Transaction Experiments by Humans in the U-Mart *Zaraba* Trading Session*
—Why Are They Strong Agents?—

Kazuhisa Taniguchi

Contents

1　Introduction
2　Experimental Outline
3　Characteristics of Price Change
4　Transaction Details of *Zaraba* Trading session
5　Transactions Made by Strong Human Agents
6　Conclusion

Key words　Artifical Market, U-Mart

概要　本稿は2007年度に行われたヒューマンによる U-Mart ザラバ実験の報告である。筆者は U-Mart プロジェクトに開発当初から関わってきたが，主に教育における利用を目的としたもので，これらの実験から得られた知見に関しては，例えば板よせ方式の場合に板情報の有無が約定率や利潤などに与える影響を報告した。昨年に U-Mart システムはザラバ方式によるマッチングが可能になったが，興味深く思われるのは毎年 1 ～ 2 名であるが，取引に関して強い学生が登場することである。そのような強い学生は，取引を始めた直後から強い場合もあれば，最初は破産することがあっても，徐々に取引の腕を上げてくる場合もある。このヒューマンエージェントの特性はザラバになってより顕著に現れるようになり，今年度は強いエージェントが 2 名出現した。本稿は実験全般の概略説明とその 2 名の取引結果を追跡し報告するものである。

1　Introduction

The present article reports the U-Mart *Zaraba* experiment by humans conducted in 2007. This article gives an explanation of the experimental outline, and reports the transactions made by the human agents who were especially strong. The author has been involved in the U-Mart project since the early stage of the development, aiming at the educational use of the U-Mart project. During this period, 32 students including third-year and fourth-year students participated in the transaction experiments using the U-Mart system from the author's seminar in 2002 at Osaka Sangyo University which is the university the author had formerly been assigned to. At Kinki University, 17 students participated in the experiments in 2004, 3 students in 2005, 9 students in 2006, and 9 students in 2007. A total of 70 students have participated in the transaction experiment using the U-Mart system. Additionally, 14 students are now also preparing for the experiments that will be conducted from the beginning of the new fiscal year. The students work on the U-Mart experiments over almost one year. Specifically, they obtain knowledge required for futures trading. For example, they become familiar with the Margin system and the Mark-to-Market system, and they also learn about trading strategies. At the same time, they develop the computer operational skills necessary for the experiment, and they conduct practical trading using the U-Mart system. After the experiment, they analyze the obtained data using computer software, such as EXCEL. The experiment can be enjoyed as though it were a game because winning or loosing is immediately evident. However, the cause and the reason of the trading results can be clearly identified subsequently by analyzing the experimental data. Hence, the students begin in earnest with data analysis, not merely being moved by the joy and sorrow of winning or losing the experiment. Moreover, the analysis results are utilized in the next experiment, so that the learning efficiency of students is also enhanced. As just described, the U-Mart system is well designed as an educational tool.

With respect to the findings obtained from these transactions, the author, for

example, empirically examined the influence of the availability of order books on execution rates and profits where the *Itayose* method is used, and these results were reported in Shiozawa et al.[2]

In addition, many of reports by the research project participants have been presented. Last year, after these reports were presented, it became possible to use the *Zaraba* method to match transactions in the U-Mart system. Regarding the *Itayose* and *Zaraba* methods, a description is given of these by the Tokyo Stock Exchange.[1] In spite of outward similarities, there can be found significant differences in the fundamentals of both transaction methods. Another article written by the author discusses this point.

The following point attracts the author's interest: there appear one or two students who are very strong in transactions every year. Among such students, some of them are already strong shortly after starting to make transactions, while others gradually improve their trading skills even after going bankrupt at an early stage. These characteristics of human agents become more noticeable in the *Zaraba* trading session. This year, two strong human agents appeared. The present article describes the outline of the entire experiment and tracks the transactions made by the two strong human agents in order to report the results. This report can serve as a useful reference for the development of machine agents, now in progress in the U-Mart project. In this article, the conditions of the experiment conducted in 2007 are described in section 2. Section 3 shows the characteristics of price change, and an explanation of the *Zaraba* trading case is given with reference to time in section 4. Furthermore, section 5 reports the transactions made by the human agents who were strong throughout the experiment.

2 Experimental Outline

The *Itayose* experiments were conducted in the first semester of 2007. 9 students were the experimental participants, and machine agents also participated in the experiments at times. Twice as many pilot experiments were conducted at first, followed by the main experiments which were conducted four times. The

Itayose method is easy to work on because it has a temporal margin in matching of order books. This makes it a desirable method to use when students make transactions for the first time.

The *Zaraba* experiments were conducted after conducting the *Itayose* experiments. With four times as many seminars being held in the second semester, a total of 12 times as many experiments were conducted (given 90 minutes, each seminar was conducted three times). Depending on the experiment, as many as 8 machine agents that place orders randomly participated in the experiment. This experiment was total five-day futures market, with opening and afternoon sessions each day. One session consisting of 50ut (U-Mart Time), and 1ut was conducted given two seconds or one second. Additionally, a modified NIKKEI futures index was used as the spot price series.

3　Characteristics of Price Change

With respect to the price change, a characteristic movement was observed. As to the price chart of the *Zaraba* experiments conducted twice in October 29, as shown in Figures 2 and 3, the change in futures price did not catch up with the change in spot price during the period from the market opening time to the initial two-thirds portion of trading. Orders were placed, once orders were executed and the prices were determined. Actually, however, the orders were not executed and the former price remained unchanged. A thin-board condition continued because only human agents participated in the experiment. If machine agents that place orders frequently are thrown into the experiment, a price change that follows the spot price occurs even with a small number of human agent participants. In addition, the *Itayose* experiment was configured to generate an order book every 20 seconds, so that participants were able to take their time when placing orders. This lead to order books emerging consecutively even with 9 human agent participants.

Why, however, were no orders that are likely to be executed placed ? Why did such a thin-board condition continue ? This was because the precedent spot

price series was stable, so that it was impossible to presume foregoing trends. When there are many days remaining in the futures market, the market is influenced by the expectation that the spot price will come back again, which causes this pattern of transaction to continue. However, the futures price starts to move when the trading period reaches the later one-third of the period, because other transactions are conducted in order to match positions as the remaining days lessen.
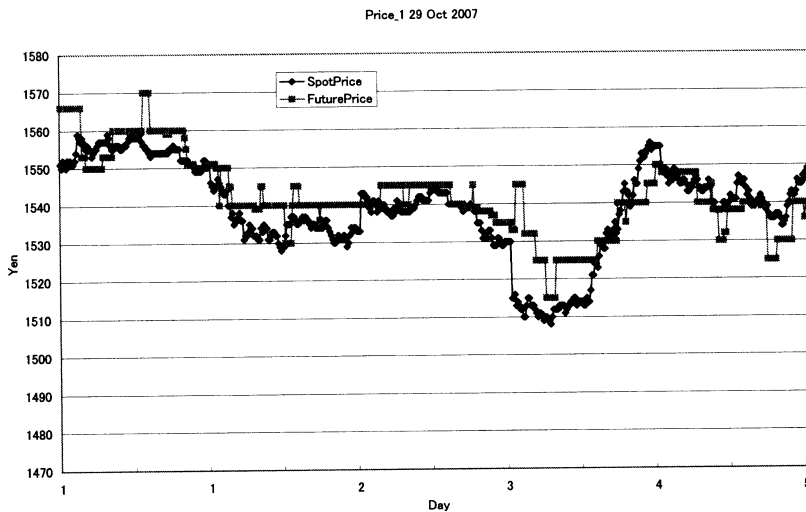
Price_1 29 Oct 2007

Figure 1. The price movement of the experiment 1, conducted on October 29, 2007

4   Transaction Details of *Zaraba* Trading session

As a specific case, let us replicate the *Zaraba* trading by reconstructing the order books using the experimental data obtained from the first experiment conducted on October 29. The opening session on the first day is tracked in this section. The price movement is shown in Figure 2. The figure shows that no order books were created each time. As already mentioned, this occurred because only 9 human agent participants were used, so that the trading volume was less.

The price was started at 1,566 yen. This was because the spot price continued to exist because no price was determined at the beginning of the first trading day. At Ut11, 500 units of sell order were placed at a price of 1,600 yen. Afterwards,
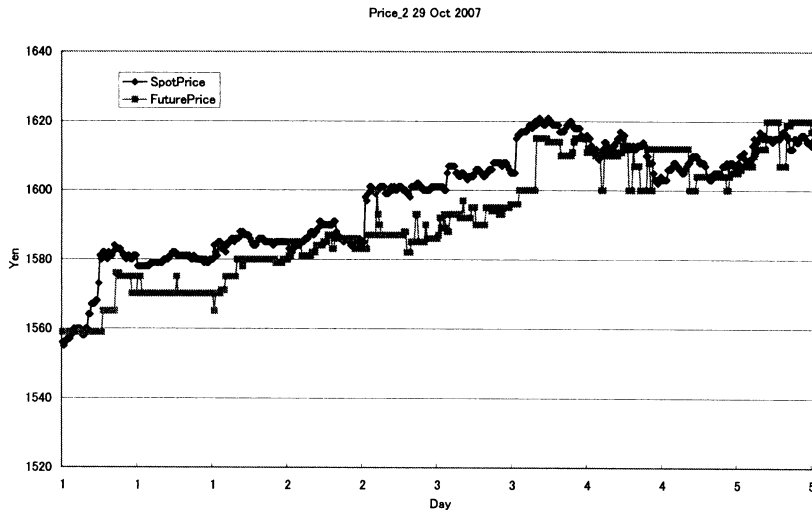
Price_2 29 Oct 2007

Figure 2.　The price movement of the experiment 2, conducted on October 29, 2007

until Ut15, 100 units of sell order were placed twice at 1,553 yen, and 100 and 10 units of sell order were placed at 1,566 yen.　No orders were executed.　When 10 units of buy order were placed at 1,555 yen at Ut15, 10 units were executed at 1,533 yen for the first time.　This price, 1,533 yen, was the price that was determined in the futures market for the first time.　Afterwards, the following units of order were executed: 100 units at 1,550 yen at Ut19; 190 units at 1,553 yen at Ut30; 10 units at 1,560 yen at Ut37.　At Ut41, 100 units were executed at 1,560 yen again.　Then orders were placed in the morning session.　However, trading entered into the afternoon session without executing any orders.　This process is replicated in Table 1.　The left order book shows the orders before execution, and the right order book shows the orders after execution.　The orders that reached execution directly are shown in Italics on the left order book.

5　Transactions Made by Strong Human Agents

Profits made by transactions are shown in Figures 3 and 4.　As shown in Figure 3, no traders who were clearly strong existed except h6 in the *Itayose* experiment conducted in the first semester. However, when the *Zaraba* trading experiments were started entering into the second semester, two strong traders

Table 1. The morning session on the first day of the experiment 1, conducted on
October 29, 2007

UtNo:11-15

Sell Volume	Price	Buy Volume
500	1600	
100+10	1566	
	1555	*10*
100+100	1553	

UtNo:15

Sell Volume	Price	Buy Volume
500	1600	
100+10	1566	
	1555	
100+90	1553	

UtNo:16-18

Sell Volume	Price	Buy Volume
100	M.O.	
500	1600	
100+10	1566	
	1555	
100+90	1553	
	1550	*500*

UtNo:19

Sell Volume	Price	Buy Volume
500	1600	
100+10	1566	
	1555	
100+90	1553	
	1550	400

UtNo:19-30

Sell Volume	Price	Buy Volume
500	1600	
100+10	1566	
	1560	*100+100*
	1555	
100+90	1553	
	1551	100
	1550	400+10+10

UtNo:30

Sell Volume	Price	Buy Volume
500	1600	
100+10	1566	
	1560	10
	1551	100
	1550	420

UtNo:31-37

Sell Volume	Price	Buy Volume
500	1600	
10	1566	
100	1570	
10	1560	10+*100+100*
	1551	100
	1550	420+500+100+100

UtNo:37

Sell Volume	Price	Buy Volume
500	1600	
10	1566	
100	1570	
	1560	200
	1551	100
	1550	1120

UtNo:38-41

Sell Volume	Price	Buy Volume
500	1600	
10	1566	
100	1570	
100	1560	200
	1551	100
	1550	1120

UtNo:38-41

Sell Volume	Price	Buy Volume
500	1600	
10	1566	
100	1570	
	1560	100
	1551	100
	1550	1120

UtNo:42-51

Sell Volume	Price	Buy Volume
500	1600	
100	1570	
	1561	500
	1560	100+100
	1555	100
	1551	100
	1550	1120
	1545	100

appeared.　Figure 4 indicates the profits of all traders obtained from the results of a total of six experiments conducted on October 22 and 29.　In the experiment conducted on October 22, machine agents that place orders randomly also participated in the first and third experiments （the participants in the rest of the experiments were human agents）.　However, only the profits of human agents, with the profits of machine agents removed, are shown in the figure.　As can be seen from the figure, h1 and h9 are outstandingly strong as traders.　The trader h9 never lost in these six experiments; in addition, he also won the U-Mart 2007.

Profit, Itayose

Figure 3.　The profits made by each of agents in the *Itayose* experiment conducted on June 4–25, 2007

Profit

Figure 4.　The profits made by each of agents in the *Zaraba* experiment conducted on October 22 and 29, 2007

Furthermore, according to the interview conducted by the author, it was found that both agents of h1 and h9 had clear intentions and ideas in making transactions. In addition, a significant difference exists in the volume of profit between the *Itayose* and *Zaraba* experiments. This is because the trading period of the two of experiments is different, 90 days for the *Itayose* experiment and 5 days for the *Zaraba* experiment.

Organizing the experimental data obtained, the author conducted interviews of the two strong traders, h1 and h9. The following section shows the results of these interviews.

The trading of h1

First, h1's ordering is considered. Regarding order volume, the order volume of h1 was outstanding in its number as indicated in Figure 5. This is because h1 hit the "Market Order" button repeatedly, pegging the number of order units to 50 units at a single order. When placing orders as a limit order, a limit price should be entered changing the price quickly in order to identify a desired price. To do that, the index entered on a trading window should be revised. The reason why orders are placed as a market order is to reduce the input time of the price revision. Additionally, when placing a large number of orders as a market order at once, the price fluctuation becomes more significant in the market because of the orders placed, which leads to an unexpected price being determined. To prevent this from occurring, h1 placed a small amount of orders (=50 units) repeatedly in order to execute the hoped-for order units at close to the desired price. Hence, the number of execution became the largest as well, as shown in Figure 7.

Next, h1's strategies are now considered. h1 made a prediction reading trends; however, the essential point is that h1 took advantage of loss cut. A profit can be made if the prediction is accurate, or a loss is made if the prediction is off target. Even supposing the probability of making a profit or a loss as 50 percent, h1 made his trading favorable in whole by taking advantage of loss cut. Actually, h1 lost in the first experiment conducted on October 29; however, this

was because his predictions were off twice and he failed to conduct loss cut at the early stage of transactions as well.

The trading of h9

With regard to h9's ordering, the order volume was not as much as that of h1. This is because h9 did not need to place market orders for the same reasons that h1 did.　In other words, h9's input operation speed was so fast; he placed orders as quickly as he could at the price he desired.　The present *Zaraba* experiment was conducted setting the Ut time as two seconds or one second.　The one second Ut time created rapid market movement, so that the operation speed of some traders were unable to keep up with the rapid movement of the market.　However, the input operation of h9 on the transaction window was fast enough to keep up with the one second Ut time.　Additionally, each number of order units placed by agents is shown in Figure 6.　The number of order units placed by h9 is outstanding here as well because h9 places a large number of orders at once.　h9 placed as much as 500 or even 1,000 units of orders at a maximum at a single order.　Hence, as to the units of execution, Figure 8 shows that h9 had the largest number of execution units.

Now, what kind of strategies did h9 adopt in order to place orders？　First of all, basically, h9 placed orders continuously.　However, his method of ordering can be divided into two stages.　As the first stage, h9 determines an order policy, buy or sell, making a certain prediction from the current price series.　Being unsure of the prediction he made, however, h9 placed orders at a limit price lower than the current market price when buying, or a higher limit price when selling. Therefore, some orders could be executed, or some could not.　Furthermore, h9 often canceled orders because of being unsure of the prediction.　However, even if orders are placed with an uncertain prediction, at times an aspect of which he could be sure of the prediction appears.　At that moment, h9's ordering enters into the second stage.　In the second stage, he places buy orders at a limit price higher than the current market price, or sell orders at a lower limit price.　Naturally, those orders are executed in most cases.　Besides, the orders are placed in

a large number at once. With the above mentioned strategies, h9 continued to win in the transactions.

Position Management

With respect to position management, each of the traders should understand the mechanisms of the Margin system and the Mark-to-Market system, and it is required that they manage their assets carefully. In the U-Mart experiments,
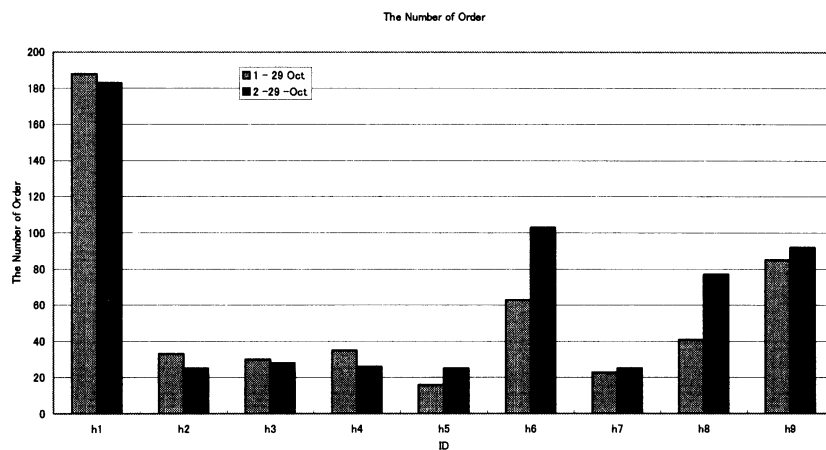

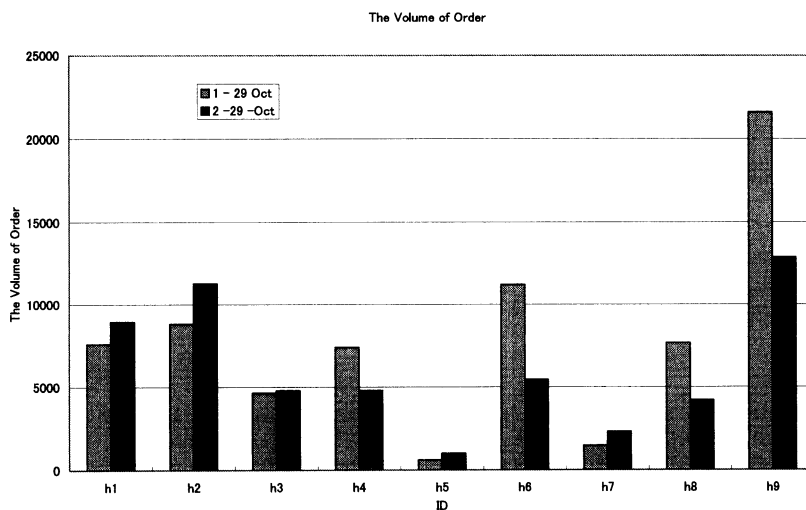Figure 5. The number of orders placed by each agent, conducted on October 29, 2007

Figure 6. The volume of orders placed by each agent, conducted on October 29, 2007

The Contracted Number
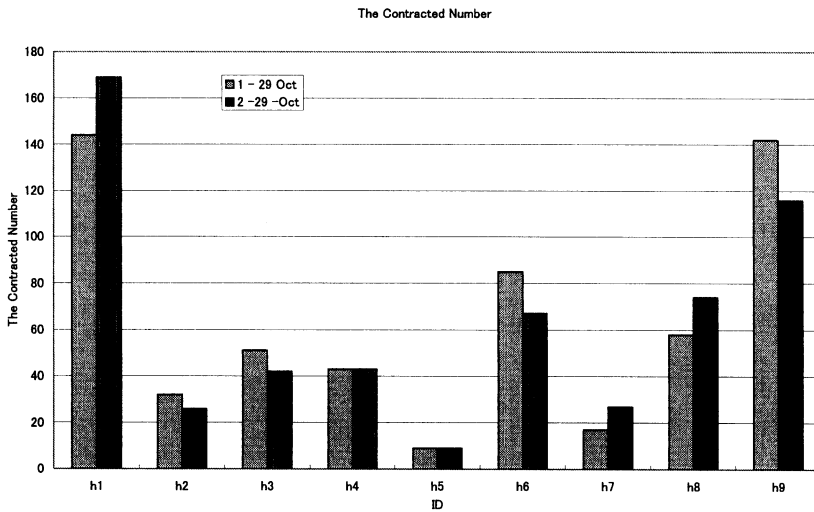
Figure 7. The number of execution of each agent, conducted on October 29, 2007
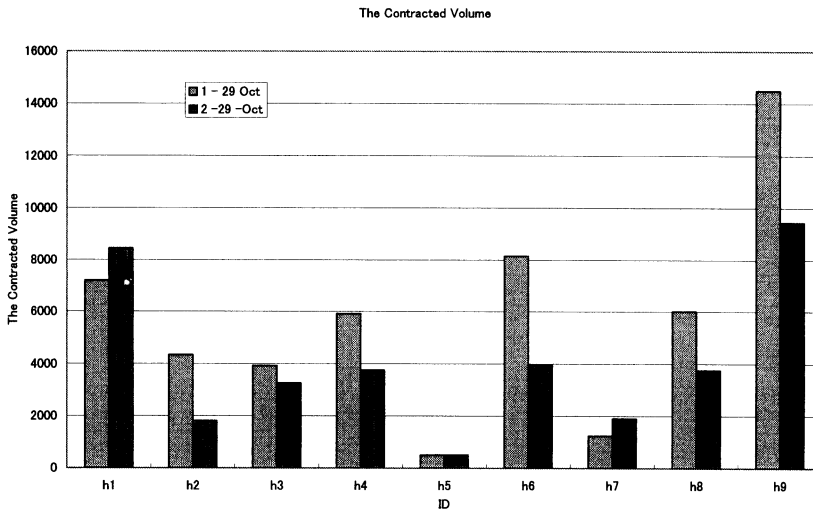
The Contracted Volume

Figure 8. The volume of execution of each agent, conducted on October 29, 2007

transactions that did not show bias were observed in the *Itayose* experiment. Traders with such strategies often won the transactions. However, when the *Za-raba* experiment was started in which the intention of traders is easily realized, the traders were able to make transactions biasing their positions significantly. As a reference, the positions of h1 are shown in Figure 9, and the positions of h9 are shown in Figure 10. In these figures, a bias of 2,000 positions can be observed.
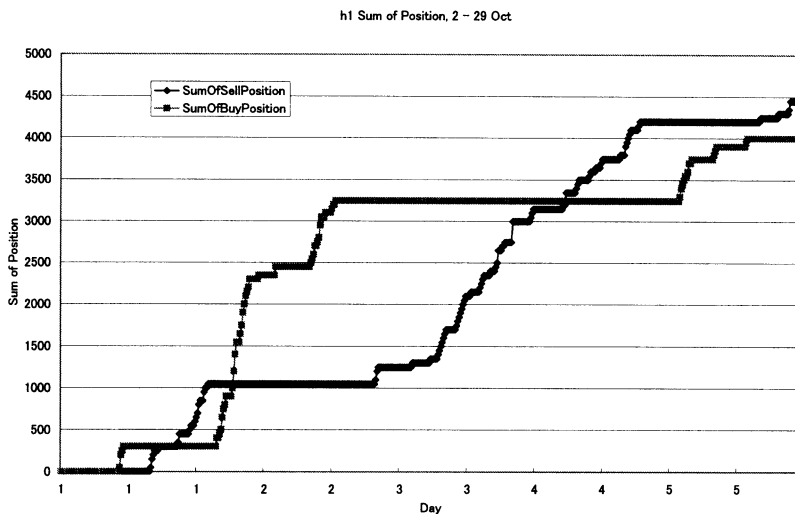
h1 Sum of Position, 2 – 29 Oct

Figure 9.   The positions of h1 in the experiment 2 conducted on October 29, 2007
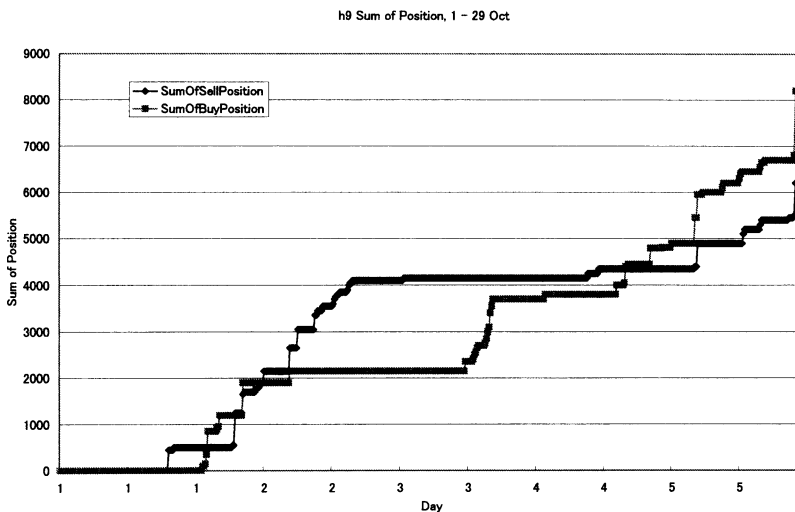
h9 Sum of Position, 1 – 29 Oct

Figure 10.   The positions of h9 in the experiment 1 conducted on October 29, 2007

6 Conclusion

The present article mainly described the transactions made by individual traders.   There is more than one method of trading that can allow a trader to win in transactions.   However, traders who can win in transactions develop trading

strategies, and create practical ways to realize their strategies. With intentions and ideas based on such strategies, the traders make transactions. Such traders have clear tactics regarding position management, how to observe price movements, and input operational skills. Traders have their own intentions, and trade in a way that can realize their intentions. In the *Itayose* trading session, traders cannot realize their clear intentions and desires in the transactions even when they have such. However, the *Zaraba* trading session provides the features of a market where traders can realize their own intensions and desires. Actually, a report based on an overview of the entire *Zaraba* trading experiment is handled in another article. However, as described in the present article, the U-Mart system which has the *Zaraba* trading function made it possible to show the transaction details which cannot be observed when using the *Itayose* method.

Currently, in the U-Mart project, the "Assist Window", which assists trading by humans upon input operation for trading, is now under development. This will mean that traders who have higher-level trading strategies and skills will appear. In addition, to take advantage of such strategies and skills, a wide variety of educational programs which correspond to various aspects, from acquisition of the basic knowledge of trading to experiments demanding more fulfilling transactions and sophisticated skills, will be required.

References

⑴　Tokyo Stock Exchange. *Guide to TSE Trading Methodology —3rd edition —*. Tokyo Stock Exchange, 2004.
⑵　Yoshinori Shiozawa, Yoshihiro Nakajima, Hiroyuki Matsui, Yusuke Koyama, Kazuhisa Taniguchi and Fumihiko Hashimoto. *Artificila Market Experiments with the U-Mart System.* Springer-Verlag, 2008.