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DSS for Extreme Decision Making: the case of high volatility stock market portfolio

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Abstract. Predicting the performance of a company's stock for decision purposes is typically made using a scientifically rigorous method known as technical and fundamental analysis. In this paper, such techniques appear insufficient for potentially extreme decision making situations. For argumentation purposes a typical 'random walk' high volatility stock market scenario is reformulated using derivative instruments, as well as CFD's (Contracts for Difference), as a way to control the interplay between results and risk. In the process attempts are made to transform an 'ill' structured decision situation into a manageable solution that is supported by an N*M factorial experimental design. The treatment consists of different types of Decision Support Systems (DSS) architectures that range from a simple calculator to an experimentally induced intelligent STOP and LIMIT mechanisms that control the critical entry and exit portfolio conditions. In the conclusion we discuss the results obtained in a laboratory experimentation as they appear "too good to be true" In particular, the results challenge the economic market efficiency principles with, it's classical "no –arbitrage' clause" and 'portfolio diversification' principle.

Keywords: Extreme decision making, Decision Support Systems, Derivative instruments, Options, Contracts for Difference (CFD), Stock market, portfolio management, no arbitrage clause

1 - Introduction

An extreme decision making situation is defined here by an 'ill'-structured 'decision process in a context of extreme events. The decision process is typically 'ill' structured' when it involves many dimensions , imply uncertainty or high risk and is affected by major conflicts . Among extreme events we could cite examples such as Chernobyl, hurricanes Andrew and Katrina, major earthquakes, global climate changes and others. In business, such extreme situations occur also relatively rarely and therefore we lack data to perform any reasonable projection based on technical analysis techniques. Business extreme situations include not only major economic crises or stock market crashes but also, for the average investor, they might be triggered by some unexpected announcements that carry the potential of large stock price movements.

In our previous work, we have addressed the issue of reacting to extreme stock market situations by claiming that a Virtual Decision Maker (VDM) technology, using intelligent agents, can be used in place of the human decision maker. (Ajenstat and al, 2004) Justification for this view can be found in human factors including behavioural considerations, decision style differentiation in relation to risk and more acutely, cognitive limitations. . Behavioural issues such as the well known anchoring or overconfidence and other hidden traps of decision making (Hammond and al, 2006), are common in on-line decision making. Research show associated behavioural biases such as (i) self attribution bias, in which the investors consider themselves the source of their own success, (ii) illusion of knowledge, in which investors fail to distinguish the overwhelming amount of data available from information, or (iii) the illusion of control (Barber and Ocean, 2000. The behaviour is further characterized by individual differences such as risk-aversion .or background risks (revenue, professional situation, past successes and failures). Typically though, human cognitive limitations constitute the most stated justification for Decision Support Systems, especially in the case of the 'ill structured' extreme decisions processes which we are addressing here. .This perspective considers the fact that human as information processors have limitation in their information processing capacity. To overcome the cognitive limitations also known as 'information overload' humans often use some oversimplified heuristics, or arbitrarily subdivide their task into subtasks to a level that remains within the limits of their cognitive capacity. Eventually humans as information processors make use of DSS technologies as a way to absorb part of the information processing effort required, while freeing the remaining capacity for judgement where they excel.

2 – Decision Support technologies

In stock market portfolio management, the most common decision aid technologies used are known as fundamental and technical analysis techniques models to predict the price movement .of a given stock.

Fundamental analysis is made at (i) the company level by examining financial data, management team ethics and competition. (ii) at the industry level mostly with an analysis of supply and demand forces for the products and services offered and (iii) at the national and international economy level .Fundamental analysis might focus on economic data to assess the current and future growth indicators. To forecast future stock prices, fundamental analysis combines company, industry, and national/international analysis to derive a fair value. If a fair value is not equal to the current stock price, fundamental analysts believe that the stock is either over or under valued and the market price will ultimately gravitate towards that fair value.

Technical analysis is a method of evaluating portfolio securities by analyzing statistics generated by market activity, past prices, and volume. It looks at peaks, bottoms, trends, patterns, and other technical factors that are affecting a stock's price as it is highly dependent on historical data, technical analysis is more effective when the patterns are repetitive in a data rich environment, a condition that is critically lacking in extreme situations.

There is a continuing debate whether technical analysis would be more effective if combined with fundamental analysis. Technical analysis believers consider that fundamental analysis is already incorporated in their approach; thus they claim it is the more dominant of the two. Fundamentalists ,on the other hand, by believing that prices do not accurately reflect all available information used in technical analysis, look to capitalize on perceived price discrepancies. In this paper we question the pertinence of that debate, focusing more on a way to design a 'step by step strategy' to proactively avoid adverse effects of the extreme situations while capitalising on the current more predictable situations in between.

3- Portfolio Strategy formulation as a building blocks puzzle resolution process.

In our prior work we have taken the stock ELAN (ELN) as an interesting illustration to support our argumentation. ELAN Corporation is "a leading worldwide specialty pharmaceutical company, representative of the Med Drug Industry that focuses on the discovery, development and marketing of therapeutic products and services in neurology, acute care and pain management and on the development and commercialization of products using its extensive range of proprietary drug delivery technologies…" ELAN's stock constitutes a challenging example of extreme behaviour, as it presents a high volatility price movement closely linked to the unpredictable successes and failures surrounding an imposed multi phase medication approval process. The various phases predetermined with FDA are closely followed by investors, and have a major impact on stock prices at the time of announcements. There is even a possibility that a medication once on the market can be recalled pending further trials, as has happened for this company in the past.. Potential consequences of negative statements by the company, such as those concerning slower than expected progression toward commercialization, or a forced withdrawal of a product from the market are often followed by legal class action launched by 'abused' investors! Those are only some of the context sensitive input explaining the sudden and sometimes extreme drops or rises in ELN's stock price as illustrated in Figure 1:

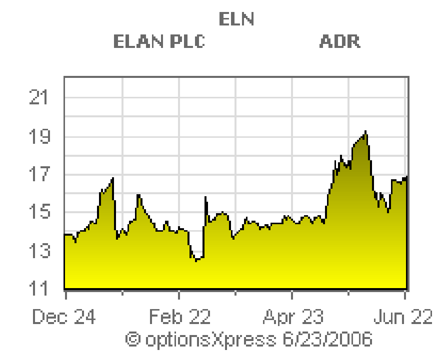

Figure 1 Six months ELN's price movement

According to LONDON (MarketWatch) – "Irish pharmaceutical Elan Corp. said Friday that its multiple sclerosis treatment, Tysabri, will return to the market on July.l. Tysabri was recalled in February 2005, after just a few months on the market, when it was discovered that three users had developed PML, an illness generally only seen in people whose immune systems' are severely compromised".

This announcement exemplifies a potential trigger for price movement .Our goal is to identify a strategy that requires a minimum investment with a minimum risk level while at the same time ensuring maximum positive reward even in extreme situations . We should notice that this goal statement is somehow in contradiction with the principle that mitigates quality and risk; namely that *'higher the risk higher the return'* and the reverse.

In this article; we propose a "step by step" market neutral approach described hereafter as a comprehensive "2 x 3" factorial experimental design. It comprises a Factor 1 with two levels: Stocks and Covered Calls strategies components that favour an up-movement (Bull market) and a Factor 2 with three levels (no protection, long PUT and short CFD) that is related to strategies protect the possible down movement of the stock. (Bear market). The resulting strategy scenarios are summarised in Table 1:

Table 1: Strategy scenarios formulation.

Bear \ Bull	**Stock**	**Covered Call o**
No protection	Stock only (cell 1,1)	CC strategy (cell 1,2)
Put (long)	Protective PUT (cell 2,1)	Neutral with PUT (cell 2,2)
CFD (short)	Neutral zero gain (cell 3,1)	Neutral with a CFD (cell 3,2)

Bull and Bear dual considerations are the basis to formulate "Market neutral" trading strategies that are widely used by hedge funds firms. A trader goes long with certain instruments while shorting others in such a way that his portfolio has little "net exposure" to broad or extreme stock market moves. Hereafter we discuss each of the strategies scenarios identified in Table 1

Step 1 Testing the Bull strategy levels: Cells 1.1 and 1.2

Cell 1.1 of Table 1 represents an acquisition of stock to become part of a portfolio .at today's value of 16.67 US$. . Figure 2 shows the corresponding results.

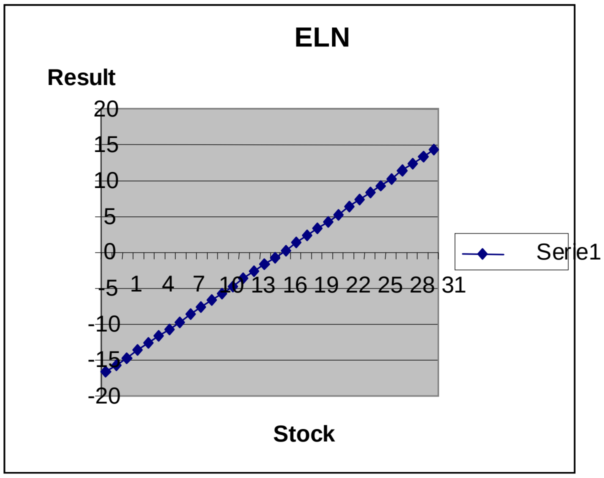

Figure 2 Stock only strategy

As shown we will experience losses when the stock value moves below the price value of acquisition. Also an investment of $16.67 is required. For 1000 shares this represents $16,670. Brokerage firms in Canada typically require a minimum of 30% of the stock's value, thus a margin deposit of about $5000 is required from the investor, leaving a large possibility for losses. .This risk justifies the strategy of cell 1.2

Cell 1.2 proposes a strategy that requires less cash injection than that of Cell 1.1.It consists of adding the writing of a Call to the stock-holding strategy of Cell 1.1, that is, selling someone a time-limited right to buy the stock for a given price, (called the strike price), in return for an up-front "premium" that the seller keeps. Both seller and buyer hope to profit from subsequent variations in the market price of the call. To illustrate such contract we selected as an example is a CALL' Jan 17.5, 2008'. This means that we sold 'the right, not an obligation, to purchase the stock' ELN for $17.50 at any time from now till Jan 2008. Certainly the call buyer will not want to exercise the right he has purchased if the stock remains below 17.5, preferring to let the right expire and forfeiting the premium he has paid the seller. Buying a stock and selling a call is called a 'Covered Call' strategy. The figure 3 indicates the result with that strategy for a range of the values of the underlined stock.

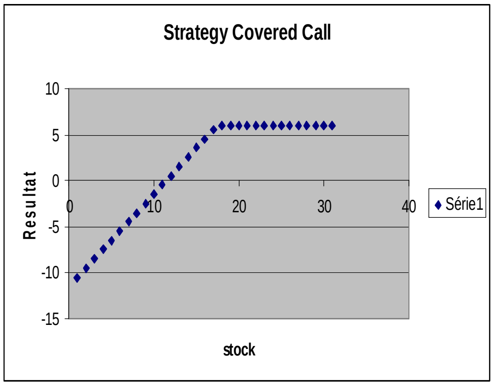

Figure:3 Covered Call strategy

Here the cash investment is reduced by 5.2 $ per stock that represents the premium received in advance from the Call sell. Also we note the two limits: on one side the maximum net losses that can occur of $11.47, as opposed to $16.67 previously, and on the other side, a profit that cannot exceed a maximum of $6.1.

As the value of ELN went below 3 $ in the past, a protection is indeed required to avoid losses. This is made possible by combining the Factor 1 and of Factor 2 levels to formulate new strategies

Step 2 testing the 'Bear' strategy' level with a PUT: Cells 2.1 and 2.2

Cell 2.2 ads a derived instrument PUT for protection often called a 'protective PUT' strategy. A PUT represents a contract giving the buyer the right, but not the obligation, to sell a stock, here ELN, at a certain price (strike) before a given date. Here we are proposing a standard strike price of 12.5 to ensure a minimum loss whatever the drop of the stock below that value. Typically the protection should in theory be of approximately of 11.47$, the cutover point, but this value is not available as a standard strike value in the chain of options. (Figure 4)

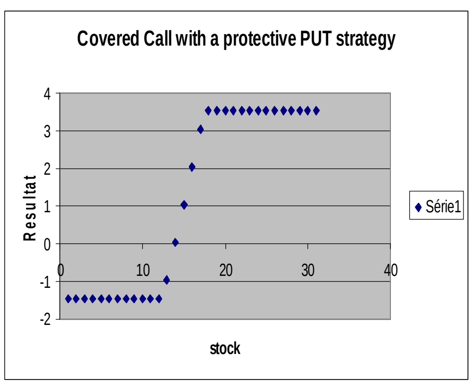

Figure 4 CC plus protective PUT strategy

The result with a PUT Jan 12.5, 08 shows that the protection is improved with a maximum loss of (1.47 $); however at the cost of a more limited profit which is now reduced to 3.53 from 6.1 $ in the previous strategy scenario due mainly to the prime paid for the PUT.

There are many other possibilities such as partial protection in time using different strike prices or varying expiration dates.

Step 3 Testing the Bear strategy levels with a CFD: Cell 3.2

How can we ensure a complete protection for a whole period till Jan 2008, for a lower cost without compromising the return? A new comer to the family instruments, known as CFD (Contract for Difference), has made its appearance in North America, and offers a solution toward that challenging goal. A CFD is a contract for a value equal to the value of the underlined stock thus having an appearance of a derived instrument. Very popular in Europe it has a much better margin accommodations than with the corresponding stock. Here we will exploit this alternative protective strategy by posting a sale or shorting of a CFD for ELN that we name ELN_ CFD for a value of 12 for example. In other words as soon as the stock ELN hits this entry condition the sale of the CFD at $12 is executed It should be noticed that this arbitrary value of $12 is closer to the cutover point of $11.47 than $12.5, the strike value used for the protective PUT. . In order to limit losses in a predetermined and proactive way we will accompany each CFD order with a classical STOP loss order. .For the sake of illustration and further discussion we have represented the result with a CFD posted at 12 along with its (i) LIMIT set to 0 to make sure the profit even in a crash (bankrupt) situation and (ii) a STOP order set initially at 12.5 , both as an alternative to the protective PUT.

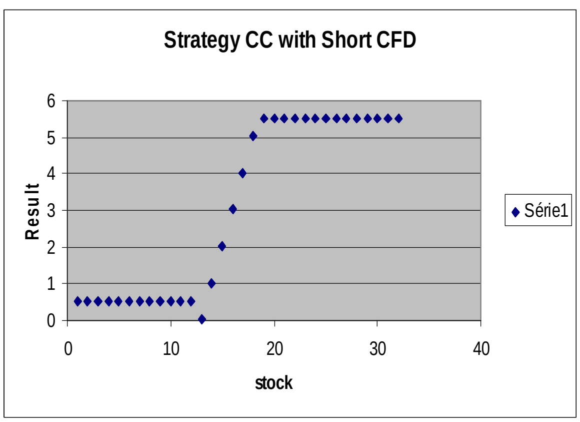

Figure 5 CC protective strategy using a CFD

The graph shows that with well-chosen parameters for entry and exit conditions (i.e.: LIMIT and STOP as per the above) the goal of ‘no losses' and high positive return are met. This appears to be a more efficient and better controlled strategy than the protective strategy using a PUT.

In many ways this strategy’s results challenge the ‘no arbitrage’ "clause" that is that guaranteed profits cannot exist without risk . There are therefore some possible explanations or caveats that should be addressed before concluding.

4 – Experimentation

We have prepared a simulation of the results over a period up to the horizon set by the option expiration date. i.e.; January 2008 .The simulation included stock market input either in the form of past data or a series of tests sets created at random which clearly expose the proposed portfolio strategy (cell 3.2) to some extreme stress test conditions

4.1 simulations of scenarios

We have taken an assumption drawn from Newtonian physics that the stock's – price – will continue to move in the same direction until it meets an opposing force. In stock market terms for ELN this means that an announcement of some important news as the extreme event creates a situation that have enough strength to deflect, or amplify the direction of the current trend. The stock price movement has three choices – not two as often considered, it can move sideways, it can move up, or it can move down

In either scenarios there are probabilities based typically on statistics or informed guesswork for each of the directions. We could even imagine as it is pertinent here a more refined scenario leaving a possibility for a unexpected high intensity up movement and a 'crash scenario' .Based on past data we have presented on figure 6 a diagram that set at 70% the probability the sideway move with an –upper trend ,and a 30% probability for the up and down possibilities. :

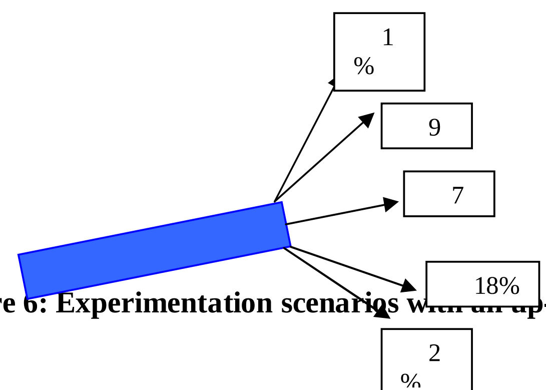

Figure 6: Experimentation scenarios with an up-trend

Within the 30% left we have set at 10% the up move with a 1% extreme situation and at 20% the down movement with a 2% change of an extreme crash situation. This discussion leaves a lot of possibilities of imaginative and creative scenarios and tests that range from no to most extremes.

4.2 The critical entry and exit conditions

Deciding how to determine the entry and exit portfolio conditions is critical to ensure synchronisation between the stock movement and the strategy. What stock to acquire, at what moment, what are the striking prices of the derived instruments and for what duration? are some of the questions to be answered? On one side this might be seen as a pure algorithmic exercise that should take into consideration the probabilities discussed before; on the other hand, it is an issue related to investor's preferences and risk profile. In fact emotional responses combined with behavioural biases and cognitive limitations are hardly the best means by which to make selling (or buying) decisions. For that reason in our simulation we assume a risk neutral strategy that is more compatible with a risk neutral investor's profile.

Setting the STOP

While many trading platforms have their own techniques for executing entry or exit conditions automatically few incorporate parameters and a certain degree of intelligence .to determine optimal trading momentum. One of the most sophisticated is the Momentum –Based Trailing STOP. It consists of a stop-loss order that is adjusted as a percentage to fluctuations in the market price. The investor is then "guaranteed" to know the exact maximum profit or loss of his entry or exit decision. Deciding what constitutes appropriate profits (or acceptable losses) is the major aspect linked to individual differences as discussed in the introduction. Setting the trailing-stop percentage can be done using a relatively vague approach (which is closer to emotion) rather than precise precepts but in theory a technical and fundamental analysis could help For instance when a stock begins to exhibit a P/E ratio that is higher than its historical P/E and above its forward projected growth rate, the trailing stops are to be tightened to a smaller percentage - the stock's apparent state of being overvalued may indicate a reduced likelihood of additional realized profits. For options, comparing historical and implied volatility is the best entry and exit indicator. Momentum is notoriously immune to technical analysis and thus it is very compatible with the case of extreme events. While the momentum-based stop-loss technique described above is undeniably appealing for its potential for massive ongoing profits, some investors, mostly risk averse, prefer a more disciplined approach suited for a more orderly market the "parabolic stop and reverse (SAR)". This technique provides stop-loss levels for both sides of the market, moving incrementally each day with changes in price. On that basis the rule that prevails within the DSS should consist of establishing the trend first and then trading with Parabolic SAR in the direction of the trend. If the trend is up, buy a CFD when the indicator moves below the price. If the trend is down, sell the CFD when the indicator moves above the price. The exact formula is quite complex and beyond the scope of this article , but interpretation is relatively straightforward if expressed in terms of STOP and LIMIT firing conditions .At the beginning of the move, the Parabolic SAR will provide a greater cushion between the price and the trailing stop. As the move gets underway, the distance between the price and the indicator will shrink, thus making for a tighter stop-loss as the price moves in a favourable direction.

There are two variables: the step and the maximum step. The higher the step is set, the more sensitive the indicator will be to price changes. If the step is set too high, the indicator will fluctuate above and below the price too often, making interpretation difficult. The maximum step controls the adjustment of the SAR as the price moves.

Setting the LIMIT

We are proposing an intuitively comprehensive One Triggers Other' (OTO) orders as an interesting concept for setting the limits on entry and exit conditions within the simulation.

An OTO order allows entering an initial order and placing a second order contingent upon the fill of the first. For example, this would allow placing a short CFD order and at the same time stage a limit order that takes into account the profit (or losses) made. We should notice that putting the LIMIT at zero for a CFD (an extreme CRASH situation) as per figure 5 is not very rational as such an extreme has a very unlikely occurrence and therefore it compromises many profit opportunities in between. OTO is therefore a better and more dynamic LIMIT mechanism. In practical terms the incremental successes are used to monitor the risk dependant of individual preferences. .

5 - DSS architecture and results to date

The current DSS's prototype was developed as an Excel model based mechanism that, for research purposes, is coupled in transparency with the simulation model. For every input profile the system generates the return figure as well the details that contributes to it. More specifically the DSS comprises (i) an entry module with the initial STOP and LIMIT conditions (ii) a processor with dynamic mechanisms for firing and stopping CFD orders and (iii) an output report indicating among others % return with or without the use of margin (see appendix). The random simulation mechanism uses the Excel's RandBetween combined with some ALEA function parameters to impact on the volatility and consequently to generate either stable , medium or extreme cases . The results that are discussed hereafter are based on the trailing STOP mechanism equivalent to SAR combined with OTO for triggering LIMIT conditions. Once the parameters are set the approach, if desired, is totally autonomous, without any human intervention.

The non diversified portfolio composed only of ELAN and associated derived instruments and CFD's was submitted to historical data as one scenario, as well as a set of random based scenarios ranging from no to most extremes ., The parameters used for setting the entry end exit conditions were

- *The % used as STEP for the trailing stop*. We have found that STEP that is inversely linked to the volatility produced the highest returns.

- The % of profits (or losses) used in the OTO for setting new limits. We have so far found that an adjustment of the STOP-LIMIT by a 50% of profits (0%

for losses) produces better results than a 100% adjustment. More specifically to avoid costly back and forth buying and selling ("churning") due to the stock price fluctuating near a steady value the new entry conditions amplify the STEP by a portion of the profits.

- Discretionary use of Long and Short CFD's. We had found that a long CFD even though not discussed in the factorial design has merit equivalent to the short CFD used as a Bear market protection as well as a Long CFD's amplify the return opportunities for a Bull market

The sensitivity to parameters appeared very material and thus required a systematic investigation. For instance the measurement system part of the experimental design captures the contribution of Long and Short CFD's, the transactions costs as well as a calculated return with or without use of a margin. Compliance with margin requirements is also ensured.

6 -Conclusion:

We have transformed a decision situation initially characterised by an acute lack of structure into a manageable solution that is supported by an experimental factorial design. In that sense it was programmable and included as part of the investor's client side controllable DSS technology as opposed to the limited mechanisms offered by some brokers. .More specifically the approach consisted of assembling building blocks, with each of them addressing the specific aspects of the initially "ill structured" decision process. At the end of the development the decision task was reduced to a suggestive DSS with the possibility of adaptation to the investors "individual" differences. The critical aspect to such goal appeared to be reduced to the entry and exit conditions that are limited to designing an intelligent and dynamic STOP and LIMIT mechanisms. This was accomplished using a SAR type of trailing stop combined with an OTO (One Trigger Other) mechanism that was applied to the CFD. The results obtained in a simulation study, produced surprisingly high returns that seemed less related to the degree of extreme conditions than to the parameters used for the entry and exit mechanisms , While very encouraging the results leave a lot of room for further discussion concerning the apparent violation of economic market efficiency principles .

Stated in more economic terms, market neutral strategies tend to generate profits by providing liquidity to the market. They can lead to losses when they provide that liquidity at an inopportune time; however the latter condition never materialized with none of over one thousand test trials. One of the questioning could be related to transactions costs as they are often neglected in such studies. In fact per-transaction profits tend to be small, and they can be consumed entirely by transaction costs. Accordingly, most arbitrage is performed by institutions that have very low transaction costs and can make up for small profit margins by trading a large volume of transactions. In our trials, total transactions costs appeared relatively small as compared to the profits in almost every trial.

One of the explanations left for further exploration is related to market neutral strategies that are controversial because they tend to be highly leveraged, are inherently speculative, and therefore they are in conflict with the efficient market hypothesis. Proponents argue that the strategies can be safely implemented with suitable risk management which is clearly the method used within the proposed DSS architecture.

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Appendix DSS Architecture

INPUT

				S	param		
					2		
T	0		7	448		1000	16,43
G			6	448	2		
	-3,00	2,00				0,5000	0,5000

PROCESSING

_L	16,86	16,43	16,86	16,74	P
	17,11	*17,11*	*17,11*	*17,11*	*R*
	16,67	16,36	16,69	16,70	O
_S	16,67	16,67	16,67	16,67	C
	16,43	*16,43*	*16,43*	*16,43*	*E*
	0,00	0,00	0,00	0,00	
	16,67	16,99	16,99	18,01	S
STOP_L	0,0	0,00	0,00	0,00	S
STOP_S	0,0	0,00	0,00	0,00	I
ONG	17,11	0,00	0,00	17,11	N
der_L	16,86	0,00	0,00	0,00	G
HORT	0,00	0,00	0,00	0,00	
der_S	16,67	0,00	16,67	16,67	
al on S	0	0	0	0	
al _S	1	1	1	1	
ns S	0	0	0	0	
nal _L	0	0	0	1	
ignal _L	0	0	0	0	
ns L	0	0	0	0	
	16,67	16,99	16,99	18,01	
d	16,67	16,58	14,67	15,28	
gy	0,47	0,09	0,64	0,62	
	1,00	-1,00	-3,00	1,00	

OUTPUT

								gin)
23419,1	308,0	6055,29	-16670,00	0,00	5200,00	18312,35	159,65	478,96
3483,0	44,0							
19936,1	264,0							