Developing a Stock Trading Simulator Using Candlestick Chart Patterns for Estimating Profitability of Global Markets

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From 1982 to 2010, he worked at an electric company in Japan in charge of databases and Web-based systems for industrial use.

He has served as a professor at Tokyo Polytechnic University during 2010-2019, and then at TUIS since Apr. 2019.

His research interests include data analytics, software engineering.

Outline of the presentation

1. Introduction

2. Structure of the Stock Trading Simulator

   ① Criteria for Spotting Trade Timings

   ② Calculating trading fee

3. Experimental results

   ① Success Rate

   ② Cumulative Profits over 10 years

4. Conclusion and Future Work

1. Introduction

- The purpose of this study is
  to develop a simulator for stock trading, and
  to compare the performances of global markets
  in terms of profits.

- The developed simulator uses candlestick chart
  patterns and the 5-day moving average to find the
  opportunities to buy and sell stocks.

Contributions

I. We developed a stock trade simulator that continuously tries
    to make profits by buying and selling a stock.

II. Profits are simulated over the seven global stock markets for
    long and short trades, with and without trade fees.

III. Detailed analysis on big trades for demonstrating usefulness and
     limitation of the developed simulator.

2. Structure of the Stock Trading Simulator

● Candlestick chart is a kind of a bar chart defined by **opening, closing, high**, and **low** prices.

● If the **opening** price is lower than the closing price, a hollow candlestick is drawn indicating uptrend (**Bullish**).

● In the other case, a filled candlestick is drawn showing downtrend (**Bearish**).
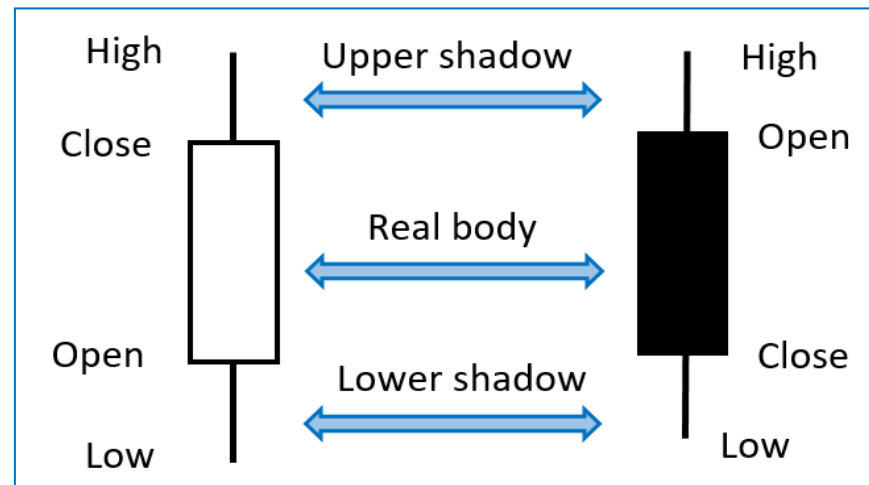

(A) **Bullish** candlestick   (B) **Bearish** candlestick

Criteria for Spotting Trade Timings

- In this study, we focus on the difference between the closing price and the 5-day average to find trade opportunities.
- The candlestick pattern has two parameters,
    - ① δ for the length of the candlestick body,
    - ② ε for the difference between the closing price and the 5-day moving average.
- The optimum values of the parameters are determined by an exhaustive search, which is described later.

δ: Length of body

①

②

ε: Defference between closing price and 5-day moving average

t–2   t–1   t–2   t–1   t
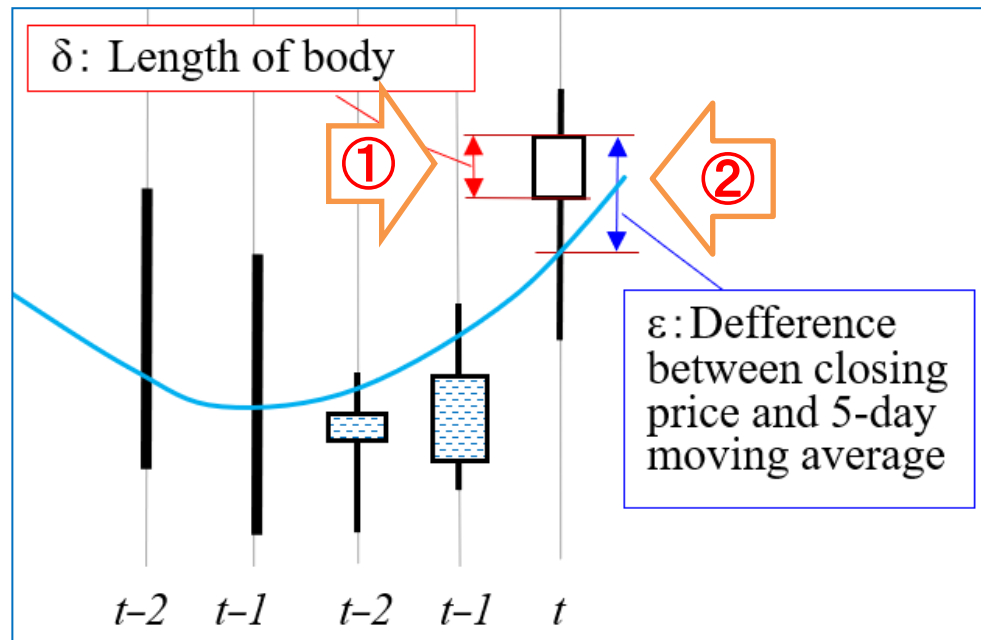
- Figure 2 depicts a bullish reversal pattern.
- Figure 3 illustrates a bearish reversal pattern.
- In this study, the perfect symmetry of the bullish and bearish reversal patterns is presumed.
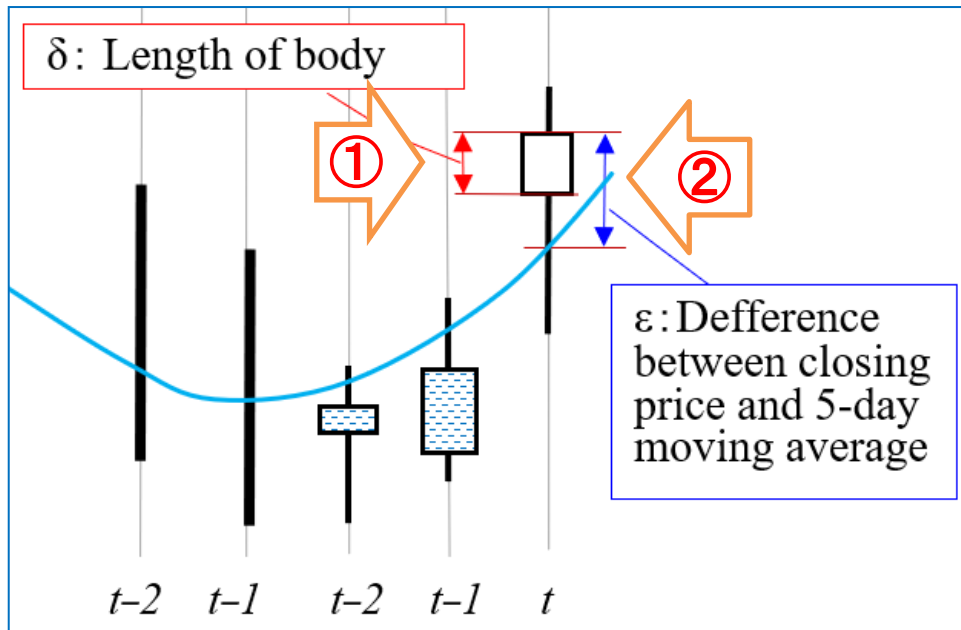
Re-posted

δ: Length of body

① ②

ε: Defference between closing price and 5-day moving average

t−2   t−1   t−2   t−1   t

Figure 2. Bullish reversal pattern.

−δ: Length of body

① ②

−ε: Defference between closing price and 5-day moving average
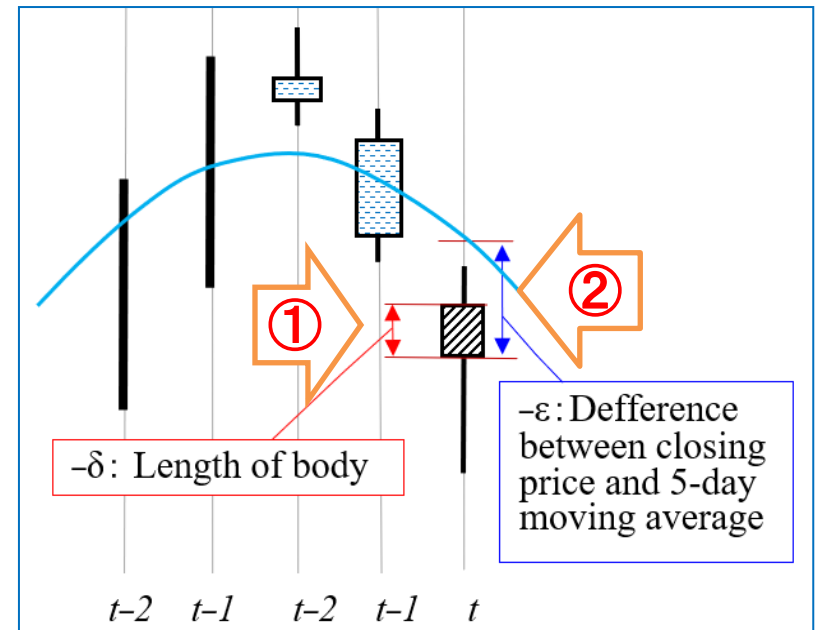
t−2   t−1   t−2   t−1   t

Figure 3. Bearish reversal pattern

Calculating **trading fee** for long position

- The trading fee varies across brokers and an amount of trade.
- The trading fee is calculated by 0.1% of the amount of a traded stock price to meet a typical trading fee in business.

Calculating **margin interest** for short position

- A trader firstly must borrow the stock to sell from an investment firm with a payment of margin interest.
- The margin interest is calculated by the following formula to fit business practices.

$$(\text{Stock price}) * (2.80\% / 365 * N + 1.15\%)$$

Determining Optimal δ and ε

- An exhaustive search approach is applied to find the optimal combination of the parameters δ and ε.

- Table III shows the optimal δ and ε for the seven global markets.

Table III OPTIMUM COMBINATIONS δ AND ε

Market	δ	ε
Euro Stoxx 50	0.05	−2.4
DJI	0	−1.7
NASDAQ	0.2	−2.4
Bovespa	0	−3.2
Sensex	0	−2.9
SSEC	−0.2	−2.3
Nikkei 225	0.05	−2.8

3. Experimental results

- **Success rate** =
  the number of profitable trades / the total number of trades

  Trades that result in a positive profit.

TABLE IV. SUMMARY OF THE SUCCESS RATES

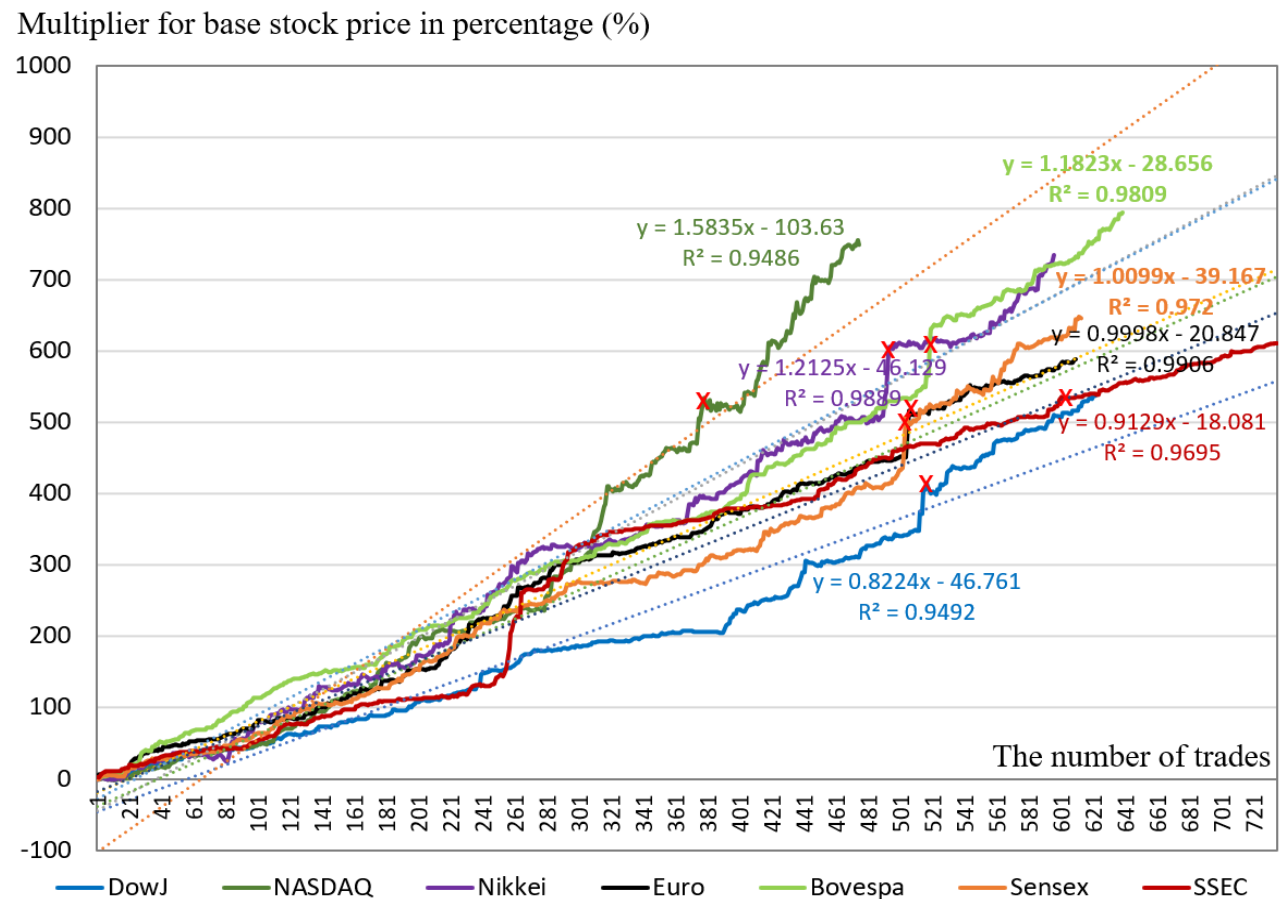|	Success rate in long position		Success rate in short position	
	Without fee	With fee	Without interest	With interest
DowJ	72.0%	64.3%	64.0%	15.9%
NASDAQ	73.1%	70.0%	61.3%	23.2%
Bovespa	70.8%	65.9%	69.6%	31.0%
Euro Stoxx 50	70.8%	64.6%	62.3%	21.3%
Sensex	79.4%	73.2%	57.4%	20.7%
SSEC	67.4%	62.1%	68.3%	22.0%
Nikkei 225	66.1%	62.9%	59.6%	22.8%
Average	71.4%	66.1%	63.2%	22.4%

Cumulative Profits over 10 years

- Figure 5 shows the graphs of cumulative profits in a **long position** with the trading fee.
- As the graphs show, the cumulative profits almost constantly increase as stock trades continue.
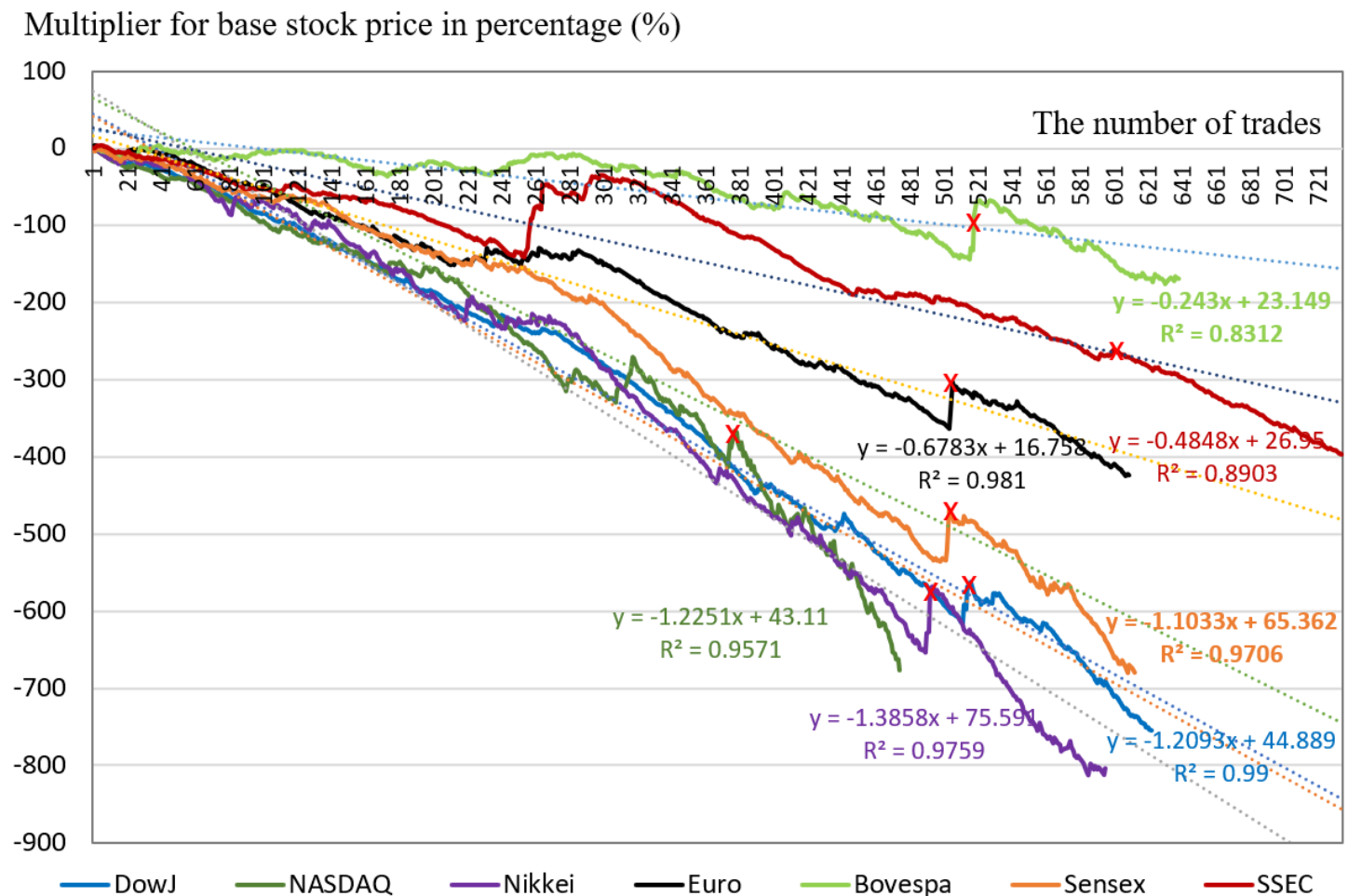
Figure 5
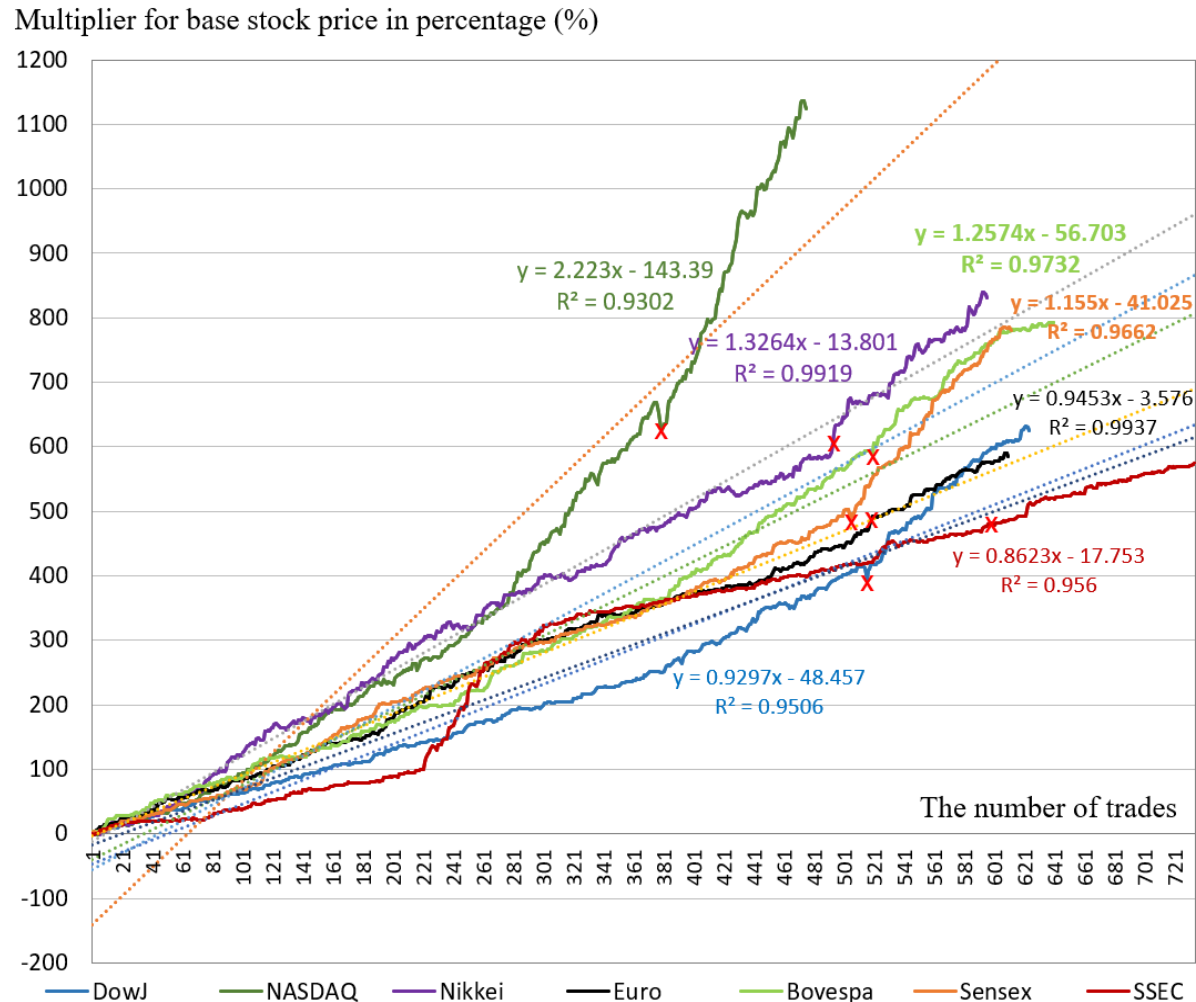
- Figure 6 shows the line graphs of cumulative profits in a short position **without the margin interest**.
- These graphs show that, ignoring the margin interest, the simulator generates the same level of profits as a long position.

Figure 6

Multiplier for base stock price in percentage (%)

$y = 1.1823x - 28.656$
$R^2 = 0.9809$

$y = 1.5835x - 103.63$
$R^2 = 0.9486$

$y = 1.0099x - 39.167$
$R^2 = 0.972$

$y = 0.9998x - 20.847$
$R^2 = 0.9906$

$y = 1.2125x - 46.129$
$R^2 = 0.9889$

$y = 0.9129x - 18.081$
$R^2 = 0.9695$

$y = 0.8224x - 46.761$
$R^2 = 0.9492$

The number of trades

DowJ — NASDAQ — Nikkei — Euro — Bovespa — Sensex — SSEC

- Figure 7 shows the line graphs of cumulative profits **including the margin interest**.
- The line graphs show that the margin interest overwhelms the simulated profits.

Figure 7

Multiplier for base stock price in percentage (%)

The number of trades

y = -0.243x + 23.149
R² = 0.8312

y = -0.6783x + 16.758
R² = 0.981

y = -0.4848x + 26.95
R² = 0.8903

y = -1.2251x + 43.11
R² = 0.9571

y = -1.1033x + 65.362
R² = 0.9706

y = -1.3858x + 75.591
R² = 0.9759

y = -1.2093x + 44.889
R² = 0.99

DowJ — NASDAQ — Nikkei — Euro — Bovespa — Sensex — SSEC

4. Conclusion and future work

➢ This study deals with a stock trade simulator that tries to make profits in both long and short positions.

➢ Simulations are performed using the daily historical stock data of the seven global markets for a period of ten years.

➢ The profits simulated in a **long position** are noteworthy.

➢ However, significant losses occur in a **short position.** Margin interest to loan stocks overwhelms a simulated profit in a short trade.

➢ **The next research topic** would be to improve the simulator so that it does not trade during periods of high market volatility. In this case, the simulator would have **three states**, i.e., buying, selling, and no trading.
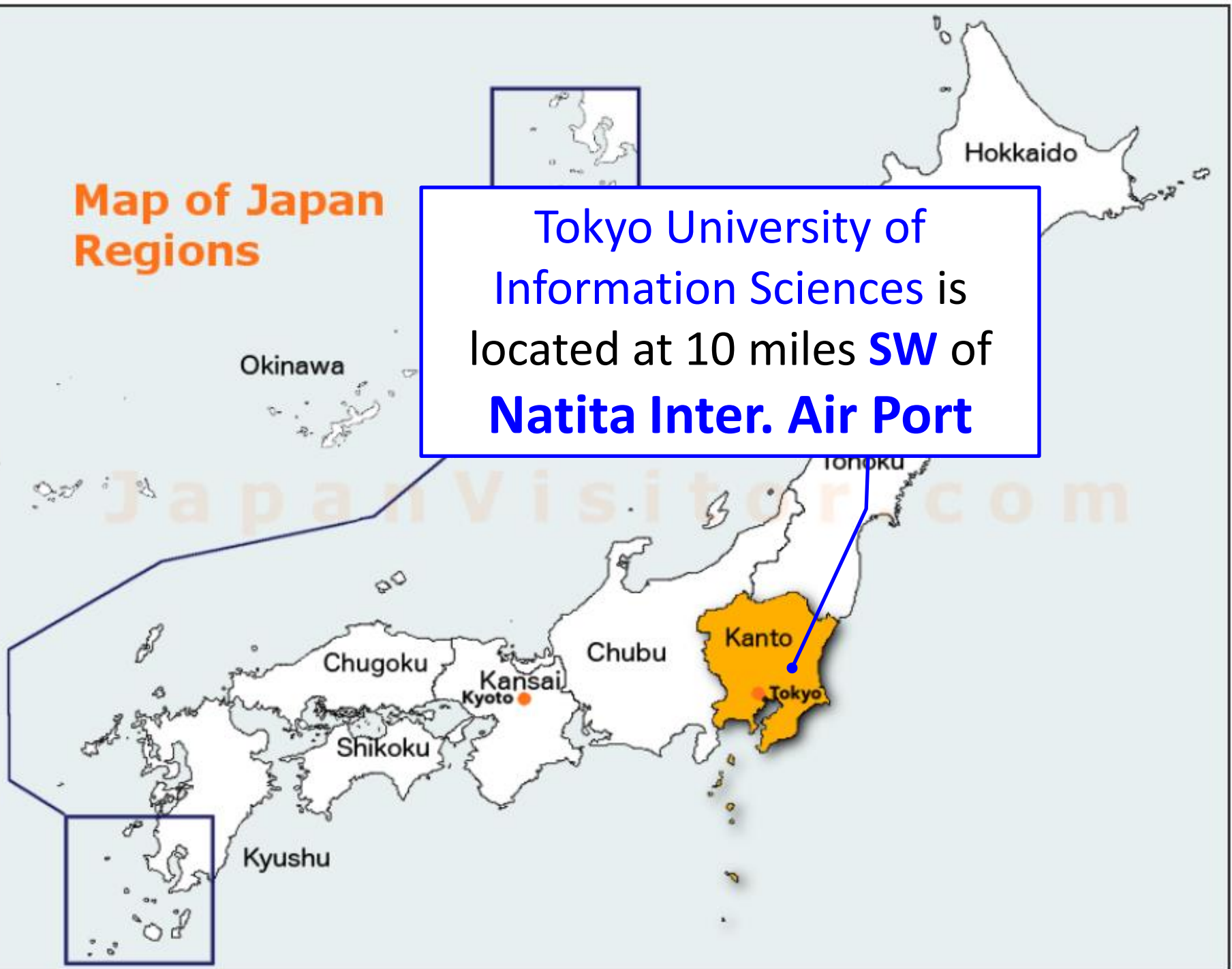
Thank you for listening

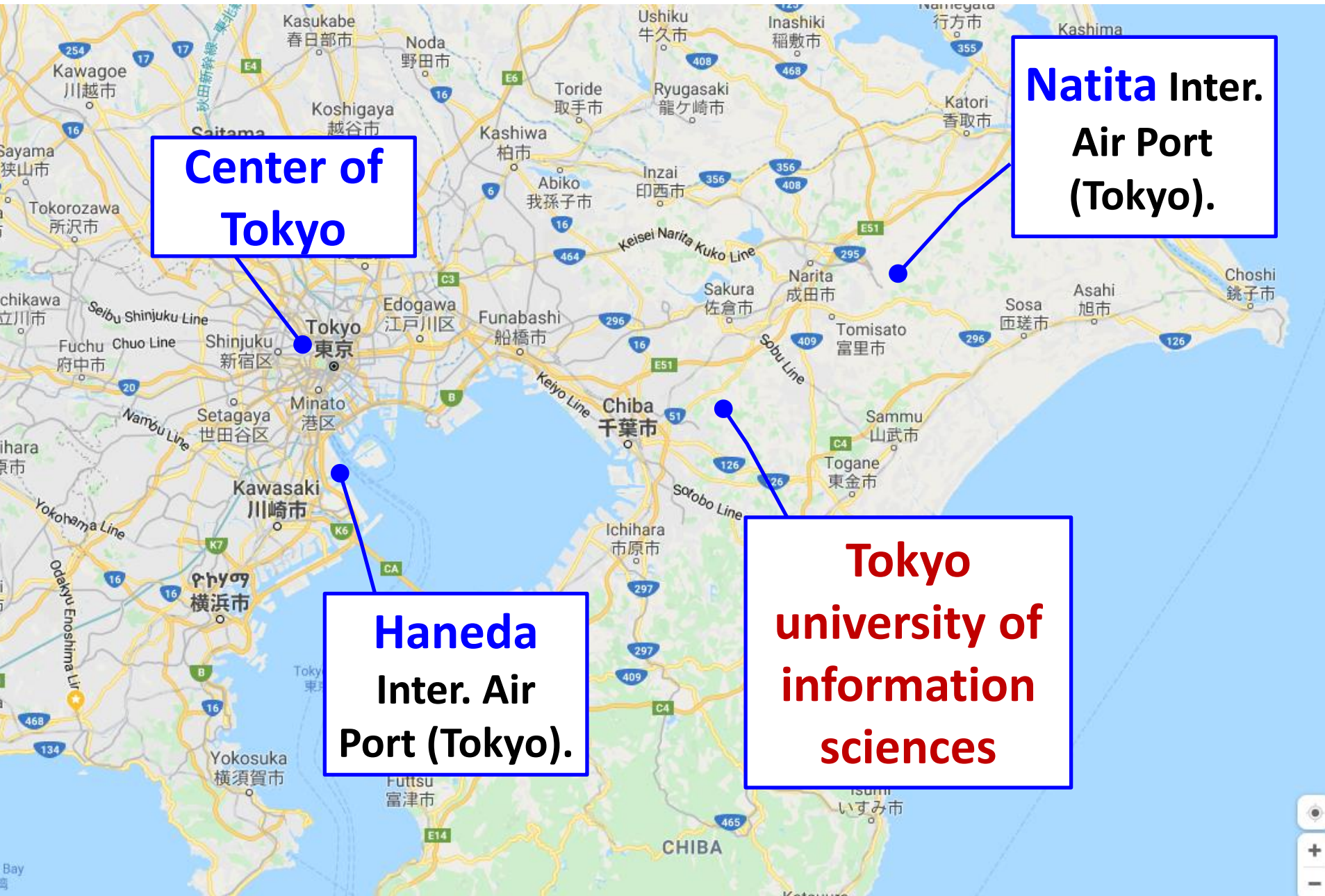Looking forward to seeing you at the next meeting!

Appendix

Where we are

Natita Inter. Air Port (Tokyo).

Center of Tokyo

Haneda Inter. Air Port (Tokyo).

Tokyo university of information sciences