Well production forecasting

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GOAL

◦ Predict change in well production to know about unexpected shutdowns and resolve the issue before it happens

◦ Dataset is a timeseries with minute level data of production, temperature and pressures of a imaginary well for 10 months.

DATASET DESCRIPTIVE STATISTICS

	PCAS	PAVTUBY	PLN	TG	FG	PTUB
count	422378.000000	422378.000000	422378.000000	422378.000000	422378.000000	422378.000000
mean	1702.092165	1707.808989	542.902226	52.348799	6830.762999	971.477766
std	758.192299	738.459380	215.349709	22.314637	3014.665250	518.280198
min	-0.914997	1.110907	-0.436380	0.000000	0.000000	-4.117486
25%	1570.820801	1583.756215	534.026062	45.699173	6736.814453	801.994690
50%	1780.812500	1775.570472	627.174255	53.640602	7670.855957	936.499207
75%	2160.536133	2094.416113	664.149475	62.300674	8840.022461	1233.186890
max	5138.380371	3283.371868	1375.019043	132.943359	11657.337891	3257.159912

FEATURES

1. Wellhead casing A Pressure - PCAS
2. Wellhead casing B Pressure - PAVTUBY
3. Flowline Pressure - PLN
4. Flowline Temperature - TG
5. Volume - Calendar Day production - FG
6. Wellhead Tubing Pressure - PTUB

PRE-PROCESSING

- Production(FG) drops suddenly due to unexpected shutdowns.

- It becomes zero and stays there for some time, which is called preventive maintenance period.
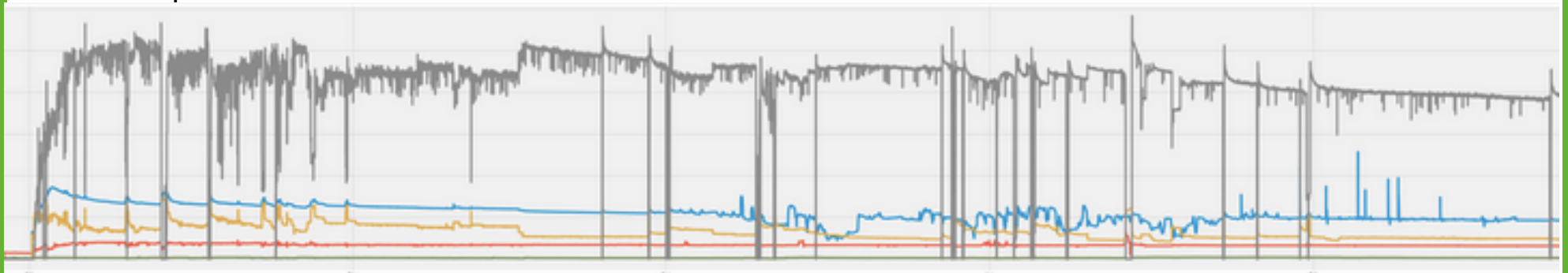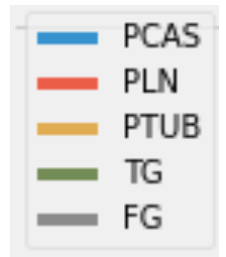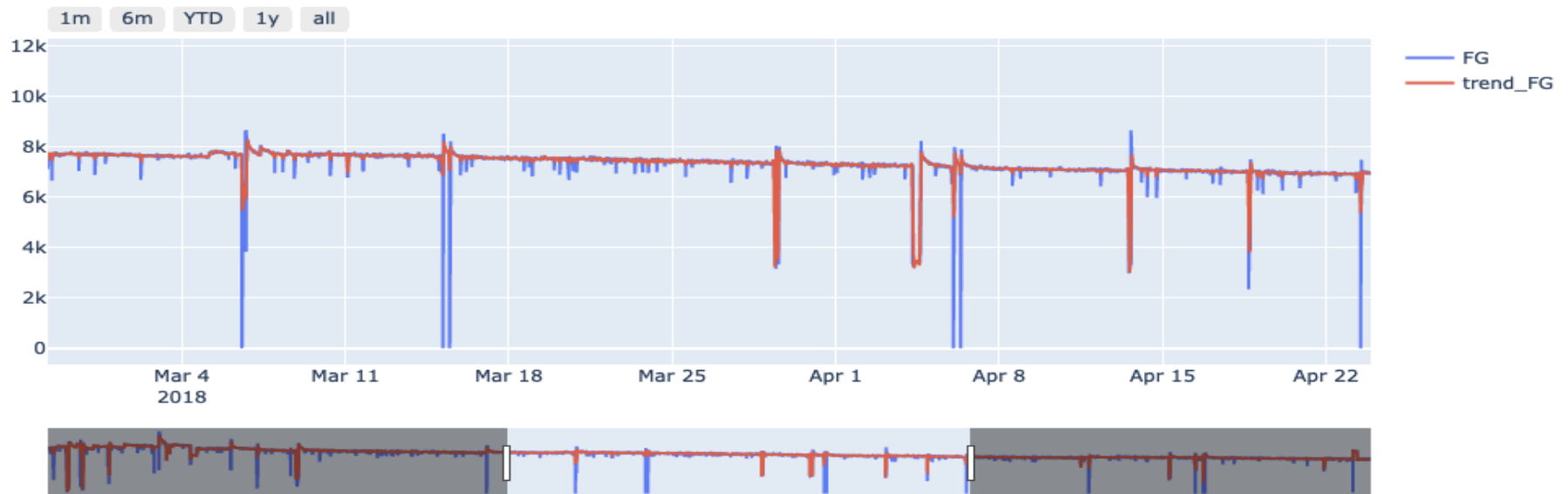
Data Labelling

◦ Identify and label the preventive maintenance periods, when output becomes zero and stays for some time.

◦ Replace labelled data with window median. Following is the sample of data after replacement period.
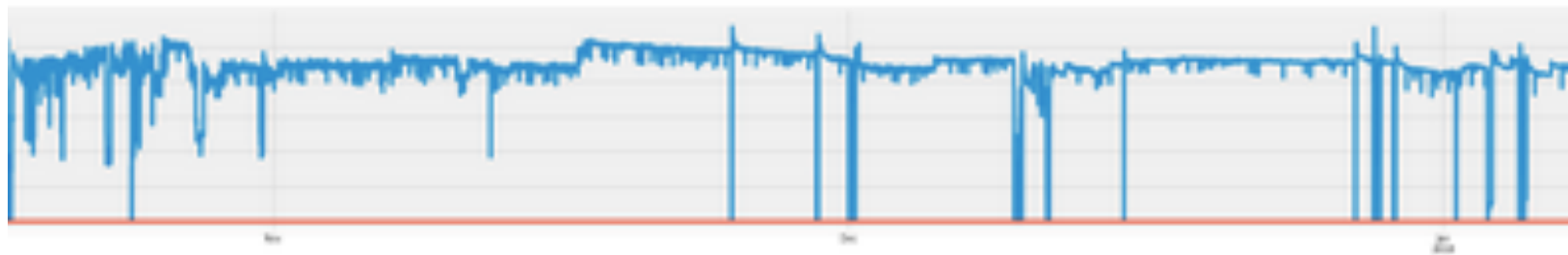
Data Preparation

○ Separated trend and cyclical components of production in the data

Univariate multi-step forecasting model

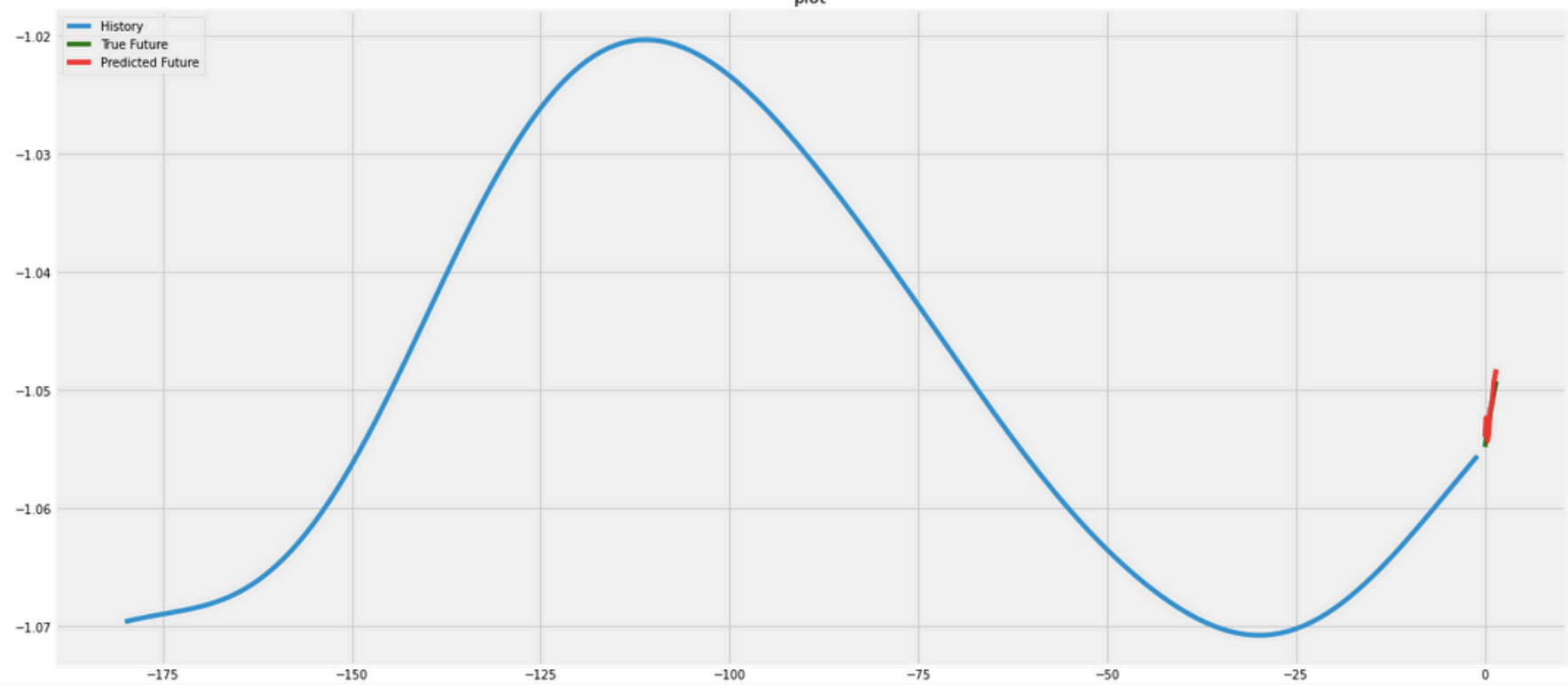We have looked at past 3 hours data to predict future 10 minutes production.

```
Model: "sequential"

_____
Layer (type)                 Output Shape              Param #
=================================================================
conv1d (Conv1D)              (None, 87, 32)            256
_____
conv1d_1 (Conv1D)            (None, 42, 64)            10304
_____
lstm (LSTM)                  (None, 42, 32)            12416
_____
lstm_1 (LSTM)                (None, 16)                3136
_____
dense (Dense)                (None, 10)                170
=================================================================
Total params: 26,282
Trainable params: 26,282
Non-trainable params: 0
_____
```

Epoch loss for validation and train data(red)

Epoch loss for validation(green) and train data(red)
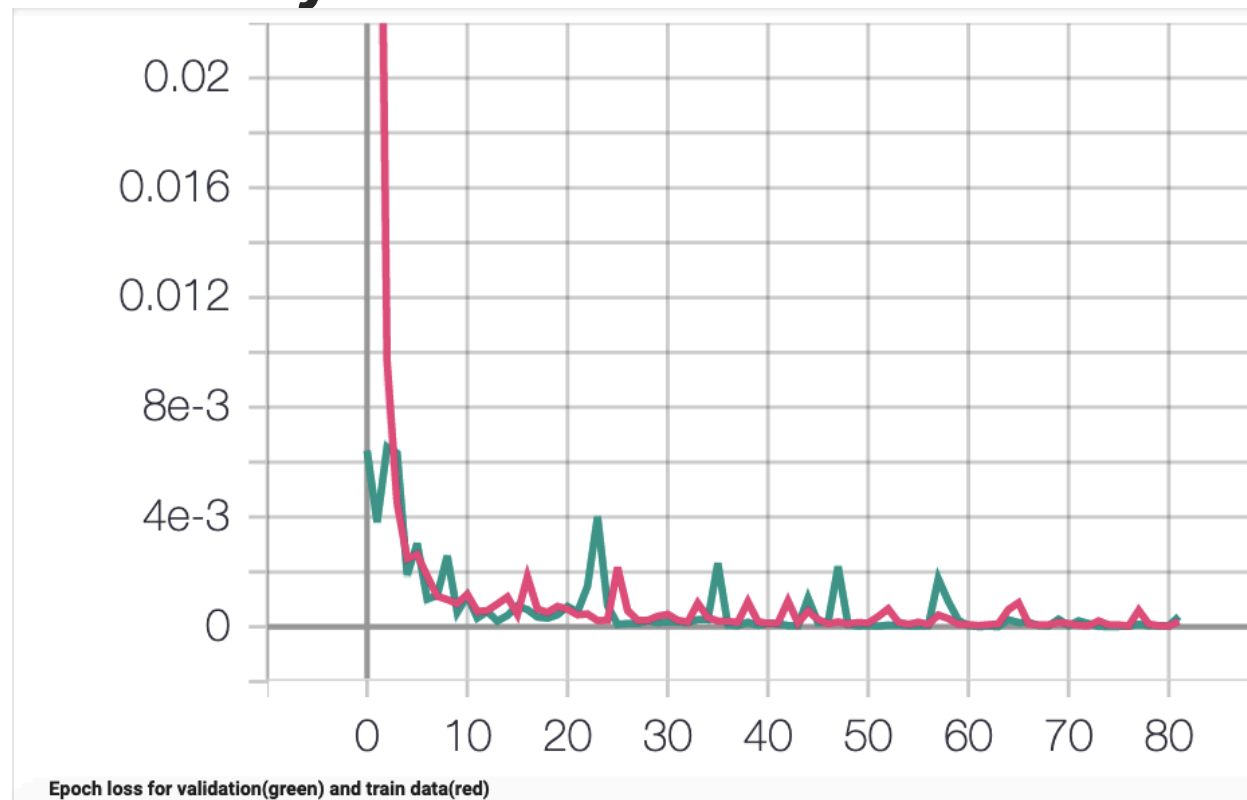
Univariate model output

Multivariate multi-step forecasting model

◦ Along with production, tube pressure has also been used as a feature.

◦ Here we have looked at past 15 hours data
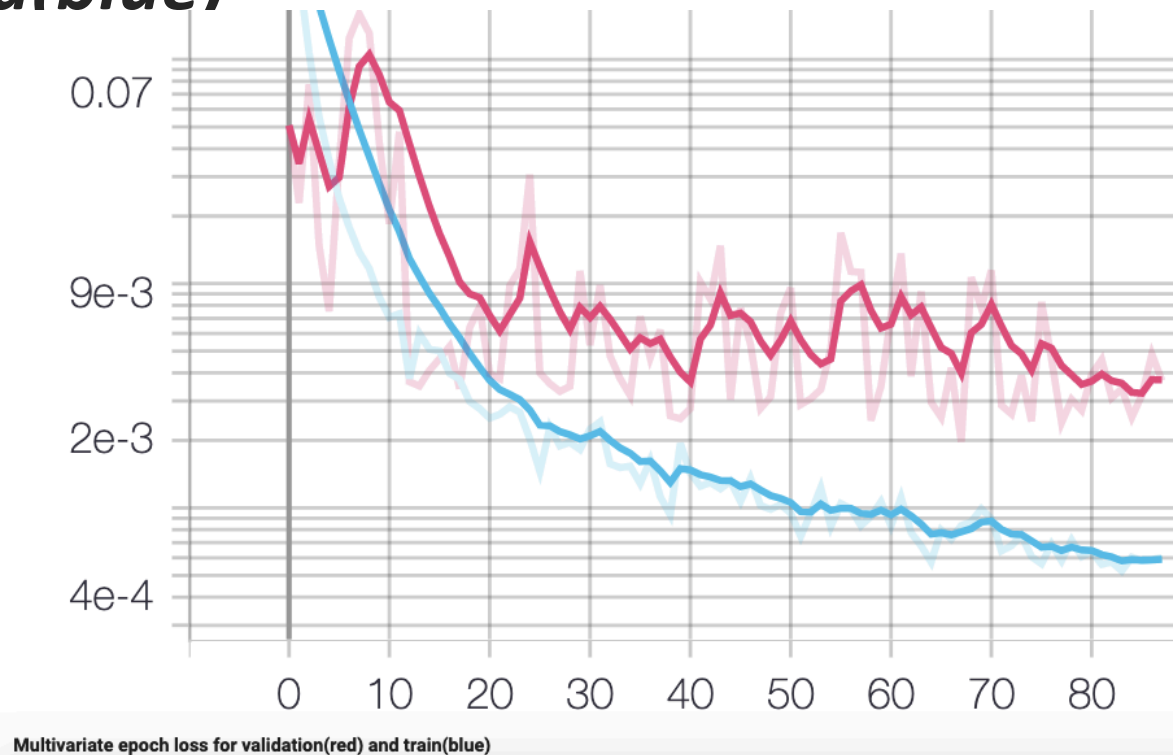to predict future 10 mins production.

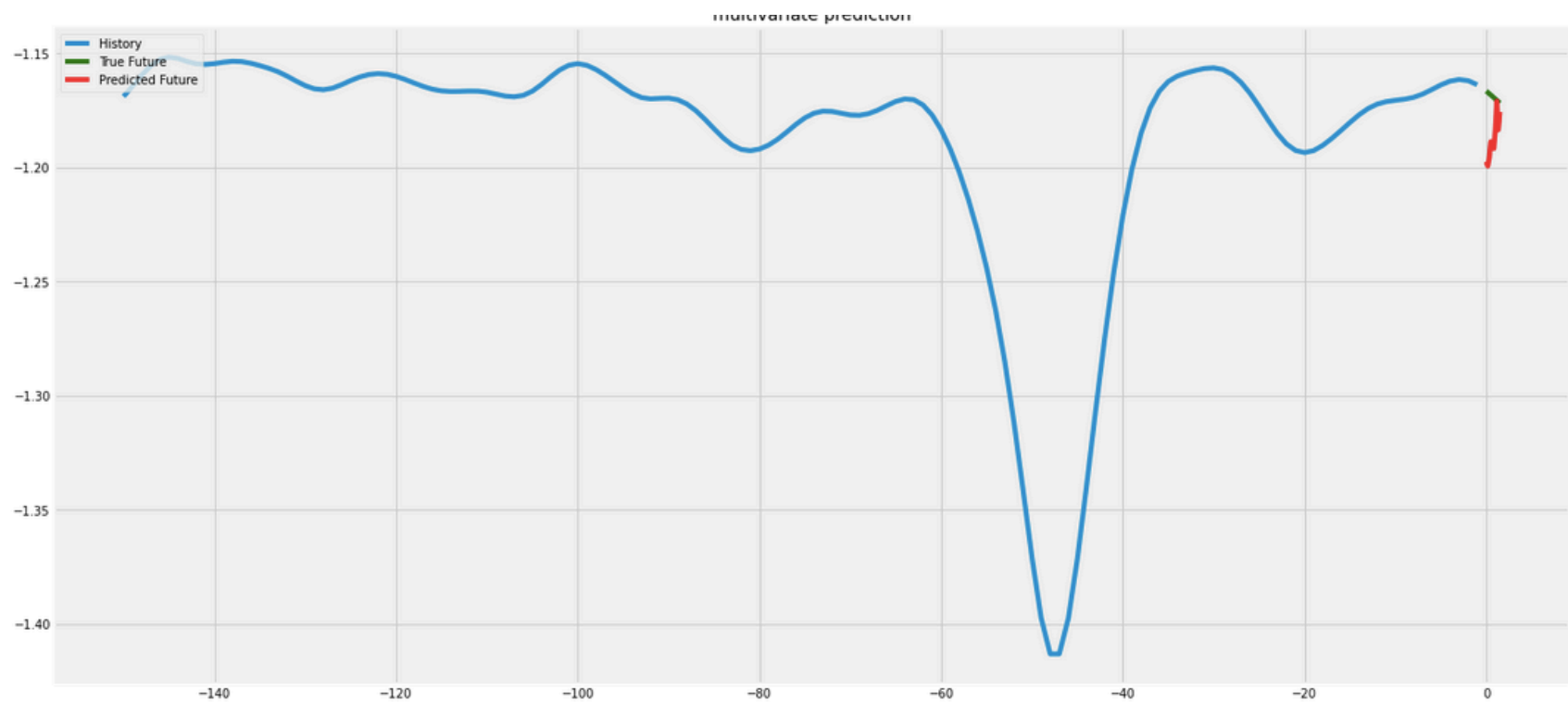| Timestamp	trend_FG	PTUB
2018-01-01 00:00:00	8506.612618	1271.876099
2018-01-01 00:01:00	8506.472984	1271.616821
2018-01-01 00:02:00	8506.333598	1271.616821
2018-01-01 00:03:00	8506.194629	1271.616821
2018-01-01 00:04:00	8506.056172	1271.616821

Multivariate multi-step forecasting model

```
Model: "sequential_3"
_____
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_6 (Conv1D)            (None, 72, 32)            480

conv1d_7 (Conv1D)            (None, 34, 64)            10304

lstm_6 (LSTM)                (None, 34, 32)            12416

lstm_7 (LSTM)                (None, 16)                3136

dense_3 (Dense)              (None, 10)                170
=================================================================
Total params: 26,506
Trainable params: 26,506
Non-trainable params: 0
_____
```

Epoch loss for validation(red) and train data(blue)

Multivariate epoch loss for validation(red) and train(blue)

Prediction for multivariate model

multivariate prediction

Legend:
- History
- True Future
- Predicted Future

Thank you