BayesianFRAM

2022/11/17

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Purpose:

To build Bayesian Network General Prediction Machine using FRAM

Output value:

Currency Exchange Rate prediction

Input values :

Short term interest rate

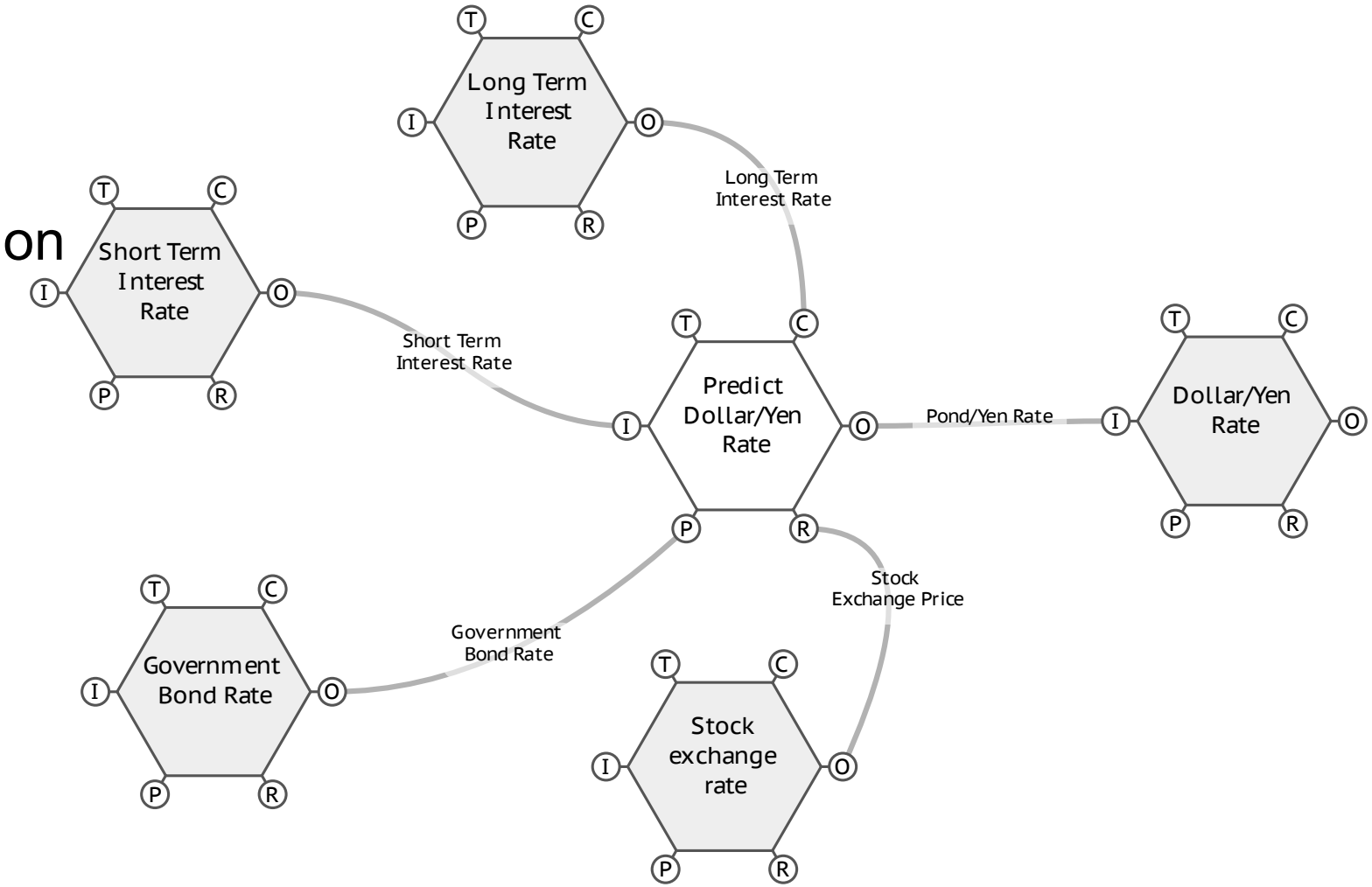
Long term interest rate

Stock exchange rate

Government bond price

Process :

Some kind of ETTOing



Purpose:

To build Bayesian Network General Prediction Machine using FRAM

Output value:

Currency Exchange Rate prediction

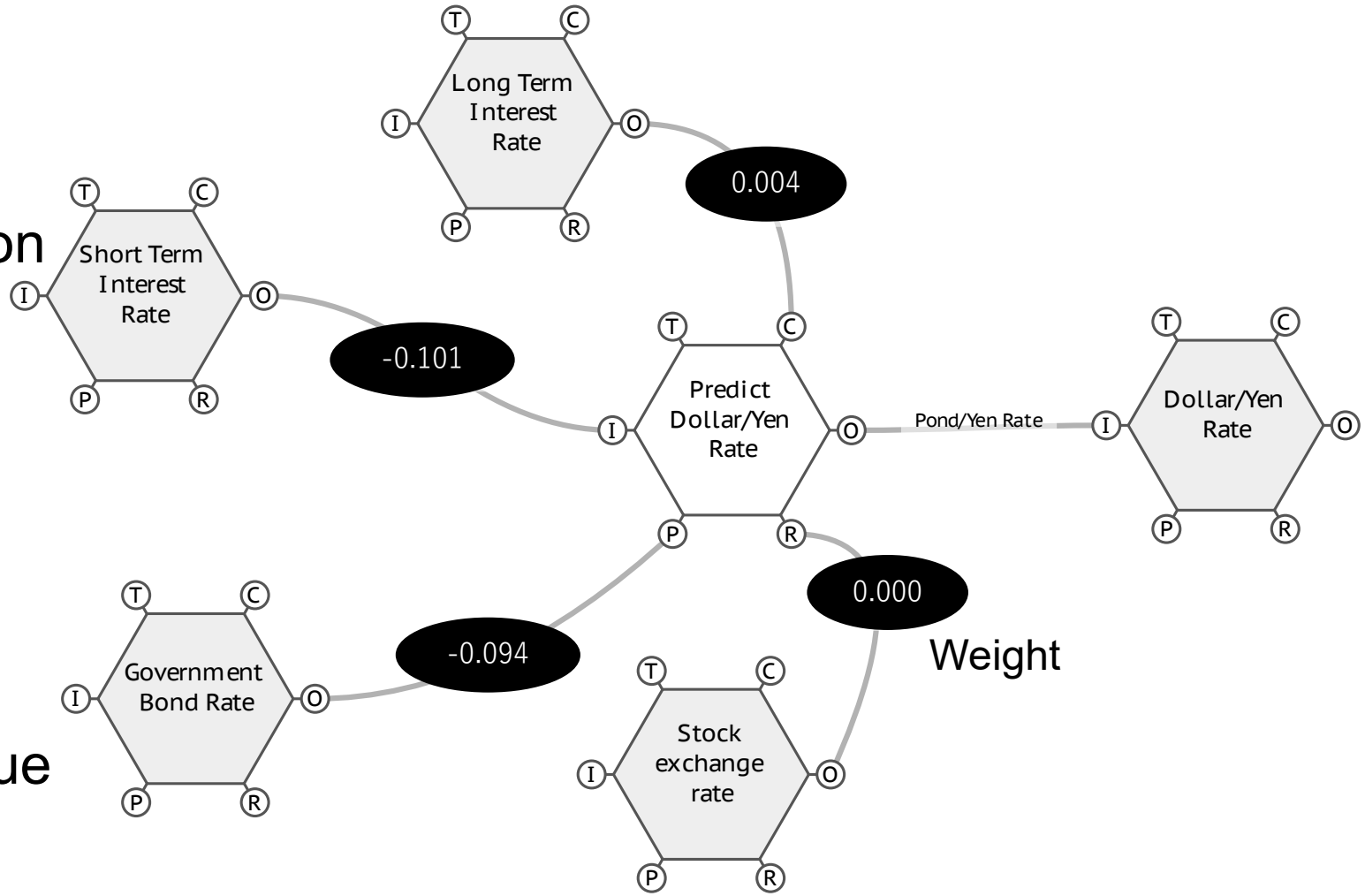
How:

Inference algorithm using input variabilities

Input variability value =

rate of change of each input value

Weight = significance value for each input



Inference logic =

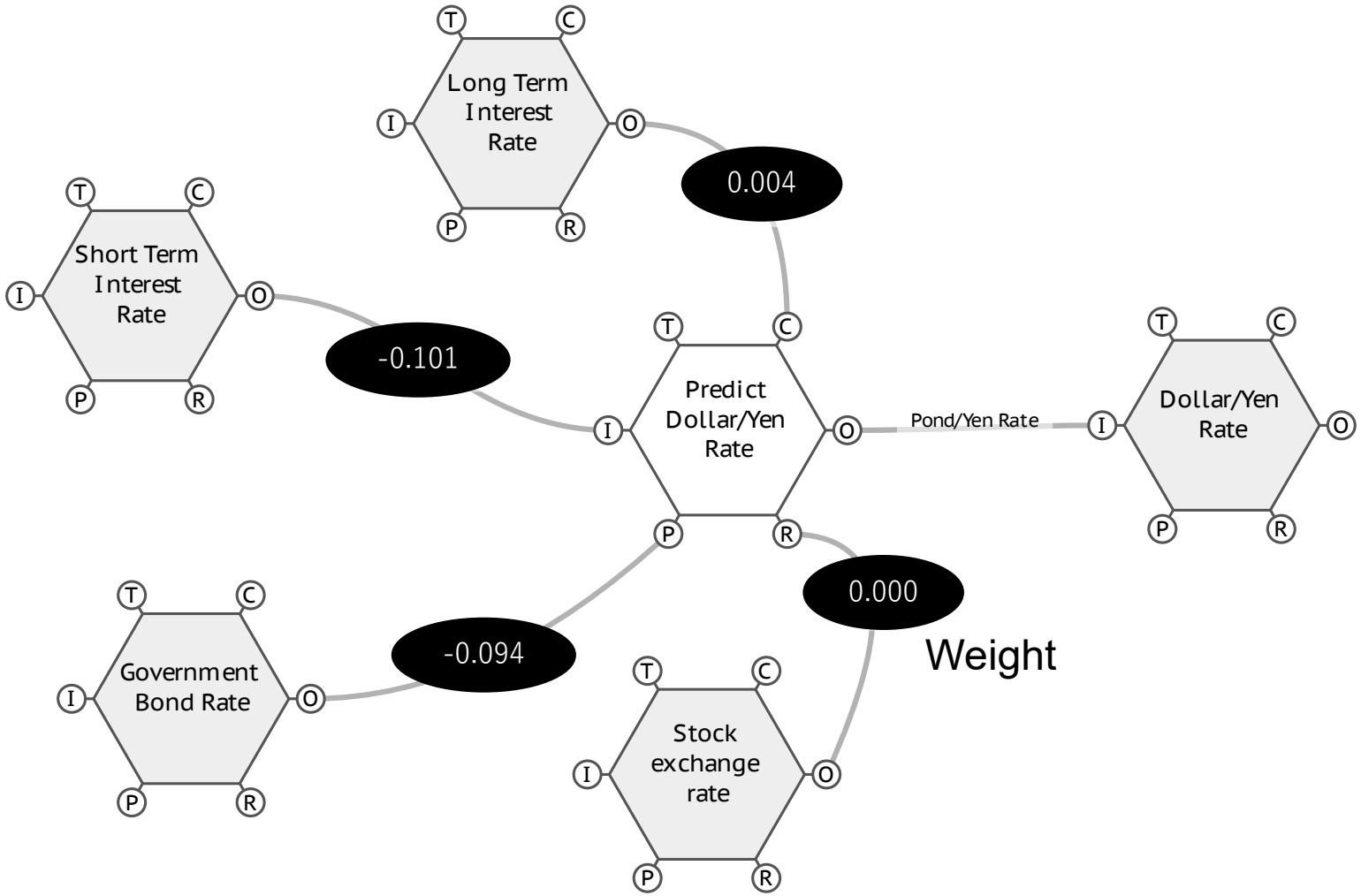
Weighted average of

the input variability values

$$x_w = \frac{\sum_{i=1}^{n} x_i w_i}{\sum_{i=1}^{n} w_i}$$

Input Variability

$$x_i = \frac{x_t - x_{t-1}}{x_t}$$



How to define the Weight values w_i:

$$x_w = \frac{\sum_{i=1}^{n} x_i w_i}{\sum_{i=1}^{n} w_i}$$

Traditional FRAM method

By Intuition

"Precise"

"Acceptable"

"Imprecise"

Bayesian FRAM method

By Machine Learning

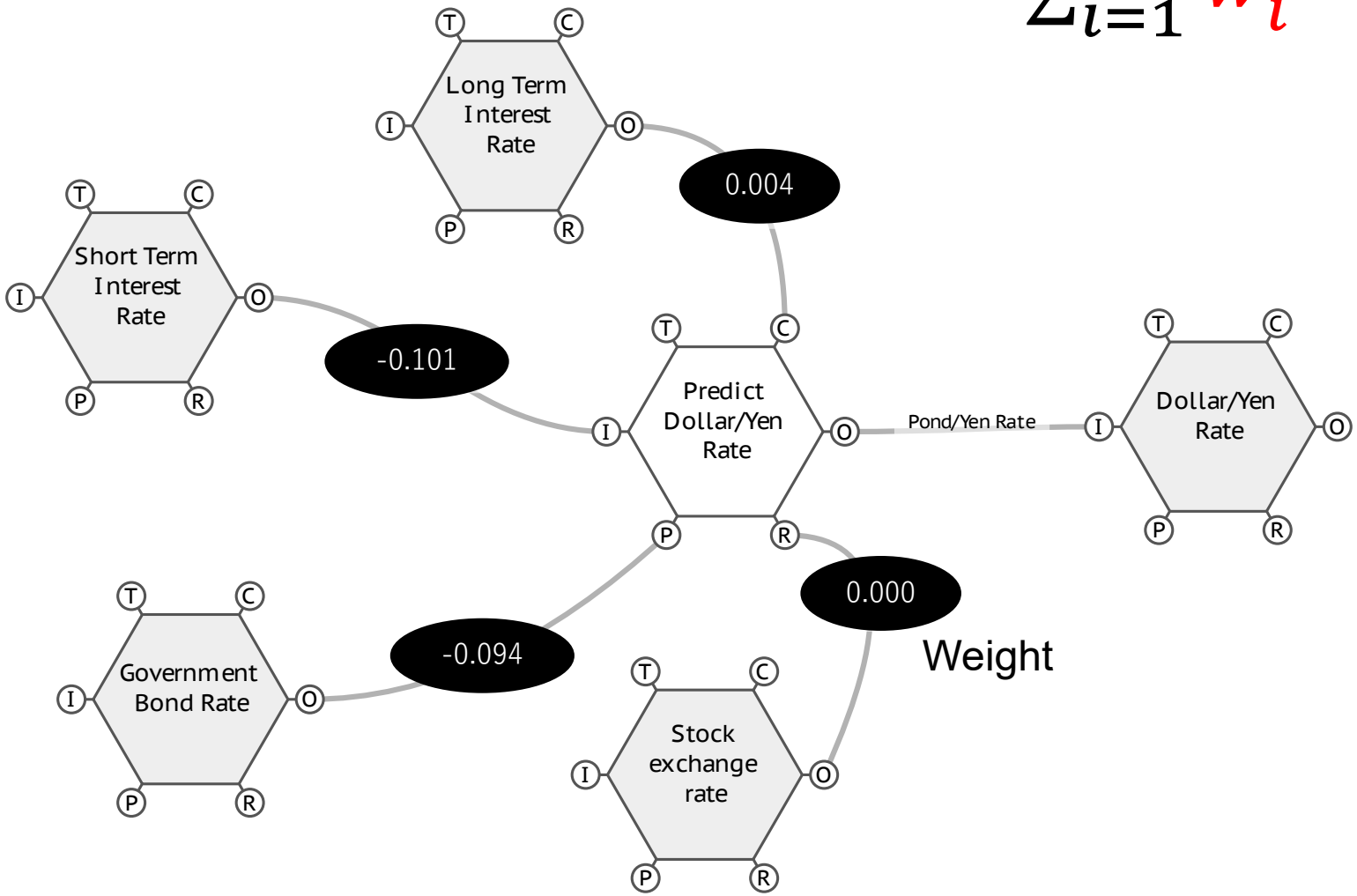
"0.004"

"-0.101"

"-0.094"

"0.000"

…



Machine Learning to calculate the Weight values w_i:

$$x_w = \frac{\sum_{i=1}^{n} x_i w_i}{\sum_{i=1}^{n} w_i}$$

If Prediction Error >= 0

$$\acute{w}_i = Wi + \frac{|x_i|}{\sum_{k=1}^{n} |x_k|} \varepsilon\eta$$

else

$$\acute{w}_i = Wi - \frac{|x_i|}{\sum_{k=1}^{n} |x_k|} \varepsilon\eta$$

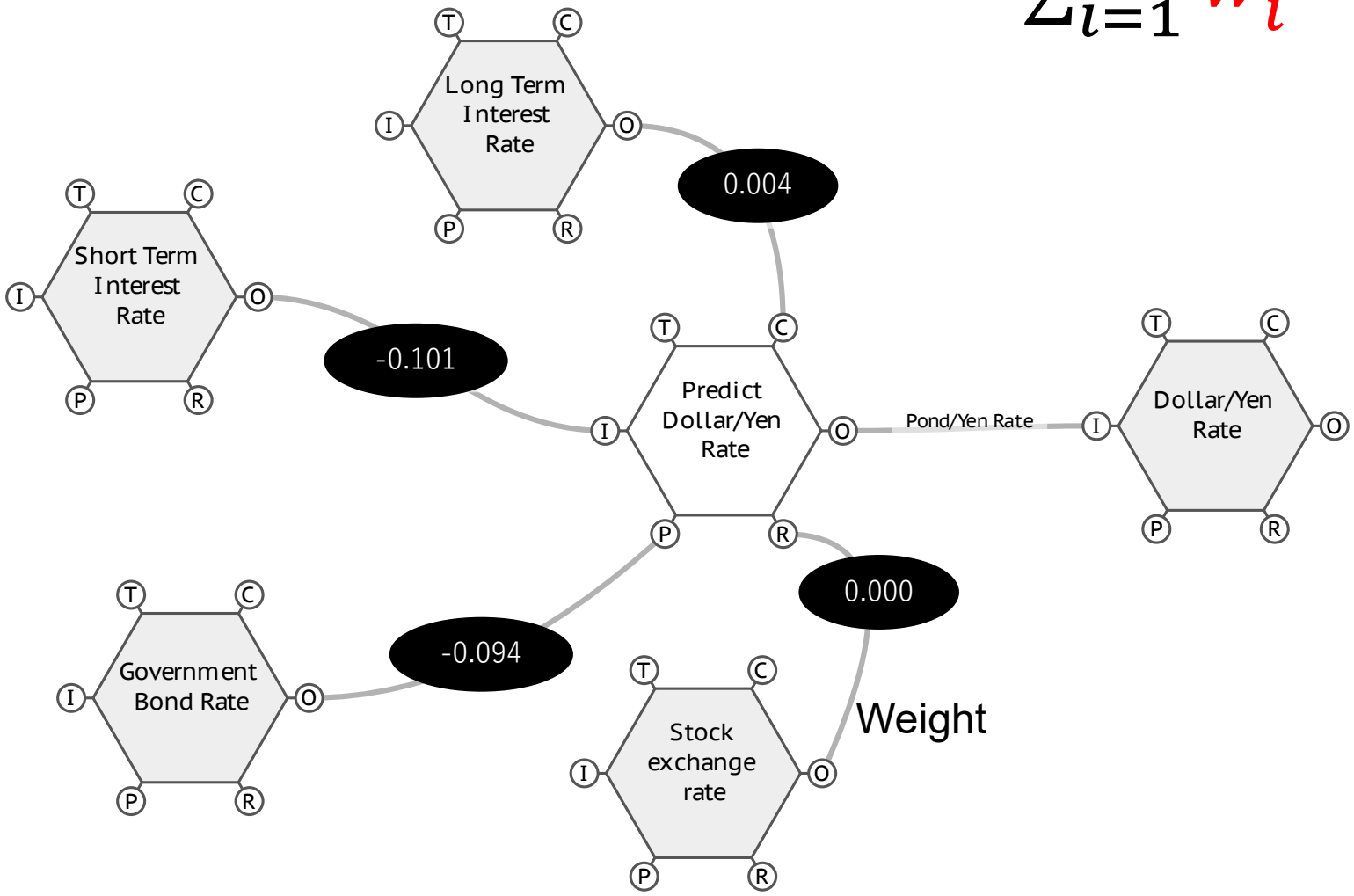
where

$\acute{w}_i$: weight value **after** learning

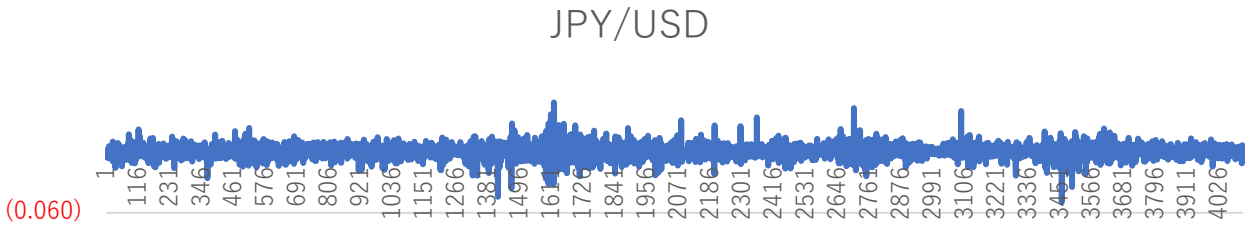
Wi : weight value **before** learning

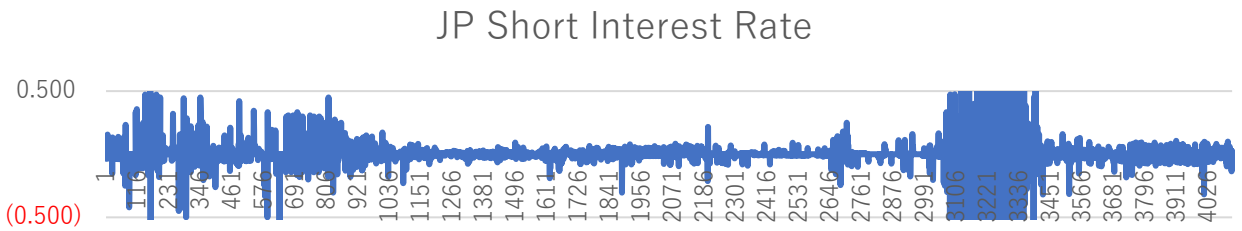
ε : Prediction Error

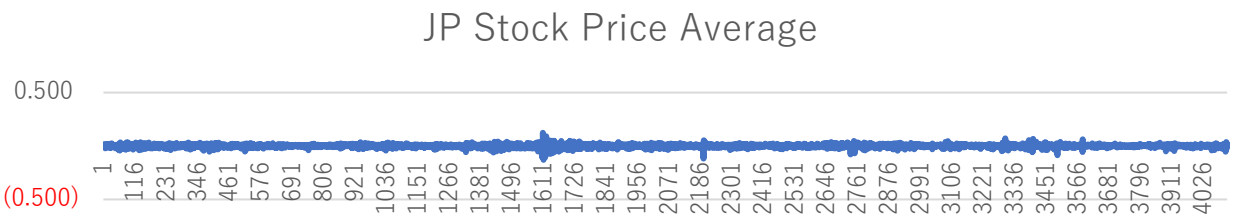
η : Learning Rate ($0 < \eta < 1$)



LEARNING Period







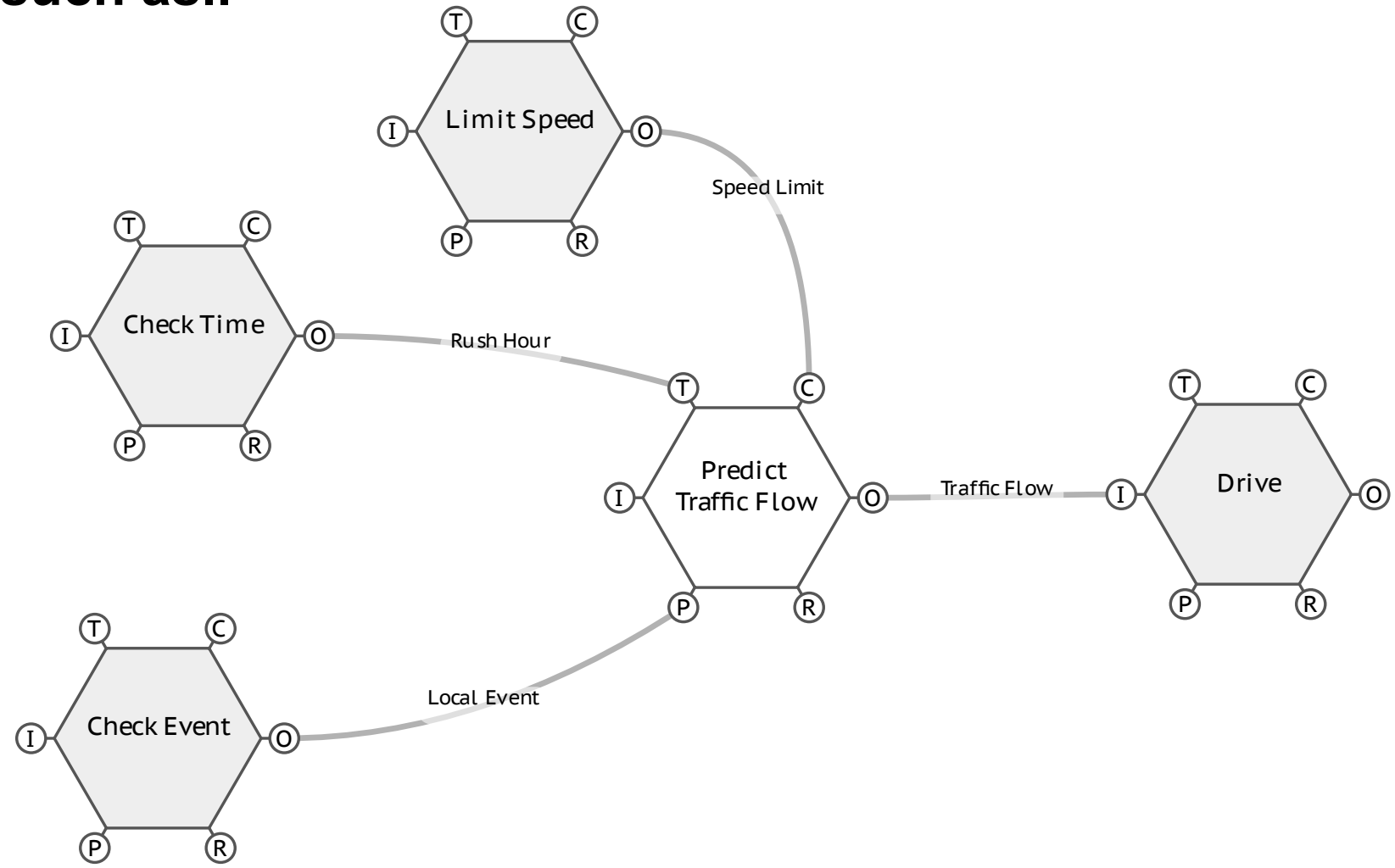
Weight Value

Short Interest Rate & Bond Rate
were the most significant inputs
(It agrees with economics theory)

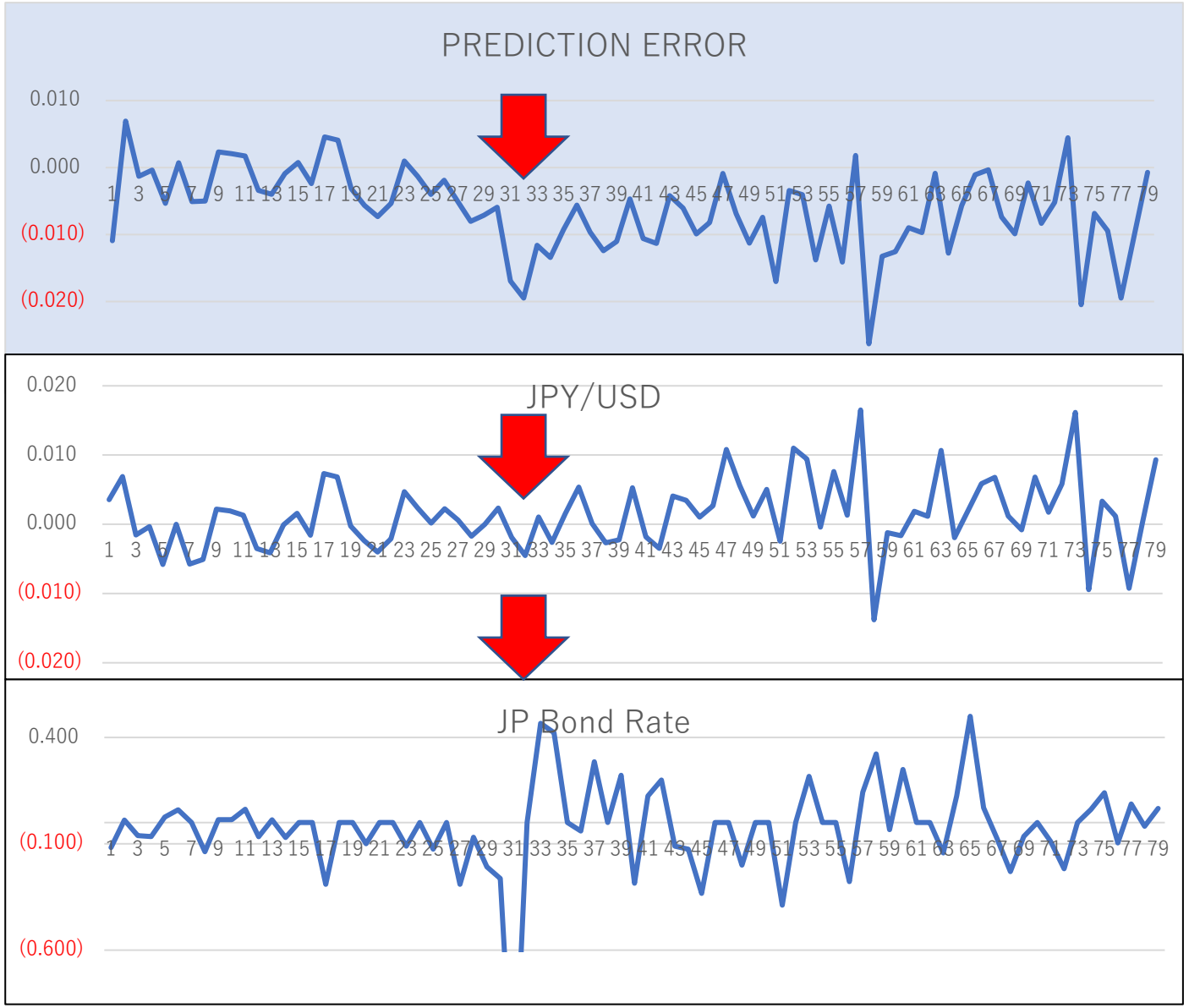
-0.020
0.001
0.000
-0.017

Since all input values are normalized as “rate of change”, it can be used as general-purpose predictor such as..

- **Traffic Flow prediction**
- **Population prediction**
- **….**



TESTING Period



Prediction accuracy dropped 30 days after completion of learning when a new trend (bond rate AND Yen/USD increased simultaneously) appeared in Feb. 2022 due to JP/US interest gap upsurge.

This shows typical Bayesian Network's behavior when fixed weight values are used against a new input trend.

Continuous learning during the operational phase is important.