

Predicting Financial Time Series using Deep Learning

Module3. Important Metrics for Financial Time Series Prediction

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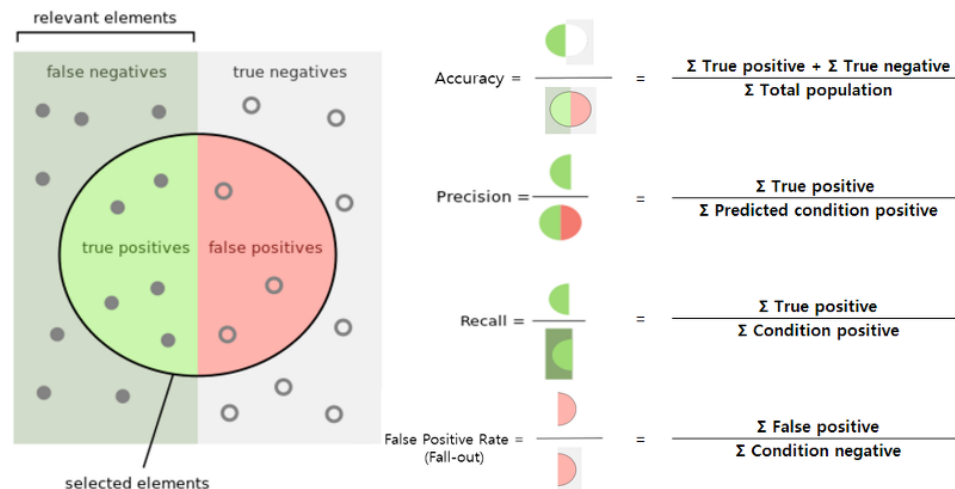
Note. Special thanks to Taejin Kim from KAIST who carefully suggest ideas and review the materials

Important Metrics for Financial Time Series Prediction

I don't agree with the metrics which
are conventionally used in ML or
Finance for our situation

Metrics from Machine Learning

- We all know conventional metrics from Machine Learning
 - For Categorical Outcome: Confusion Matrix



- For Continuous Variable: Mean Absolute Error

$$\text{MAE} = \frac{\sum_{i=1}^n |y_i - x_i|}{n} = \frac{\sum_{i=1}^n |e_i|}{n}$$

Does it still hold for financial time series prediction?

Without theory, how do we assure whether our algorithms have **consistent alpha seeking capability**?

Does it still hold for financial time series prediction?

- The key of trading algorithm is **consistent performance** over multiple periods, rather than a profit from short time periods regardless of how much they are profitable (lucky punch).
 - “지속적으로 수익을 내는 것이 아닌, 한번에 크게 번 알고리즘은 좋은 알고리즘이 아니다”
- However, **aforementioned metrics do not measure consistency of profitability**

We shouldn't use some common metrics in ML

- For example: mean average return
 - We usually calculate mean average return
 - However, if we lose 10% and gain 10% then our remaining budget become 99% ($100 * 0.9 * 1.1 = 99$), not 100%
 - Therefore, we need to evaluate the return by geometric mean of return rather than arithmetic average

Metrics from Finance Literature

- Also, I think common metrics in Finance doesn't fit well on ML problems

- For example: Sharpe Ratio

- There are two key parameter:
 - Standard Deviation
 - Portfolio Return
 - (assume R_f is fixed)

- Measuring Standard Deviation is so Naïve Approach

- How do we determine the size of windows under highly volatile situation?

The ELI5 Version of the Sharpe Ratio

$$\frac{R_p - R_f}{\sigma_p}$$

Where:

R_p = Portfolio Return

R_f = Risk-Free Rate (3-month Treasury Rate is standard)

σ_p = Portfolio Risk, aka Standard Deviation of Returns



We need a new standard of metrics for algorithm evaluation

- Although there are scarce literature in Finance for algorithmic trading
- We need a valid set of measurements for evaluation of algorithms
- Thus, below list of measurements are not from literature, but ideas from brainstorming
 - Measurement for Consistency
 - Measurement for Robustness
 - Measurement for Risk

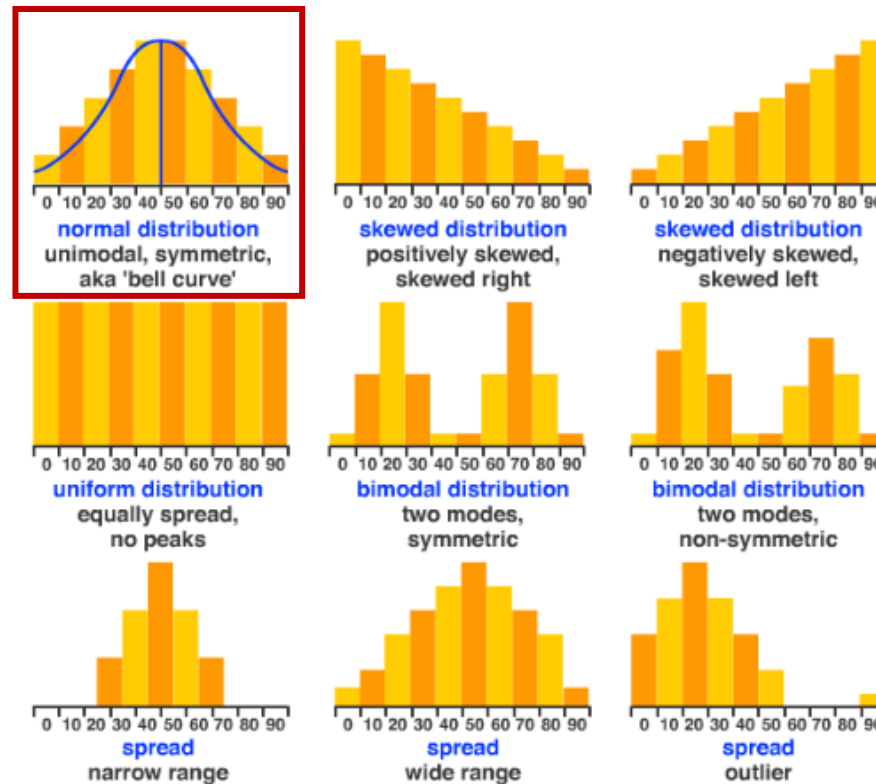
Measurement for Consistency

- Evaluate truncated geometric average return
- Try to remove biased performance: when we measure the average performance, remove top 10% and bottom 10% returns in magnitude, after then evaluate the geometric average return by remaining 80%

Measurement for Robustness

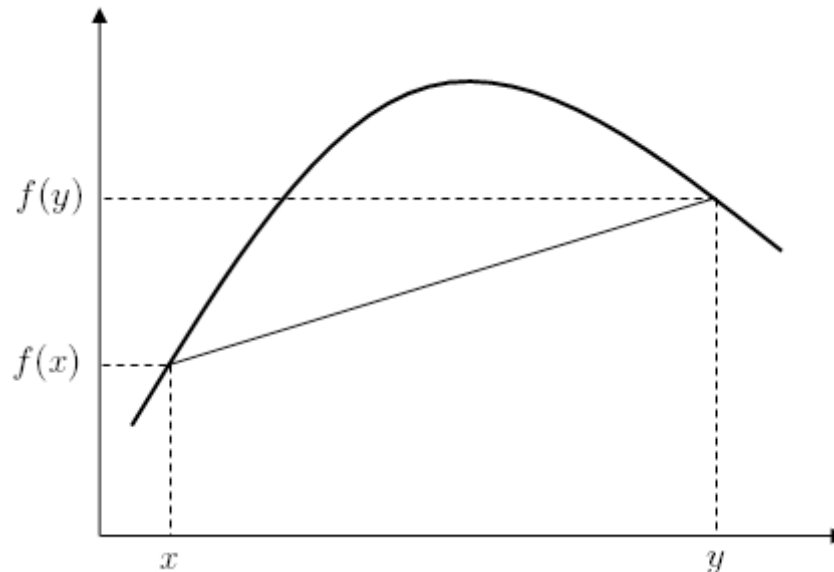
- Are the distributions of the average performance evenly distributed across test samples?

This is the best! →



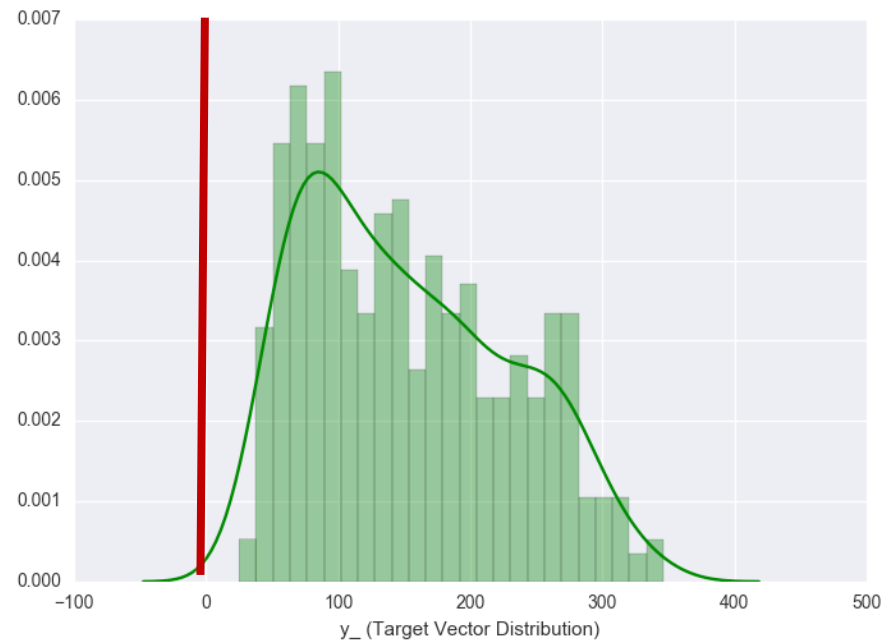
Measurement for Robustness

- Performance should be concave for the nearby hyper-parameter
 - If your algorithm is so right then the performance should be consistent for minor parameter changes
- For example: 10-minute trading, 11-minute trading, etc. all have similar profitability



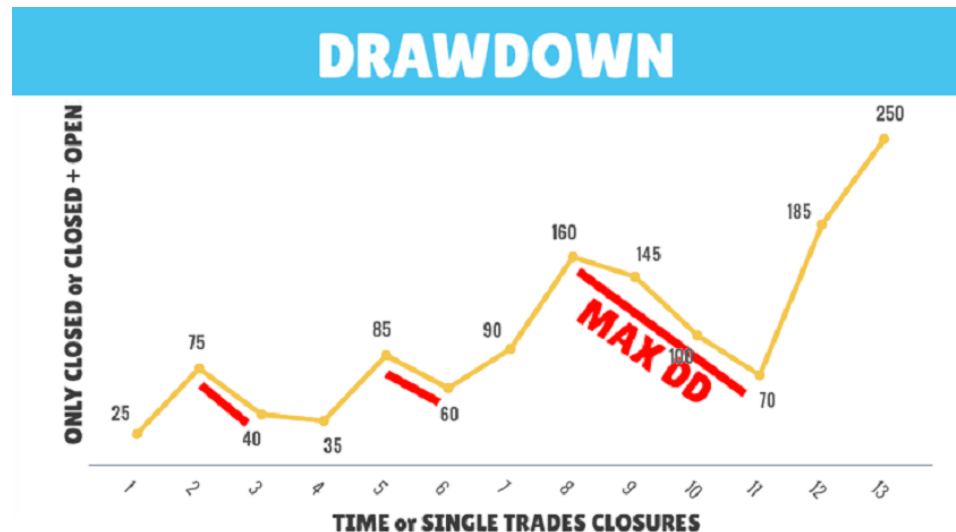
Measurement for Risk

- How many test samples show loss of principal (원금 손실 비중)
 - Choose the algorithm with less number of loss of principal



Measurement for Risk

- Measuring maximum drawdown
 - Choose the algorithm with the minimum of maximum drawdown



- 역사적 상황에서 입을 수 있었던 최대 손실
- 전체 기간 내 전략의 최대 손실

Another Tips

- How do we reflect such ideas on our algorithms?
 - Develop customized loss functions
- Draw your portfolio value in log scale
 - If your strategy is consistently good then the portfolio value over time should be flat (log scale makes it much visible)

Thank you ☺

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