3151 - val_loss: 0.5380
Epoch 48/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3114 - val_loss: 0.5487
Epoch 49/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3074 - val_loss: 0.5050
Epoch 50/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3063 - val_loss: 0.5171
Epoch 51/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3036 - val_loss: 0.4990
Epoch 52/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3016 - val_loss: 0.5047
Epoch 53/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2956 - val_loss: 0.5000
Epoch 54/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2944 - val_loss: 0.4837
Epoch 55/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2911 - val_loss: 0.4999
Epoch 56/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2870 - val_loss: 0.5260
Epoch 57/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2850 - val_loss: 0.5138
Epoch 58/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2801 - val_loss: 0.4958
Epoch 59/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2775 - val_loss: 0.5643
Epoch 60/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2765 - val_loss: 0.5107
Epoch 61/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2723 - val_loss: 0.5550
Epoch 62/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2700 - val_loss: 0.5213
Epoch 63/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2680 - val_loss: 0.5248
Epoch 64/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2656 - val_loss: 0.4875
Epoch 65/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2678 - val_loss: 0.5343
Epoch 66/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2605 - val_loss: 0.5209
Epoch 67/100
```

```
50/50 [==============================] - 5s 104ms/step - loss: 0.2612 - val_loss: 0.4971
Epoch 68/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2627 - val_loss: 0.5350
Epoch 69/100
50/50 [==============================] - 6s 115ms/step - loss: 0.2563 - val_loss: 0.5292
Epoch 70/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2660 - val_loss: 0.5590
Epoch 71/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2537 - val_loss: 0.4806
Epoch 72/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2522 - val_loss: 0.5311
Epoch 73/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2719 - val_loss: 0.5211
Epoch 74/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2487 - val_loss: 0.5102
Epoch 75/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2533 - val_loss: 0.5328
Epoch 76/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2484 - val_loss: 0.5238
Epoch 77/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2645 - val_loss: 0.5002
Epoch 78/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2470 - val_loss: 0.5082
Epoch 79/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2456 - val_loss: 0.5137
Epoch 80/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2440 - val_loss: 0.5293
Epoch 81/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2469 - val_loss: 0.5245
Epoch 82/100
50/50 [==============================] - 6s 115ms/step - loss: 0.2579 - val_loss: 0.5089
Epoch 83/100
50/50 [==============================] - 6s 113ms/step - loss: 0.2438 - val_loss: 0.5108
Epoch 84/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2422 - val_loss: 0.5228
Epoch 85/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2416 - val_loss: 0.5079
Epoch 86/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2418 - val_loss: 0.5182
Epoch 87/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2642 - val_loss: 0.5064
Epoch 88/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2401 - val_loss: 0.5295
Epoch 89/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2388 - val_loss: 0.5077
```

```
Epoch 90/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2508 - val_loss: 0.5699
Epoch 91/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2402 - val_loss: 0.5259
Epoch 92/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2390 - val_loss: 0.5149
Epoch 93/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2374 - val_loss: 0.5147
Epoch 94/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2379 - val_loss: 0.5143
Epoch 95/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3222 - val_loss: 0.8172
Epoch 96/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4567 - val_loss: 0.7776
Epoch 97/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3241 - val_loss: 0.4959
Epoch 98/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2435 - val_loss: 0.5004
Epoch 99/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2385 - val_loss: 0.5074
Epoch 100/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2372 - val_loss: 0.5069
```


Multi-Step Training and validation loss for WI_1

Multi_step LSTM for WI_1

Tail of Multi_step LSTM for WI_1
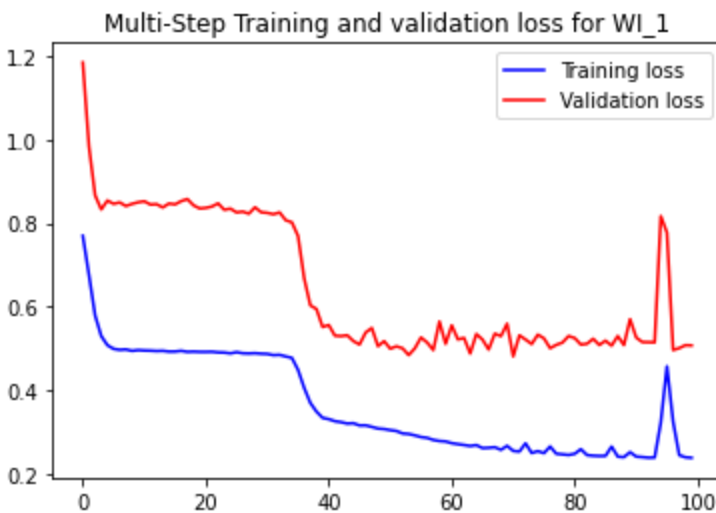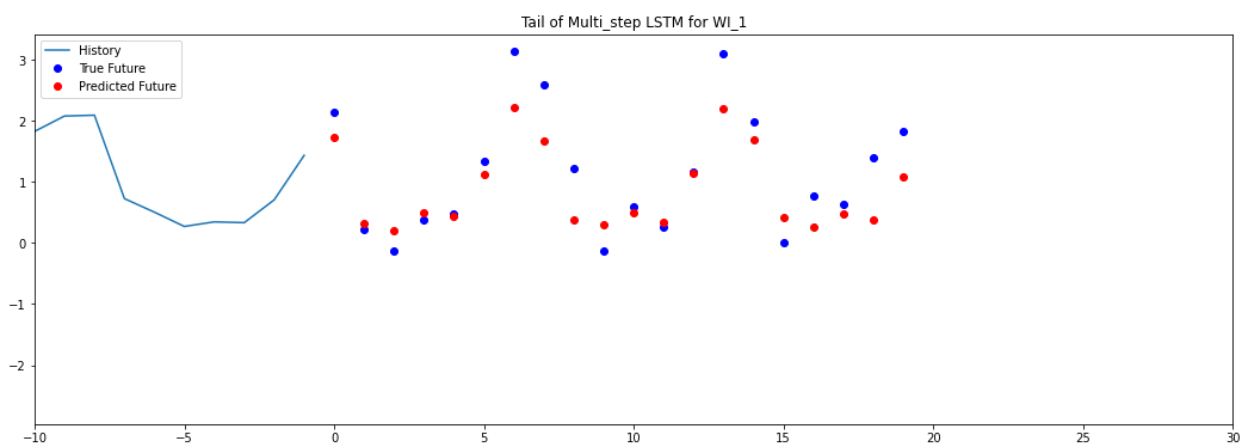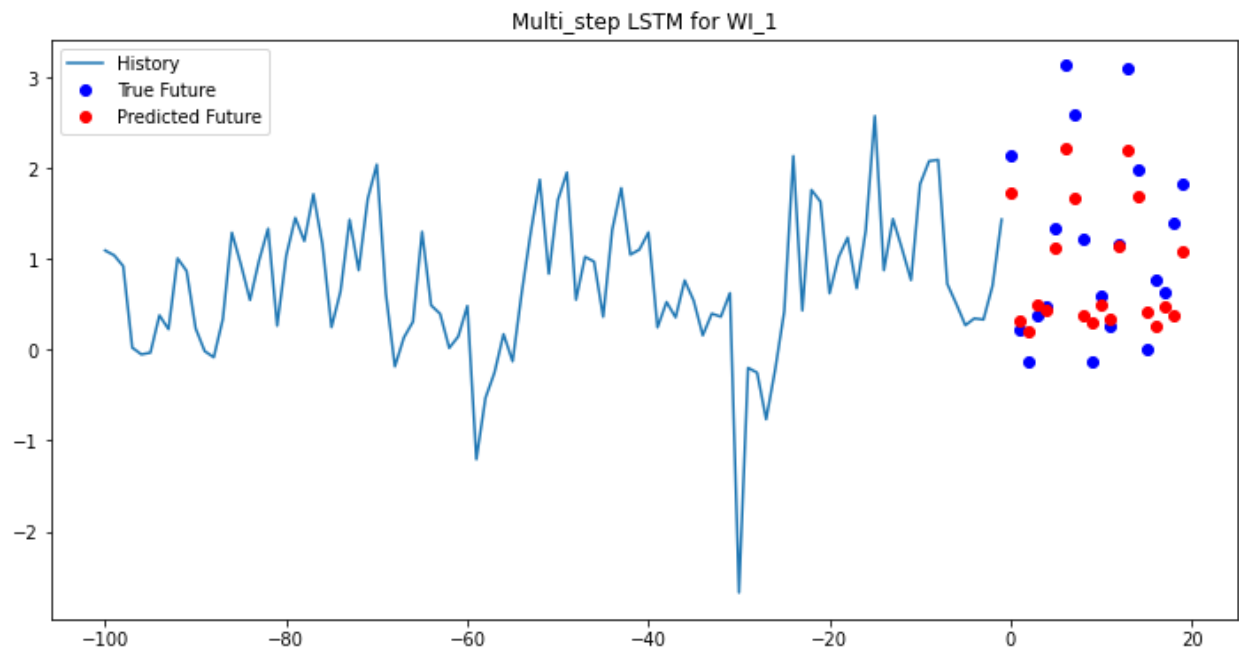
WI_1 - True Future: [4600. 2798. 2466. 2937. 3036. 3845. 5538. 5034. 3740. 2460. 3135. 2831.
 3676. 5516. 4461. 2597. 3313. 3180. 3899. 4308.]
WI_1 - Model Prediction: [4222.0806 2894.2563 2772.2117 3058.57   3002.7678 3633.9607
4680.7266
 4165.12   2945.3992 2861.0469 3054.8223 2906.5369 3655.7178 4653.0693
 4184.992 2983.1082 2825.7183 3033.154 2945.3027 3615.1558]
WI_1 - Model Percentage Error: [8.21563986 3.44018398 12.41734266 4.13926007 1.09460401
5.48866857
 15.47983816 17.26022811 21.2460115 16.3027185   2.55750349 2.66820435
  0.55174719 15.64413822 6.18712873 14.8674684 14.708172   4.61779708
 24.46004785 16.08273534]%
WI_1 - Model Mean Percentage Error: 10.371471902548457%
====================================
====================================
Training for WI_2

Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 117ms/step - loss: 0.8016 - val_loss: 1.6214
Epoch 2/100
50/50 [==============================] - 5s 103ms/step - loss: 0.7879 - val_loss: 1.5457
Epoch 3/100
50/50 [==============================] - 5s 103ms/step - loss: 0.7648 - val_loss: 1.1862
Epoch 4/100
50/50 [==============================] - 5s 100ms/step - loss: 0.6710 - val_loss: 0.9221
Epoch 5/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5413 - val_loss: 0.9370
Epoch 6/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4901 - val_loss: 1.0379
Epoch 7/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4739 - val_loss: 1.0356
Epoch 8/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4674 - val_loss: 1.0312
Epoch 9/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4588 - val_loss: 1.0460
Epoch 10/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4457 - val_loss: 1.0319
Epoch 11/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4329 - val_loss: 1.0189
Epoch 12/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4207 - val_loss: 1.0281
Epoch 13/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4083 - val_loss: 1.0154
Epoch 14/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3981 - val_loss: 0.9993
Epoch 15/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3907 - val_loss: 1.0270
Epoch 16/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3844 - val_loss: 1.0164
Epoch 17/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3804 - val_loss: 0.9705
Epoch 18/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3780 - val_loss: 1.0352
Epoch 19/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3756 - val_loss: 1.0046
Epoch 20/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3743 - val_loss: 0.9499
Epoch 21/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3728 - val_loss: 0.9404
Epoch 22/100

```
50/50 [==============================] - 5s 108ms/step - loss: 0.3709 - val_loss: 0.9133
Epoch 23/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3704 - val_loss: 0.9215
Epoch 24/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3675 - val_loss: 0.9198
Epoch 25/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3685 - val_loss: 0.9474
Epoch 26/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3665 - val_loss: 0.8864
Epoch 27/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3658 - val_loss: 0.9043
Epoch 28/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3638 - val_loss: 0.8638
Epoch 29/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3633 - val_loss: 0.8646
Epoch 30/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3633 - val_loss: 0.8415
Epoch 31/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3614 - val_loss: 0.8425
Epoch 32/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3606 - val_loss: 0.8006
Epoch 33/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3602 - val_loss: 0.7523
Epoch 34/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3594 - val_loss: 0.7987
Epoch 35/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3590 - val_loss: 0.7890
Epoch 36/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3576 - val_loss: 0.7801
Epoch 37/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3580 - val_loss: 0.7588
Epoch 38/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3561 - val_loss: 0.7975
Epoch 39/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3558 - val_loss: 0.7256
Epoch 40/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3551 - val_loss: 0.7297
Epoch 41/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3545 - val_loss: 0.7225
Epoch 42/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3527 - val_loss: 0.7493
Epoch 43/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3539 - val_loss: 0.7320
Epoch 44/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3522 - val_loss: 0.7124
```

```
Epoch 45/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3509 - val_loss: 0.7685
Epoch 46/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3500 - val_loss: 0.7464
Epoch 47/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3507 - val_loss: 0.7316
Epoch 48/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3470 - val_loss: 0.7834
Epoch 49/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3487 - val_loss: 0.7792
Epoch 50/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3455 - val_loss: 0.7132
Epoch 51/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3436 - val_loss: 0.7221
Epoch 52/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3441 - val_loss: 0.6586
Epoch 53/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3416 - val_loss: 0.7766
Epoch 54/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3413 - val_loss: 0.7393
Epoch 55/100
50/50 [==============================] - 6s 124ms/step - loss: 0.3376 - val_loss: 0.7568
Epoch 56/100
50/50 [==============================] - 7s 142ms/step - loss: 0.3373 - val_loss: 0.6855
Epoch 57/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3369 - val_loss: 0.7489
Epoch 58/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3341 - val_loss: 0.7668
Epoch 59/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3321 - val_loss: 0.8853
Epoch 60/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3316 - val_loss: 0.8362
Epoch 61/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3284 - val_loss: 0.8071
Epoch 62/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3283 - val_loss: 0.8638
Epoch 63/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3246 - val_loss: 0.8108
Epoch 64/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3230 - val_loss: 0.9613
Epoch 65/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3214 - val_loss: 0.8239
Epoch 66/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3187 - val_loss: 0.7944
Epoch 67/100
```

```
50/50 [==============================] - 5s 106ms/step - loss: 0.3191 - val_loss: 0.8463
Epoch 68/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3159 - val_loss: 0.8212
Epoch 69/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3142 - val_loss: 0.8857
Epoch 70/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3098 - val_loss: 0.8984
Epoch 71/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3105 - val_loss: 0.9172
Epoch 72/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3071 - val_loss: 0.8281
Epoch 73/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3068 - val_loss: 0.8990
Epoch 74/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3042 - val_loss: 0.7882
Epoch 75/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3081 - val_loss: 0.8519
Epoch 76/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3072 - val_loss: 0.8704
Epoch 77/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3062 - val_loss: 0.7540
Epoch 78/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3042 - val_loss: 0.7249
Epoch 79/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3006 - val_loss: 0.7823
Epoch 80/100
50/50 [==============================] - 6s 110ms/step - loss: 0.2984 - val_loss: 0.8163
Epoch 81/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2989 - val_loss: 0.8050
Epoch 82/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2969 - val_loss: 0.8507
Epoch 83/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2951 - val_loss: 0.7625
Epoch 84/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2955 - val_loss: 0.8000
Epoch 85/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2938 - val_loss: 0.8234
Epoch 86/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2931 - val_loss: 0.7851
Epoch 87/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2937 - val_loss: 0.8692
Epoch 88/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2929 - val_loss: 0.8720
Epoch 89/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2911 - val_loss: 0.7955
```

Epoch 90/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2902 - val_loss: 0.8090
Epoch 91/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2906 - val_loss: 0.7714
Epoch 92/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2904 - val_loss: 0.8270
Epoch 93/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2893 - val_loss: 0.8262
Epoch 94/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2883 - val_loss: 0.7885
Epoch 95/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2889 - val_loss: 0.7647
Epoch 96/100
50/50 [==============================] - 6s 112ms/step - loss: 0.2877 - val_loss: 0.7729
Epoch 97/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2869 - val_loss: 0.8558
Epoch 98/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2881 - val_loss: 0.7666
Epoch 99/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2868 - val_loss: 0.8032
Epoch 100/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2865 - val_loss: 0.7757

Multi-Step Training and validation loss for WI_2

Multi_step LSTM for WI_2

Tail of Multi_step LSTM for WI_2
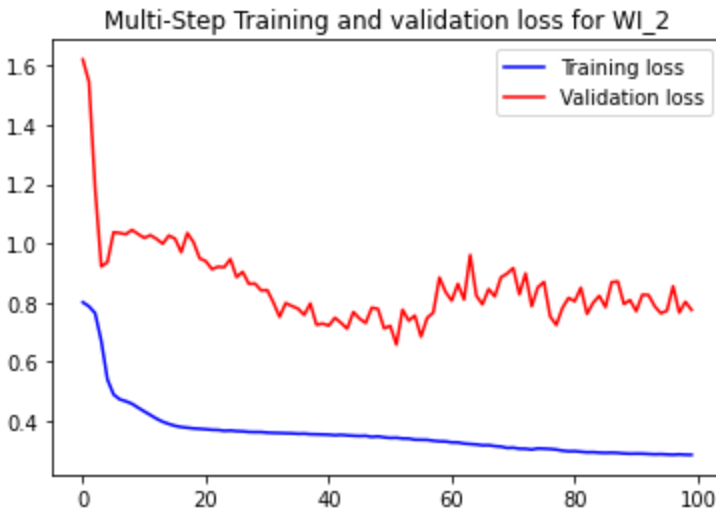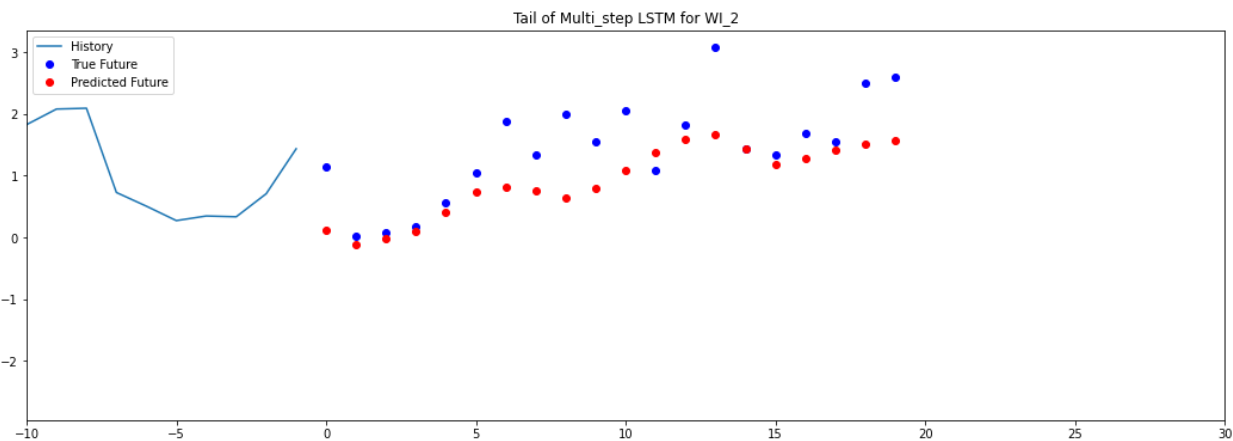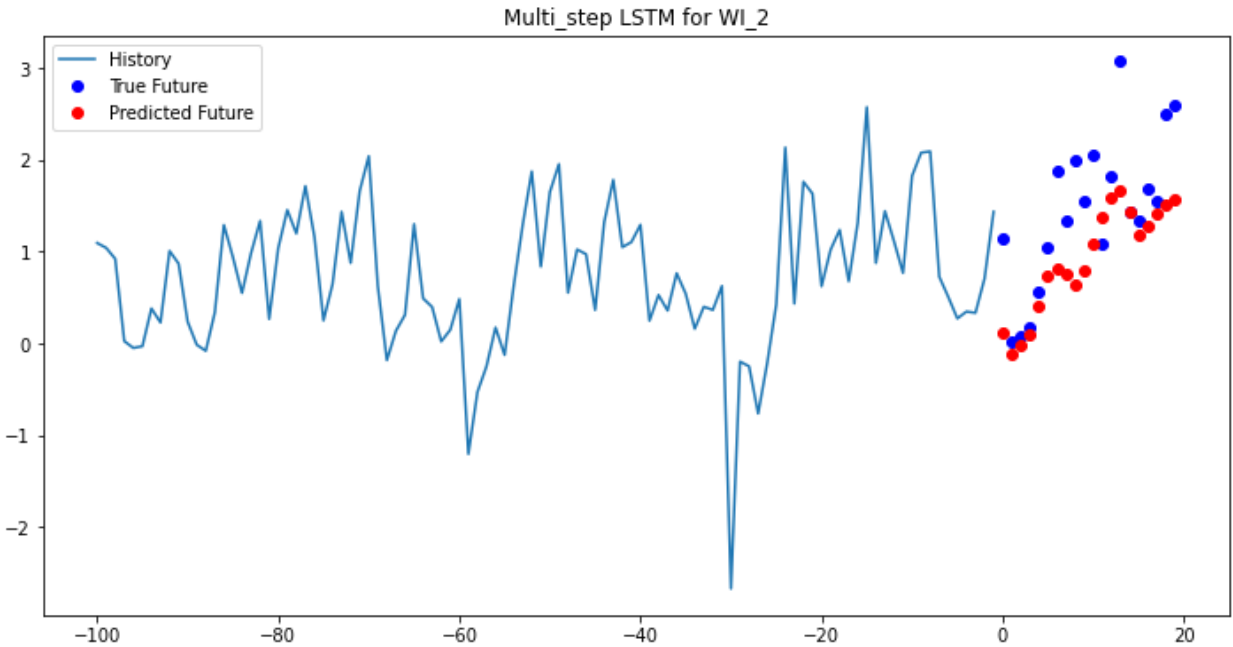
WI_2 - True Future: [4670. 3301. 3386. 3500. 3961. 4569. 5586. 4915. 5718. 5169. 5786. 4607. 5506. 7046. 5046. 4907. 5358. 5180. 6333. 6463.]

WI_2 - Model Prediction: [3410.8977 3148.053 3260.845 3397.085 3780.695 4190.628 4266.9795 4195.669 4072.92   4249.1636 4602.782 4957.001 5237.4067 5330.8647 5036.327 4727.945 4836.669 5009.9766 5130.406 5210.6484]

WI_2 - Model Percentage Error: [26.96150524 4.63335418 3.69625013 2.94042969 4.55200534 8.28128847 23.61297006 14.63542329 28.77020074 17.7952491 20.44966771 7.59715599   4.87819219 24.34197068 0.19169345 3.64897444 9.72995623 3.28230574 18.98932952 19.37724838]%

WI_2 - Model Mean Percentage Error: 12.418258527832677%

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Training for WI_3

Single window of past history : (100, 3)

```
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 117ms/step - loss: 0.7901 - val_loss: 1.0074
Epoch 2/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7852 - val_loss: 1.0275
Epoch 3/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7780 - val_loss: 1.0543
Epoch 4/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7700 - val_loss: 1.0738
Epoch 5/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7568 - val_loss: 1.0387
Epoch 6/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7447 - val_loss: 1.0203
Epoch 7/100
50/50 [==============================] - 5s 103ms/step - loss: 0.7366 - val_loss: 1.0058
Epoch 8/100
50/50 [==============================] - 5s 101ms/step - loss: 0.7321 - val_loss: 0.9909
Epoch 9/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7276 - val_loss: 0.9761
Epoch 10/100
50/50 [==============================] - 6s 111ms/step - loss: 0.7232 - val_loss: 0.9593
Epoch 11/100
50/50 [==============================] - 5s 102ms/step - loss: 0.7169 - val_loss: 0.9429
Epoch 12/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7092 - val_loss: 0.9333
Epoch 13/100
50/50 [==============================] - 6s 110ms/step - loss: 0.7041 - val_loss: 0.9303
Epoch 14/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6969 - val_loss: 0.9329
Epoch 15/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6928 - val_loss: 0.9379
Epoch 16/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6852 - val_loss: 0.9534
Epoch 17/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6807 - val_loss: 0.9764
Epoch 18/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6750 - val_loss: 0.9885
Epoch 19/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6699 - val_loss: 0.9969
Epoch 20/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6612 - val_loss: 1.0497
Epoch 21/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6525 - val_loss: 1.0285
Epoch 22/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6428 - val_loss: 1.0372
```

```
Epoch 23/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6314 - val_loss: 0.9396
Epoch 24/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6200 - val_loss: 0.9623
Epoch 25/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6030 - val_loss: 0.8915
Epoch 26/100
50/50 [==============================] - 5s 107ms/step - loss: 0.5853 - val_loss: 0.8657
Epoch 27/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5584 - val_loss: 0.7636
Epoch 28/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5202 - val_loss: 0.6821
Epoch 29/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4858 - val_loss: 0.6527
Epoch 30/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4580 - val_loss: 0.6583
Epoch 31/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4464 - val_loss: 0.6317
Epoch 32/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4346 - val_loss: 0.6287
Epoch 33/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4329 - val_loss: 0.6369
Epoch 34/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4255 - val_loss: 0.6105
Epoch 35/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4198 - val_loss: 0.6344
Epoch 36/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4186 - val_loss: 0.5774
Epoch 37/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4152 - val_loss: 0.5916
Epoch 38/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4138 - val_loss: 0.5901
Epoch 39/100
50/50 [==============================] - 6s 110ms/step - loss: 0.4110 - val_loss: 0.5892
Epoch 40/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4100 - val_loss: 0.5941
Epoch 41/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4069 - val_loss: 0.6155
Epoch 42/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4061 - val_loss: 0.5405
Epoch 43/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4040 - val_loss: 0.5779
Epoch 44/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4019 - val_loss: 0.5542
Epoch 45/100
```

```
50/50 [==============================] - 5s 105ms/step - loss: 0.3992 - val_loss: 0.5654
Epoch 46/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3997 - val_loss: 0.5544
Epoch 47/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3967 - val_loss: 0.5267
Epoch 48/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3935 - val_loss: 0.5376
Epoch 49/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3949 - val_loss: 0.5009
Epoch 50/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3902 - val_loss: 0.5572
Epoch 51/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3892 - val_loss: 0.5505
Epoch 52/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3863 - val_loss: 0.5312
Epoch 53/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3842 - val_loss: 0.5154
Epoch 54/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3824 - val_loss: 0.5280
Epoch 55/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3802 - val_loss: 0.5209
Epoch 56/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3793 - val_loss: 0.5234
Epoch 57/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3745 - val_loss: 0.5117
Epoch 58/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3738 - val_loss: 0.5139
Epoch 59/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3703 - val_loss: 0.4892
Epoch 60/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3695 - val_loss: 0.4757
Epoch 61/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3665 - val_loss: 0.5065
Epoch 62/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3694 - val_loss: 0.4465
Epoch 63/100
50/50 [==============================] - 5s 98ms/step - loss: 0.3662 - val_loss: 0.4590
Epoch 64/100
50/50 [==============================] - 5s 99ms/step - loss: 0.3614 - val_loss: 0.4670
Epoch 65/100
50/50 [==============================] - 6s 126ms/step - loss: 0.3589 - val_loss: 0.4799
Epoch 66/100
50/50 [==============================] - 9s 186ms/step - loss: 0.3612 - val_loss: 0.4436
Epoch 67/100
50/50 [==============================] - 8s 159ms/step - loss: 0.3576 - val_loss: 0.4498
```

```
Epoch 68/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3553 - val_loss: 0.4387
Epoch 69/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3542 - val_loss: 0.4407
Epoch 70/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3550 - val_loss: 0.4291
Epoch 71/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3513 - val_loss: 0.4356
Epoch 72/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3502 - val_loss: 0.4174
Epoch 73/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3540 - val_loss: 0.4519
Epoch 74/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3465 - val_loss: 0.4381
Epoch 75/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3584 - val_loss: 0.4479
Epoch 76/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3467 - val_loss: 0.4350
Epoch 77/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3479 - val_loss: 0.4274
Epoch 78/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3450 - val_loss: 0.4481
Epoch 79/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3462 - val_loss: 0.4503
Epoch 80/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3412 - val_loss: 0.4384
Epoch 81/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3470 - val_loss: 0.4268
Epoch 82/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3416 - val_loss: 0.4451
Epoch 83/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3533 - val_loss: 0.4382
Epoch 84/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3410 - val_loss: 0.4500
Epoch 85/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3410 - val_loss: 0.4298
Epoch 86/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3399 - val_loss: 0.4325
Epoch 87/100
50/50 [==============================] - 6s 116ms/step - loss: 0.3443 - val_loss: 0.4281
Epoch 88/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3360 - val_loss: 0.4280
Epoch 89/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3456 - val_loss: 0.4393
Epoch 90/100
```

```
50/50 [==============================] - 5s 107ms/step - loss: 0.3370 - val_loss: 0.4355
Epoch 91/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3402 - val_loss: 0.4454
Epoch 92/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3356 - val_loss: 0.4406
Epoch 93/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3473 - val_loss: 0.4497
Epoch 94/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3343 - val_loss: 0.4438
Epoch 95/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3332 - val_loss: 0.4524
Epoch 96/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3337 - val_loss: 0.4343
Epoch 97/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3373 - val_loss: 0.4398
Epoch 98/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3317 - val_loss: 0.4714
Epoch 99/100
50/50 [==============================] - 6s 116ms/step - loss: 0.3315 - val_loss: 0.4538
Epoch 100/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3377 - val_loss: 0.4491
```


Multi-Step Training and validation loss for WI_3

Multi_step LSTM for WI_3

Tail of Multi_step LSTM for WI_3
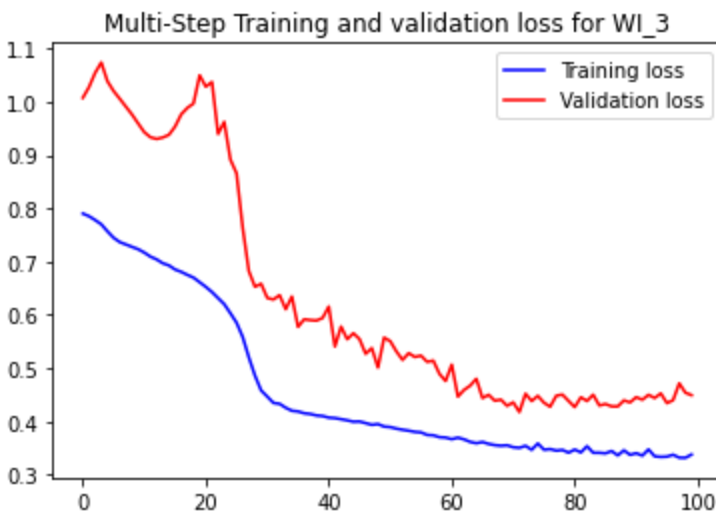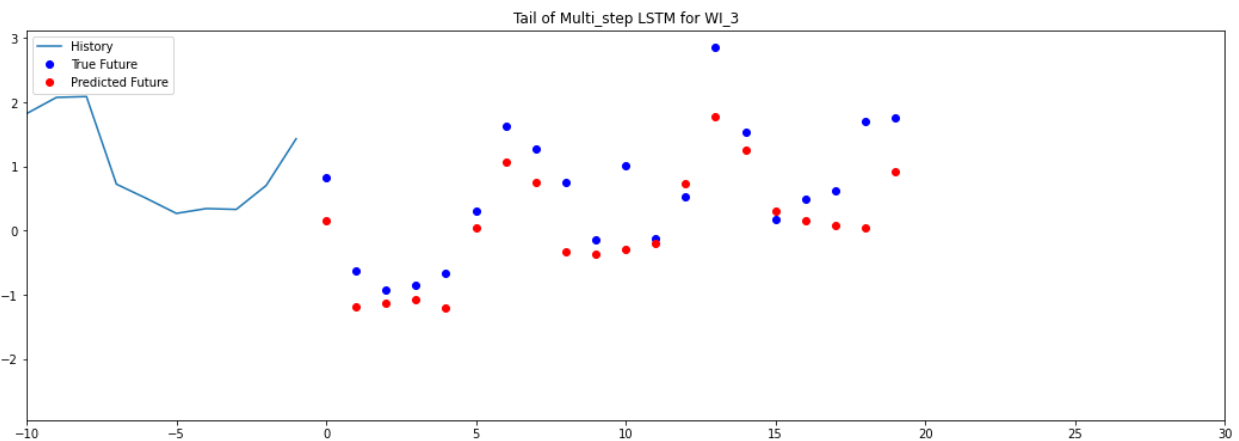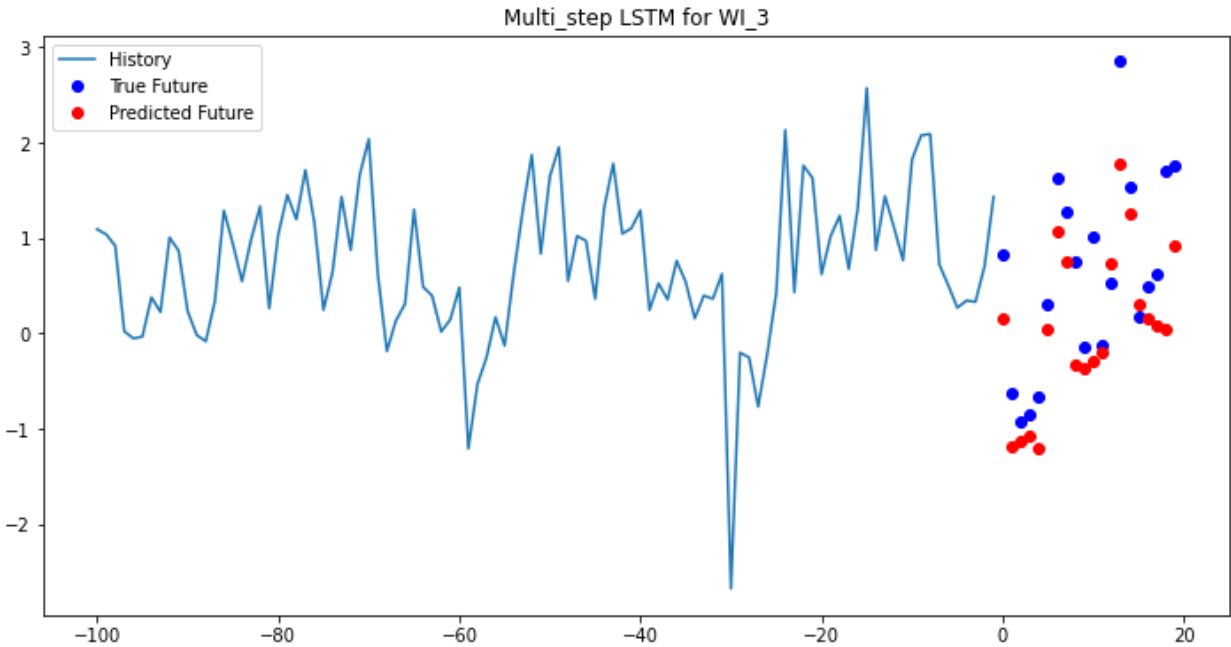
WI_3 - True Future: [3998. 2806. 2564. 2632. 2775. 3580. 4653. 4362. 3938. 3210. 4153. 3219.
 3756. 5657. 4577. 3468. 3728. 3833. 4721. 4759.]
WI_3 - Model Prediction: [3458.982 2354.2622 2396.0215 2438.0547 2345.6936 3353.3545
4205.7407
 3938.7063 3058.8872 3029.309 3080.494 3156.56   3922.9712 4785.051
 4354.2812 3575.7742 3451.647 3395.6282 3354.86   4077.859]
WI_3 - Model Percentage Error: [13.48219276 16.09899476 6.55142417 7.36874288 15.47050077
6.33088011
  9.61227761 9.7041197 22.32383933 5.62900056 25.824852   1.93973102
  4.44545238 15.413633   4.86604217 3.10767503 7.41290309 11.41069205
 28.93751096 14.31269412]%
WI_3 - Model Mean Percentage Error: 11.512157922928832%
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