T-Fold Sequential Validation Technique for Out-Of-Distribution Generalization with Financial Time Series Data

Juan Francisco Muñoz-Elguezabal [1] **Juan Diego Sánchez-Torres** [1]

[1]Western Institute of Technology and Higher Education (ITESO)

Presented Case Specifications

Hipothesis: There exists a set of conditions under which a cross-validation process can be defined and conducted in order to achieve Out-Of-Sample and Out-Of-Distribution Generalization when performing a Predictive Modeling Process using Financial Time Series Data.

Dataset: Continuous futures prices of the UsdMxn (U.S. Dollar Vs Mexican Peso), extracted from CME group MP Future Contract. Prices are Open, High, Low, Close in intervals of 8 Hours, **OHLC** data. GMT timezone-based and a total of 66,500 from 2010-01-03 18:00:00 to 2021-06-14 16:00:00.

Experiment: A classification problem is formulated as to predict the target variable, CO_{t+1}, which is defined as the sign$(Close_{t+1} - Open_{t+1})$. For the explanatory variables, the base definition is to use only those of endogenous nature, that is, to create them using only **OHLC** values.

A discrete multi-period characterization

Let V_t be the value of a financial asset at any given time t, and S_t as a discrete representation of V_t if there is an observable transaction Ts_t. Similarly, if there is a set of discrete Ts_t observed during an interval of time T of $n = 1, 2, ..., n$ units of time, $\{S_T\}_{T=1}^{n}$, can be represented by $OHLC_T$: $\{Open_t, High_t, Low_t, Close_t\}$. The frequency of sampling T, can be arbitrarily defined.

OHLC representation

For every $OHLC_T : \{Open_t, High_t, Low_t, Close_t\}$:

Timestamp: The date and time for each interval.
Open: The first price of the interval.
High: The highest price registered during the interval.
Low: The lowest price registered during the interval.
Close: The last price of the interval.

Candlestick Visual Representation

Figure 1: OHLC Prices Representation

Type 1

A simple text to describe the type of Folds

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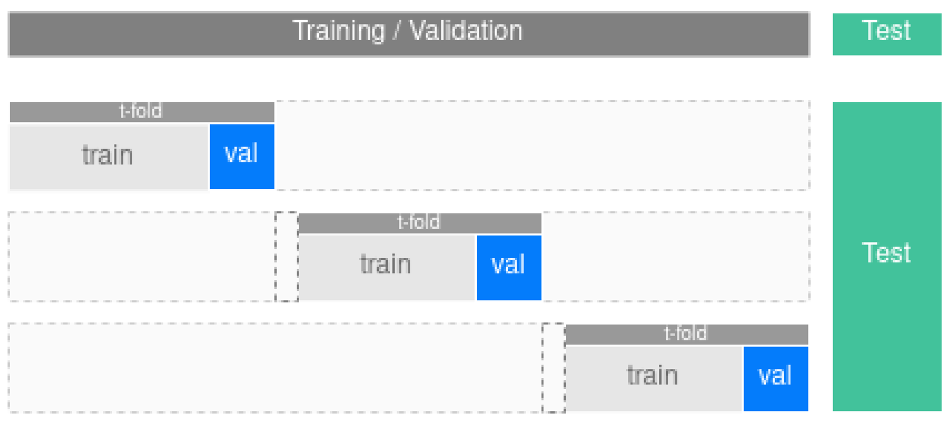

Figure 2: OHLC Prices Representation

Type 2

A simple text to describe the type of Folds

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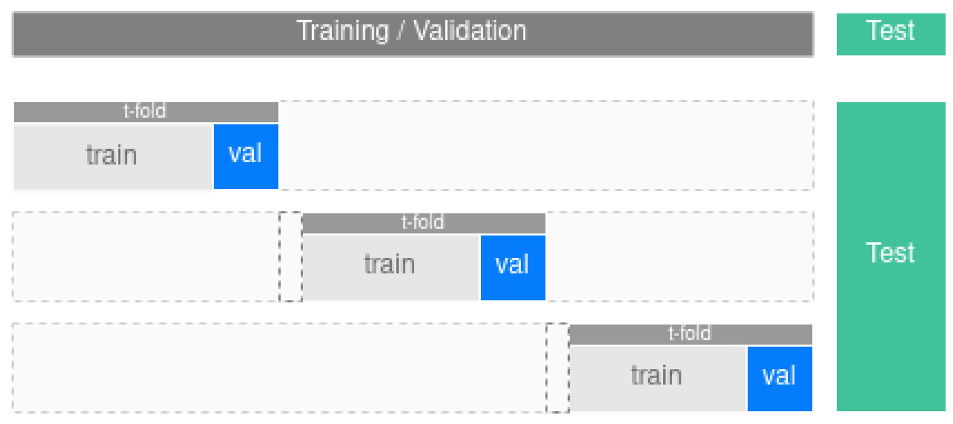

Figure 3: OHLC Prices Representation

Predictive Modeling: Part 1

One common component of the predictive modeling process is binary-logloss cost function with *elasticnet* regularization:

$$J(w) = J(w) + C\frac{\lambda}{m}\sum_{j=1}^{n} \|w_j\|_1 + (1-C)\frac{\lambda}{2m}\sum_{j=1}^{n} \|w_j\|_2^2 \quad (1)$$

L_1: Also known as *Lasso*
L_2: Also known as *Ridge*
C: A coefficient to regulate the effect between L_1 and L_2

Predictive Modeling: Part 2

Two models were defined, Logistic-Regression and Multi-layer Feedforward Perceptron.

Metric	ann-mlp	logistic
acc-train	0.9155	0.8311
acc-val	0.8245	0.7368
acc-weighted	0.4486	0.4061
acc-inv-weighted	0.4213	0.3778
auc-train	0.9924	0.9300
auc-val	0.8401	0.8017

Metric	ann-mlp	logistic
auc-weighted	0.4810	0.4521
auc-inv-weighted	0.4353	0.4137
logloss-train	0.2290	5.8333
logloss-val	6.0595	9.0892
logloss-weighted	0.6975	3.2422
logloss-inv-weighted	2.4467	4.2190

Repository

For more information about the code implementation, data, and file templates go to the GitHub repository for this work.

- github.com/IFFranciscoME/EcoSta2021

References

- Lopez de Prado, Marcos M (2018), *Advances in Financial Machine Learning, Wiley.*
- Pezeshki et al (2020). *Gradient Starvation:A Learning Proclivity in Neural Networks*, Mohammad Pezeshki, Sekou-Oumar Kaba, Yoshua Bengio, Aaron Courville, Doina Precup, Guillaume Lajoie, arXiv:2011.09468.
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