

Uncertainty Quantification for Time Series Forecast

Final Project by Maryam Kegel

Spiced Academy

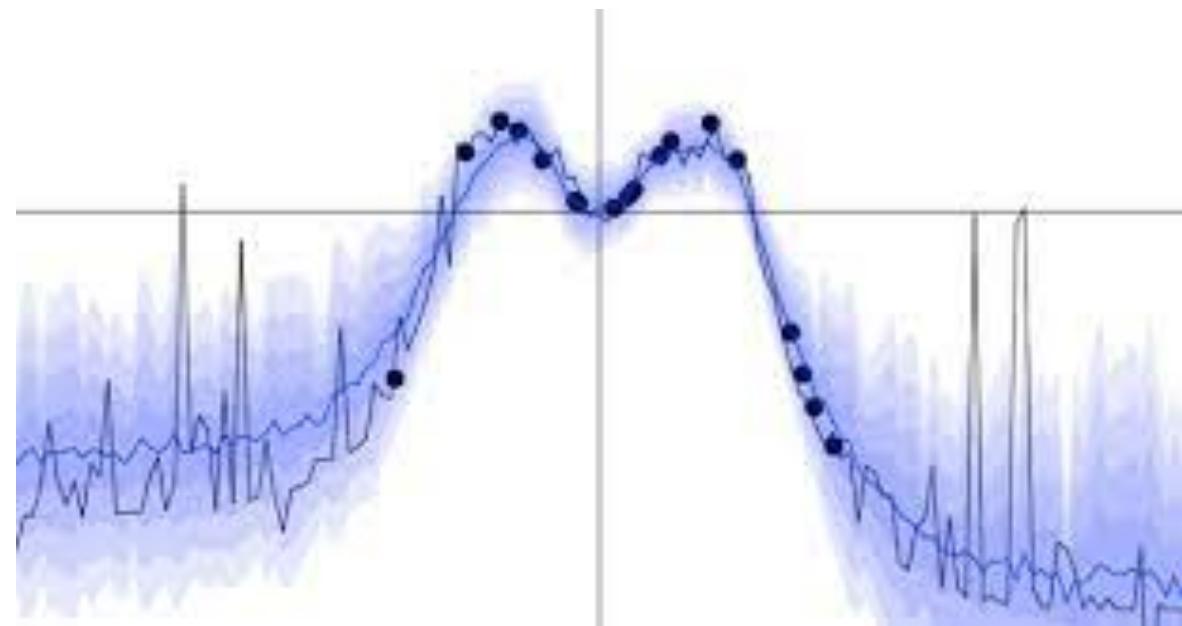
04.04.2023

What is uncertainty?

**Getting a distribution over prediction
rather than a single prediction**

Classification: Output label + its
confidence

Regression: Output mean + its variance



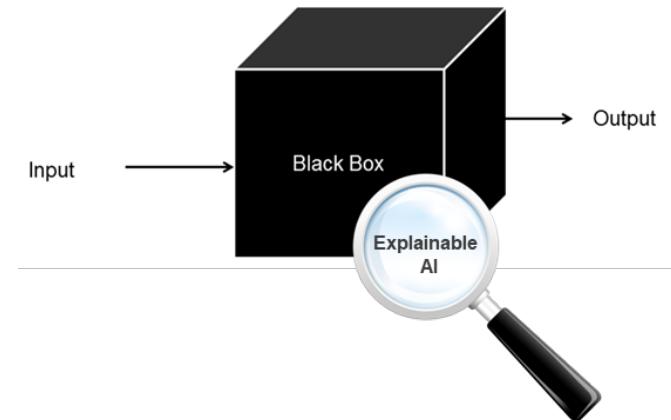
Why is it important?

Critical applications:

Medical diagnosis

Financial decision

Self-driving car

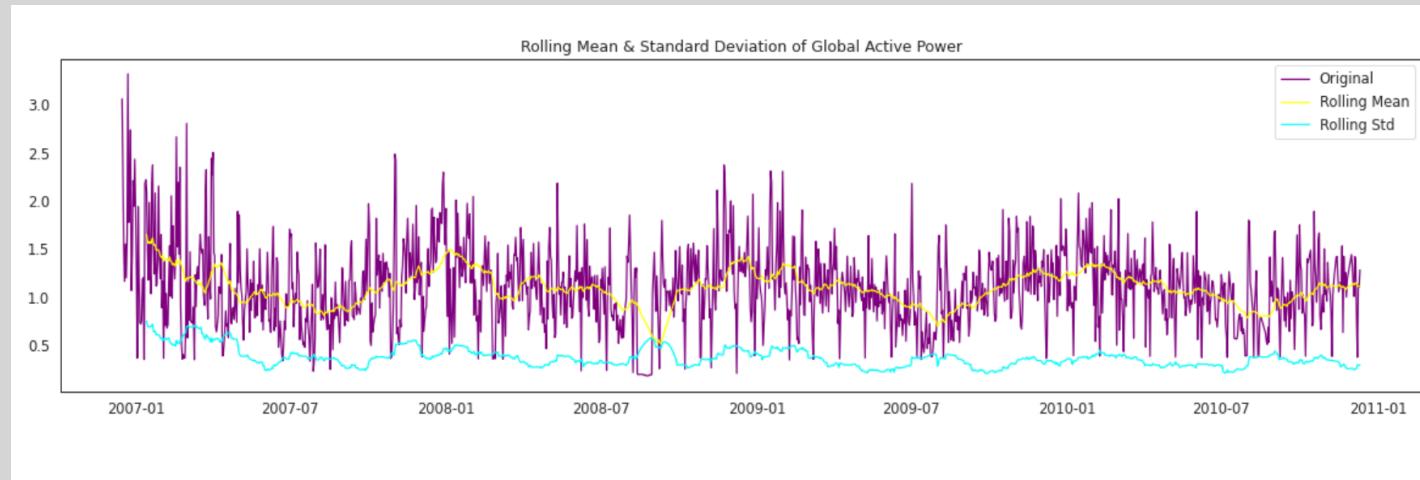


All models are wrong, but some – that know when they are wrong - are useful!

George Box

Uncertainty Quantification for Time Series

Data: Household electric power consumption



	Date	Time	Global_active_power	Global_reactive_power	Voltage	Global_intensity	Sub_metering_1	Sub_metering_2	Sub_metering_3	date_time
0	16/12/2006	17:24:00	4.216	0.418	234.840	18.400	0.000	1.000	17.000000	2006-12-16 17:24:00
1	16/12/2006	17:25:00	5.360	0.436	233.630	23.000	0.000	1.000	16.000000	2006-12-16 17:25:00
2	16/12/2006	17:26:00	5.374	0.498	233.290	23.000	0.000	2.000	17.000000	2006-12-16 17:26:00
3	16/12/2006	17:27:00	5.388	0.502	233.740	23.000	0.000	1.000	17.000000	2006-12-16 17:27:00
4	16/12/2006	17:28:00	3.666	0.528	235.680	15.800	0.000	1.000	17.000000	2006-12-16 17:28:00
5	16/12/2006	17:29:00	3.520	0.522	235.020	15.000	0.000	2.000	17.000000	2006-12-16 17:29:00
6	16/12/2006	17:30:00	3.702	0.520	235.090	15.800	0.000	1.000	17.000000	2006-12-16 17:30:00
7	16/12/2006	17:31:00	3.700	0.520	235.220	15.800	0.000	1.000	17.000000	2006-12-16 17:31:00
8	16/12/2006	17:32:00	3.668	0.510	233.990	15.800	0.000	1.000	17.000000	2006-12-16 17:32:00
9	16/12/2006	17:33:00	3.662	0.510	233.860	15.800	0.000	2.000	16.000000	2006-12-16 17:33:00

Source: <https://www.kaggle.com/>

Data Exploring

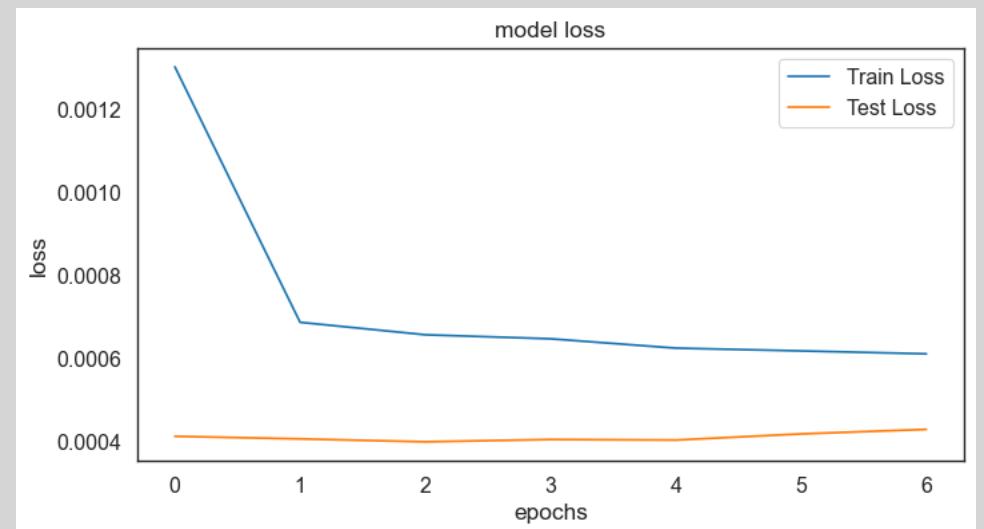
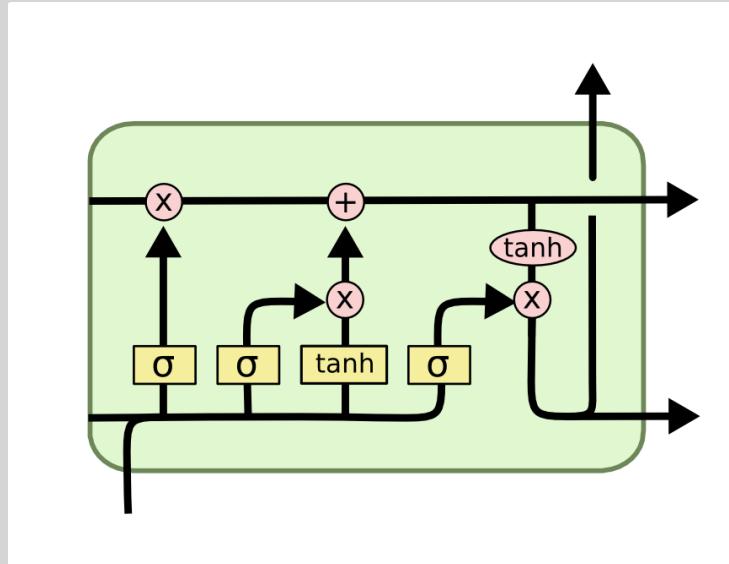
Data: Global active power



The Model

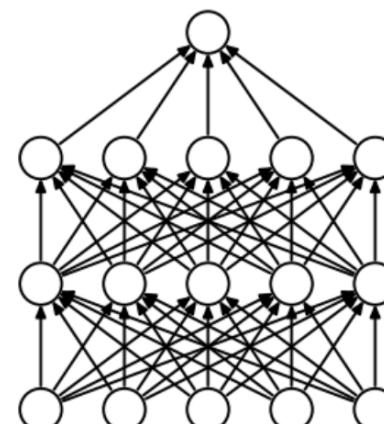
LSTM for Stationary Univariate Time Series

- Look_back = 30
- Total params: 55,665

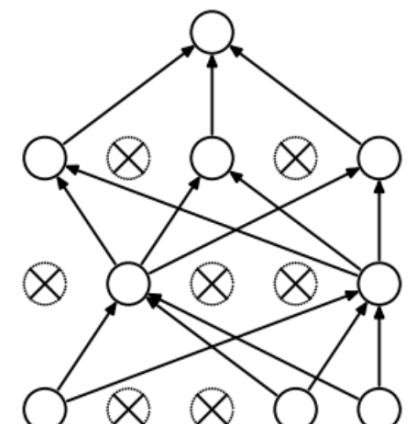


Monte Carlo Dropout

- Adding dropout to LSTM layer in model
- Activate the dropout during prediction
- Predicting the test data several times
- Achieving the mean and std of y



(a) Standard Neural Net

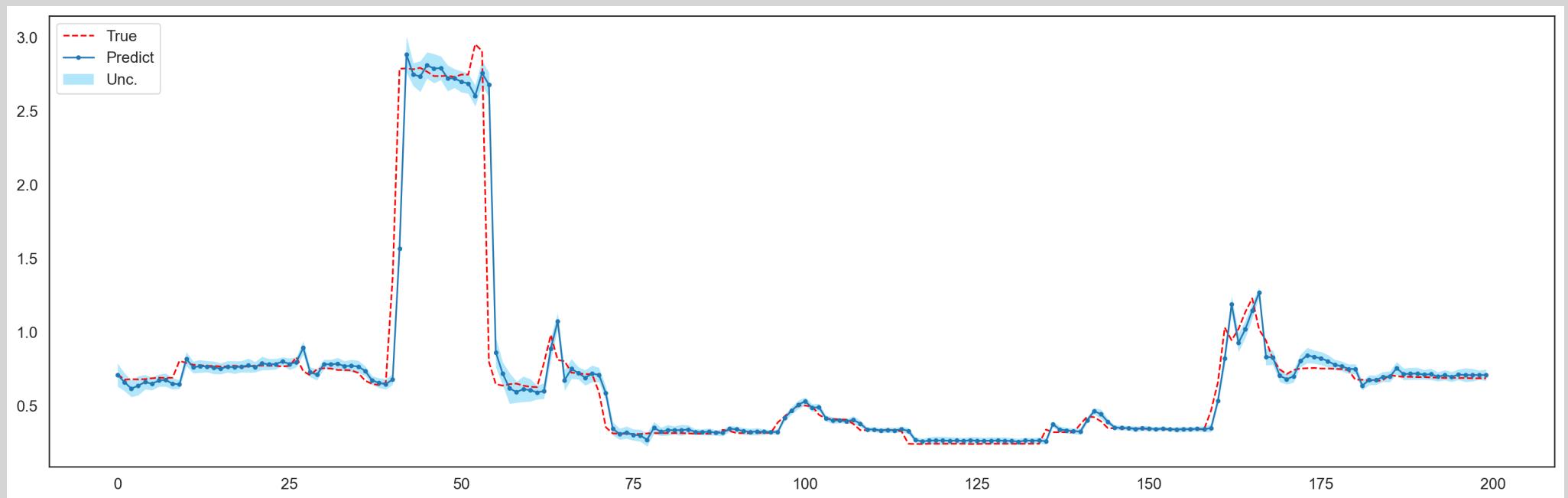


(b) After applying dropout.

Gal, Y., and Z. Ghahramani. 2016. "Dropout as a Bayesian Approximation: Representing Model Uncertainty in Deep Learning." *33rd International Conference on Machine Learning (ICML 2016)*

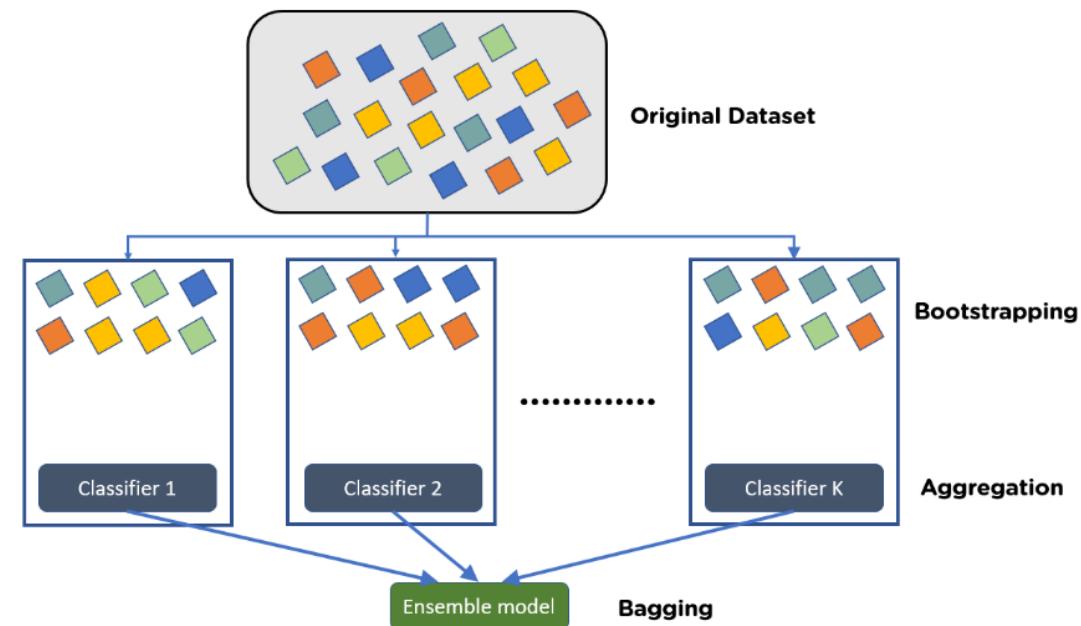
Monte Carlo Dropout

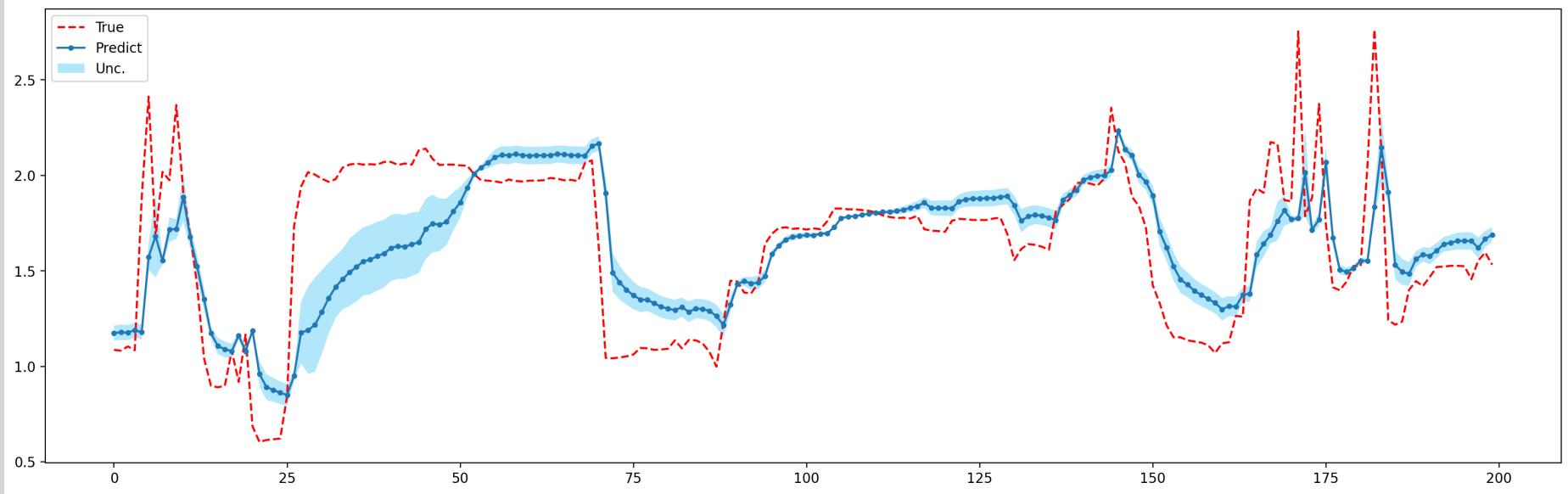
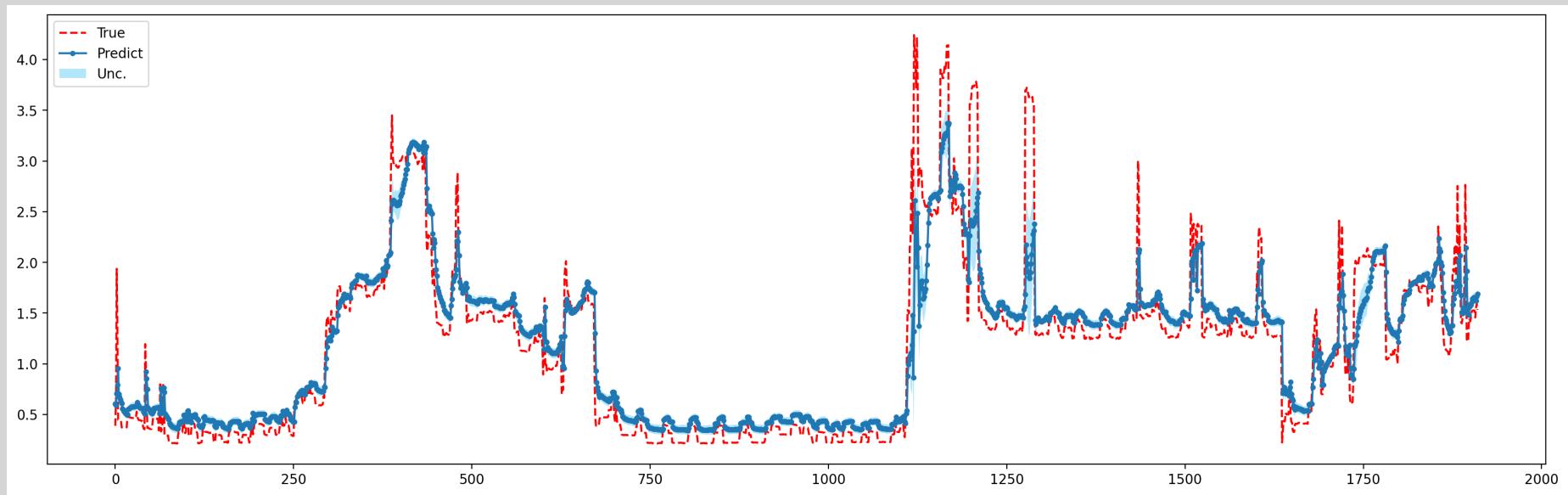
Results after 50 predictions



Bootstrapping

- Bootstrapping the training data
- Training and predicting several times
- Achieving the mean and std of y



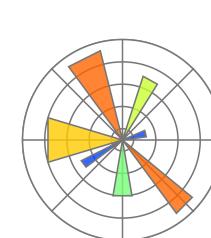
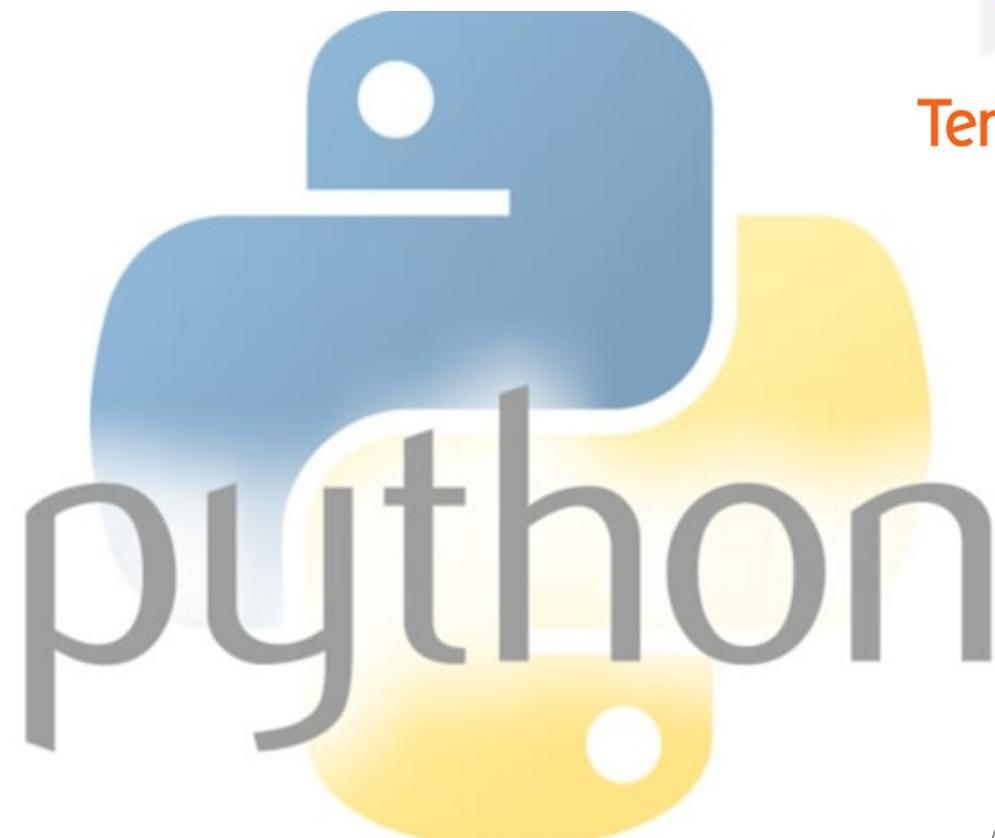


Pandas



tsmoothie 1.0.4

pip install tsmoothie



Thank You for Your Attention

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