Advanced Investment Strategy for Trading Major Currency Pairs

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Abstract

In this paper there is a description of one of the possible approaches to investing in the currency market, which is based on the statistical analysis of price movements of major currency pairs. It is the currency pairs EUR/USD, GBP/USD and USD/JPY which consist of major currencies of the world powers. For the analysis includes no fundamental information such as the rate of unemployment, sales, GDP, inflation, etc., and is thus a purely technical analysis, which is based on the actual price. The proposed investment strategy works with short-term investments, which have an average duration of several hours. The logic used strategy is based on the psychological reaction of investors to the previous trading session and their future expectations. To increase the effectiveness of strategies financial leverage is used. This type of investment requires precise compliance with the rules for risk management. Due to diversification, the proposed strategy is put into more currency pairs and achieves stable growth of capital. Due to the computationally intensive optimization problems genetic algorithms that can effectively deal with this type of task were used. The proposed investment portfolio is applied in the time period January 2010 to January 2012 and has been stable profitably.

Keywords: portfolio, currency, optimization, profit, investment strategy, genetic algorithm

Introduction

Advanced methods of analyses, modelling and simulation are currently implemented in the process of investment portfolios design by almost all major financial institutions. The primary goal is to find optimum of function, which maximizes the profit with limitations given by the volatility of the distribution of partial profits and losses, maximum draw-down, success rate of investment decisions, profit/risk ratio, and other indicators. The search of the optimum using standard algorithmic approaches becomes an almost unsolvable task, and requires the application of genetic algorithms based on the evolutionary process. Investment strategies using genetic algorithms, fuzzy logic, neural networks combined with the quantitative analysis can be regarded as advanced investment strategies (Bauer 1994; Dostál 2008).

The main goal of this paper is creation of an investment portfolio, which is implemented to trade with world currencies. This market is called ForEx. The portfolio is created by one advanced investment strategy used for three different currency pairs. The significant step in process of proposing investment portfolio is determination enough of the appropriate financial instruments in terms of volatility and liquidity. Request of volatility and liquidity is given because of the implementation investment decisions in short periods of time lasting for about several hours. As appropriate financial instruments are selected currency pairs EUR/USD, GBP/USD and USD/JPY, which are created from currencies of largest world economies. Daily price change of selected financial instruments is very small and it is necessary to increase efficiency of realized investment decision by using of financial leverage.

The financial leverage allows the investor to realize the a bigger investment position then allowed by his/her financial capital. It can radically increase the efficiency of a realized investment decision, because brokers allow using financial leverage from 1:2 to 1:400, but it is necessary to observe strict risk management rules. Unhedged positions are exposed to loss in the size of the investor's financial capital (Miner 2008; Williams 1999; Ruey 2001).

Materials and methods

Advanced investment strategies

Implementation of advanced methods of analyses, modelling and simulation in investment decision-making can develop strategy for financial capital management in large financial institutions. With these strategies, it is possible to manage financial capital in millions up to hundreds of millions of Euros.
These strategies can be divided into two basic categories:

- Trend following strategies
- Non-trend following strategies

An advanced investment strategy can be defined as a set of rules for the implementation of particular investment decisions and a set of rules for risk management and reinvestment (Altucher 2004).

The proposed strategy requires trend Following in order to achieve profit and it's called "trend following strategies".

Design process of advanced investment strategy

The most important part of the advanced investment strategy design process is the incorporation of the a priori knowledge of an expert in financial decision-making. A large number of options exist, types and sorts of a priori knowledge in the process of investment, and it is up to the expert which one of the options he/she prefers and masters. An important part of the selected a priori knowledge is its ability to quantify into a form that can be processed by a computer. The design process of the advanced investment strategy includes methods of analyses, modelling and simulation, which are connected to a quantified form of

a priori knowledge and search for optimal parameters of the risk management strategy (Kantardzic 2002).

A priory knowledge of advanced investment strategy

An expert in financial decision-making transfers information concerning the possibility of investing in financial markets on the basis of breaks specific price levels. The determination of significant price levels is described by several parameters that are defined by the financial expert based on subjective information derived from experience.

The primary feature is the implementation of investment decisions in a short time interval not exceeding several hours. Due to this relatively short time intervals, it is necessary to increase the efficiency of the performed investment transactions by using a financial leverage. With this tool, it is possible to increase the efficiency of the selected strategy in the order of 2 to 400 times, depending on the size of used leverage and the volume of financial capital that is available to the investor and average monthly return can be in the order of units of percent (Dostál 2008; Rejnuš 2008; Jílek 2005).

Determination of significant price levels is the key of this investment approach, and requires the most effort for optimization. Due to the intraday approach, it is necessary to search every day for new specific price levels applicable for the particular day before starting the trading session. The primary parameter for the search of specific price level is the time. Significant price levels are generated as the maximum and minimum in the selected time period. The optimization process determines specific time periods during which significant price levels are generated every day.

The basic structural element of the selected strategy rests on the assumption of strict placement of protective orders that will automatically close an investment position in loss. Concurrently with the order to limit maximum losses an order, which defines the amount of open profit when positions should be closed, is implemented.

Method of optimization

The priori knowledge of an expert in financial decision-making does not necessarily need to contain the optimal setting of values for the definition of the maximum loss and profit and optimal time intervals for the definition of significant price levels. As the search for the optima of these parameters is rather time consuming, it is necessary to use computer technology in combination with sophisticated algorithms. Standard algorithms for finding relationships in data have become insufficient and inappropriate for this type of tasks.

Genetic algorithm

A genetic algorithm is used when the exact task solutions from practice would take an endlessly long time by systematic searching. They enable the solving of difficult problems very elegantly. The considerable advantage of genetic algorithms is the ability to solve the tasks abstractedly on the character of data

(linear, nonlinear, leap), cohesion of individual parts of system or existence of feedback. Genetic algorithms are generally used for optimizations. For economical tasks it is typical to use for example for the solution of decision problems to minimize the costs or maximization of turnovers (profit). Practical use can be seen at the solving at the task problems like cluster analysis, approximation of economic curve, prediction etc.

The most implementations of genetic algorithms work with the conceptions used in genetics, for example the conception chromosome. In a human genetics is the chromosome defined as a functional complex of heritable record of genetic information in a cell, capable of independent function at information transfer. In a genetic algorithm the chromosome is represented by ones and zeros, i.e. binary representation. In this case chromosomes are represented by a binary chain, for example 01100110. For the manipulation with chromosomes are used operators for selections, crossover and mutation. The important standpoint, which directly or indirectly asserts at the choice at least one parent, is its fitness.

A proper solution of a task in optimization is to use a genetic algorithm that will bring the final solution when searching of optimum in real time. The principle of these algorithms is based on evolution, when only the "strong" individuals (solutions) can advance to the next step of development (iteration step), and, subsequently, their crossing, mutation and reproduction is carried out. In this manner an optimum solution in the search for the above variables can be found (Bauer 1994; Budík and Doskočil 2011).

In this paper the genetic algorithm search for optimal values of following parameters is:

- Start time for the selection of significant price levels
- End time for the selection of significant price levels
- Price level for closing open position in loss
- Price level for closing open position in profit

Proposed model of advanced investment strategy

Description of investment strategy design

The proposed model of an advanced investment strategy works on the basis of a quantitative analysis of price movements of selected financial instruments of the foreign exchange market. The primary parameter observed is the increase in volatility thought trading day in connection with a specific time period. This piece of priori information is inserted into the design process of the investment strategy by the expert in financial decision-making, and is further tested and optimized using advanced methods of analyses.

The increase in volatility of financial instruments in specific time periods is caused by periodic repetition of specific situations. These situations include the following:

- Opening of financial markets
- Closing of financial markets

- Announcement of fundamental news
- Responses to previous trend of trading sessions
- Responses to historic minima and maxima

A Priori Knowledge of the Expert for Financial Decision-Making

The a priori knowledge of the expert in financial decision-making in the proposed model is based on increased volatility of the foreign exchange market in the period of opening European financial markets. During the trading day at the foreign exchange market the volatility changes depending on the opening times of the world markets. Table 1 contains the time periods in which the respective markets are open. In the beginning of these periods an increase in volatility of selected financial instruments is expected.

Tab. 1: World markets opening hours (UTC + 1:00)

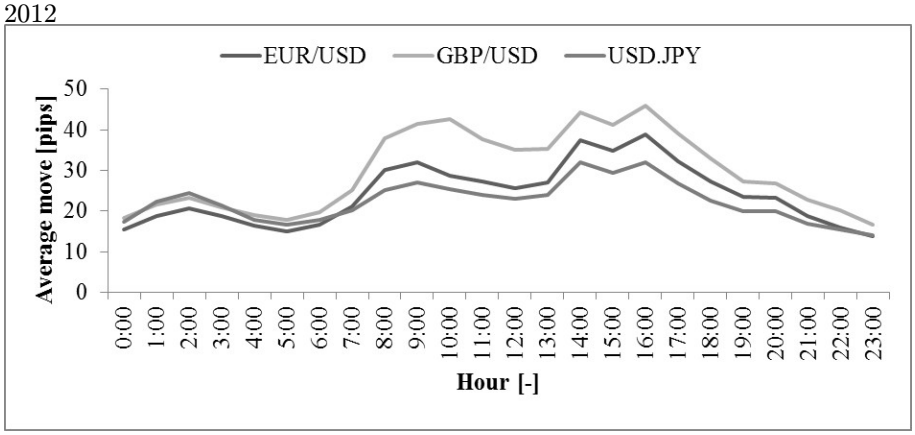
City	Time period
Tokyo	2 a.m. – 11 a.m.
London	9 a.m. – 6 p.m.
New York	2 p.m. – 11 p.m.
Sydney	11 p.m. – 8 a.m.

Source: www.forexfactory.com

An increase in the volatility of selected financial instruments is caused by the opening and closing of speculative positions of banks, funds and individual investors. Volatility is measured in accordance with the following formula:

where $Volatility$ = size of volatility for time period;
$Maximum$ = maximum price of time period;
$Minimum$ = minimum price of time period.

Fig. 1: Average price movements during a trading day for the period of 1999–2012



Source: own processing

Figure 1 shows the graphs of average values of the movements for each hour during the trading day for the following currency pairs: EUR/USD, GBP/USD and USD/JPY. Using graphical analysis it can be easily determined that in the time periods that correlate with the time intervals when world markets are opening, there is a tendency to increase the average movements thus increasing the volatility of the selected financial instruments.

Results

The output of the optimization process is a set of rules which generates the results for the period 2010–2012 presented in Table 2, where the values of total profits of the strategies, gross profits and gross losses, total number of investments, number of profitable and unprofitable investments and their percentage are shown. All of partial investment decisions are realized with 100 000 $. This reference size of investment amount is called "lot".

Tab. 2: Results of individual strategies in the period of Jan 2010 to Jan 2012

Indicator	EUR/USD Strategy	GBP/USD Strategy	USD/JPY Strategy
Total profit	17 913 $/lot	12 000 $/lot	6 589 $/lot
Gross profit	91 172 $/lot	32 100 $/lot	40 170 $/lot
Gross loss	-73 259 $/lot	-20 100 $/lot	-33 581 $/lot
No. of investments	534	509	407
Profitable investments	163	107	113
Unprofitable investments	371	402	294
Profitable investments	30.52%	21.02%	27.76%
Unprofitable investments	69.48%	78.98%	72.24%

Source: Own processing

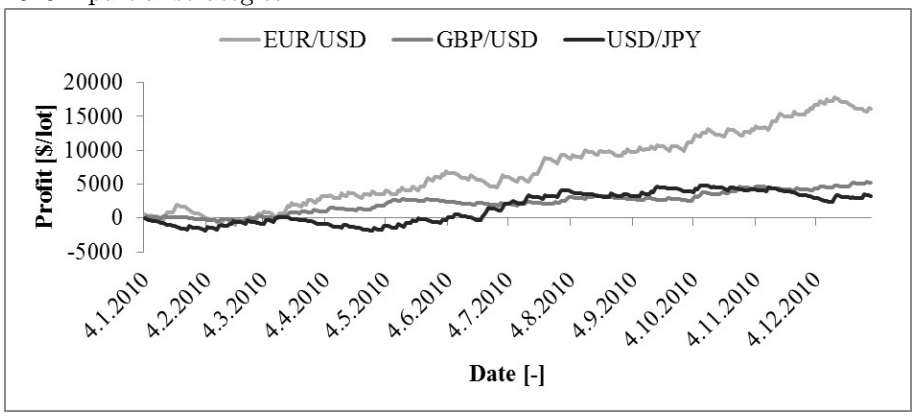
Tab. 3 shows total profits, gross profits and gross losses, total number of investments, number of profitable and unprofitable investments and their percentage. The results represent the sum of the three partial strategies listed in Table 2.

Tab. 3: Cumulative result of the proposed strategies for the period of Jan 2010 to Jan 2012

Indicator	EUR/USD + GBP/USD + USD/JPY
Total profit	36 502 $/lot
Gross profit	163 442 $/lot
Gross loss	-126 940 $/lot
No. of investments	1 450
Profitable investments	383
Unprofitable investments	1 067
Profitable investments	26.41%
Unprofitable investments	73.59%

Source: Own processing

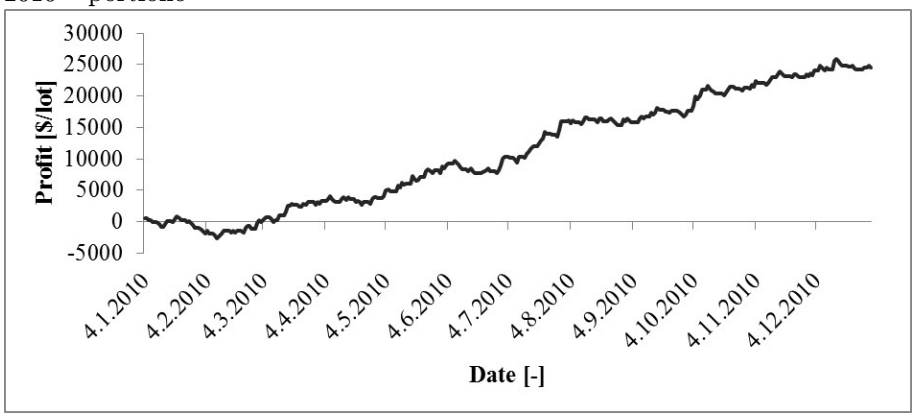
Fig. 2: Accumulation of profits and losses distribution for Jan 2010 to Dec 2010 – partial strategies



Source: own processing

Figure 2 shows a graphic representation of accumulation of profits and losses distribution of an investment portfolio consisting of the three above-mentioned investment strategies.

Fig. 3: Accumulation of profits and losses distribution for Jan 2010 to Dec 2010 – portfolio

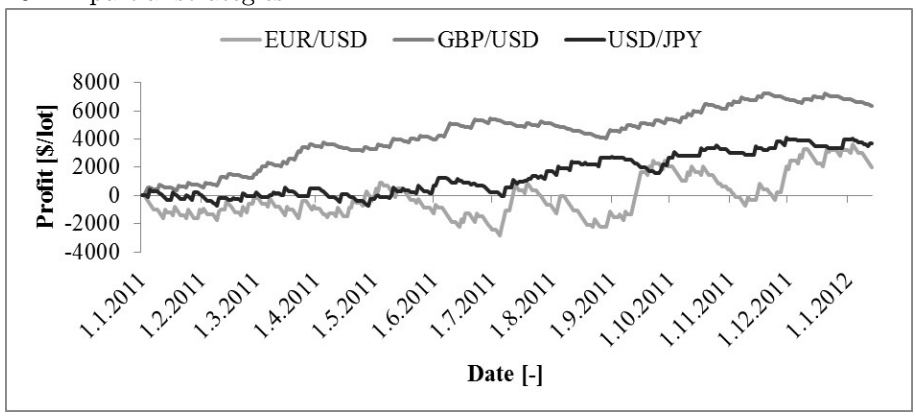


Source: Own processing

Advanced investment strategy model

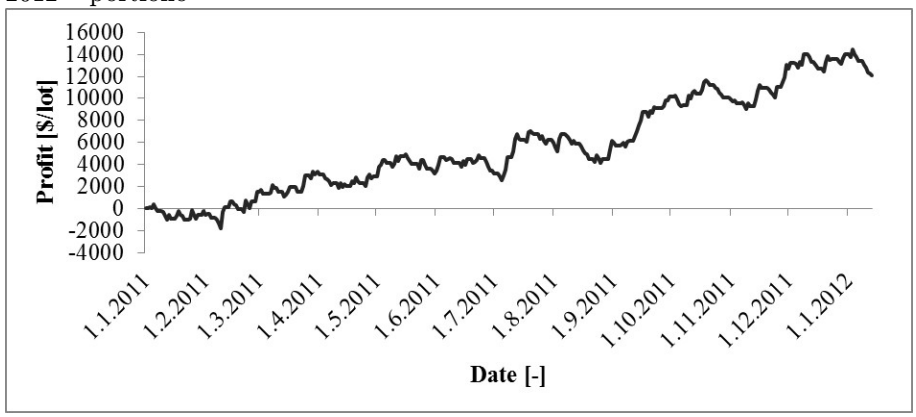
The model of the proposed advanced strategy is developed for three currency pairs made up of world currencies including EUR, USD, GBP and JPY. The choice of the selected financial instruments is based on high liquidity and the possibility of using trading orders 24 hours a day.

Fig. 4: Accumulation of profits and losses distribution for Jan 2011 to Jan 2012 – partial strategies



Source: Own processing

Fig. 5: Accumulation of profits and losses distribution for Jan 2011 to Jan 2012 – portfolio



Source: Own processing

The economic model uses significant price levels that are generated in the following time periods:

- EUR/USD 4:00 – 9:00
- GBP/USD 1:30 – 9:00
- USD/JPY 8:30 – 9:00

During these time intervals, significant price levels are detected as maximum and minimum prices for this period of time. Trade orders are placed at these price levels in such a manner that a buy entry order is placed at the maximum price, and a sell order is placed at the minimum price. Both orders are waiting for breakout of these price levels. The optimization process determined the

opposite value to the entry price as an appropriate placement of the order to close position in loss, i.e. when the buy order is activated (the maximum price in the selected time period is broken), the protective order is placed to the minimum price in the selected time period. When a sell order is activated, the principle is reversed and the protective order is placed at the maximum of the price achieved in the selected time period. The principle of placing a protective order is the same for all three currency pairs.

The placement of the order for profit-taking differs for each currency pair. Table 4 shows the limits for closing position in profit and in loss. These values were found by an optimization process.

Tab. 4: Optimal parameters for closing profit and loss making positions

Currency pair	Stop loss	Profit taking
EUR/USD	1 * (Max – Min)	3 * (Max – Min)
GBP/USD	1 * (Max – Min)	6 * (Max – Min)
USD/JPY	1 * (Max – Min)	5 * (Max – Min)

Source: Own processing

Discussion

Results show, that it's possible to successfully implement advanced investment strategy into the real market environment. Proposed advanced investment strategy, which is used for three different currency pairs, create an investment portfolio for trading major currency pairs. Each strategy used for different currency pairs has different value of parameters for closing open position in profit. These values are generated by an optimization process and it's necessary to re-optimize it for ensuring stability and profitability of a proposed portfolio.

Stability and profitability of investment strategies is a key issue, which is necessary to solve during the design process of the portfolio. The proposed investment strategy works with short time periods, which require specific elements for increasing stability and profitability than investment strategies, which work in a long time frame. Stability and profitability increasing can be achieved with more a sophisticated procedure of position opening process, position closing process in profit and in lose or implementation of additional filters for choosing investment opportunities with a higher probability of win.

The test of proposed portfolio was realized with a broker with no transaction cost. Brokers include their fees into the spread, which is difference between Ask and Bid price. All realized transaction work with Ask price for buy orders and Bid price for sell orders.

Conclusion

The use of advanced methods of analyses, modelling and simulation in the design of investment portfolios facilitates a more efficient processing of input data and their optimization in real time. The above-mentioned methods are used by most bank and investment institutions, unit trusts, hedge funds and other

institutions processing data for investment and analytical purposes. In the proposed model for the development and design of advanced investment strategies, genetic algorithms are used in the optimization process, when parameters are searched for in order to define the significant price levels. These price levels are used as a point of entry into an investment position. Another outcome of the optimization process is the determination of optimal parameters of the risk management process focusing on the price levels for closing position in profit and in loss. The economic model of investment strategy is based on the a priori knowledge of an expert in financial decision-making. The expert in financial decision-making enters to process of designing twice. In the beginning, when he/she implements the a priori knowledge into the creation of the model, and at the end of the process, when he/she validates the designed models. The principle of a priori knowledge is based on an increased volatility in specific time periods during day. The increase in volatility is a result of the opening of the world's markets, when the investors react to the previous trading day, significant historic minima and maxima, fundamental news and other factors affecting price movements.

The proposed economic model uses the time period in which the London Stock Exchange opens (9 a.m.). The optimization process determined time periods in which the relevant price levels were created. When these price levels are broken, a speculative position opens and the position is further controlled in accordance with the designed parameters of the optimization process. The proposed model uses strategies for the following currency pairs: EUR/USD, GBP/USD and USD/PY. Simultaneous application of all three strategies creates an investment portfolio that generated a total profit of 36 502 $/lot in the period from Jan 2010 to Jan 2012, with the probability of a successful trade of 26.41 %. This rate of successful trade may seem as low, but profit of each trade is much bigger then loses. The distribution of profits and losses of individual investment strategies shows a low value of the correlation coefficient, and, as a result, they are suitable for diversification.

Reference

ALTUCHER, J., 2004. *Trade Like a Hedge Fund: 20 Successful Uncorrelated Strategies & Techniques to Winning profits.* USA: Wiley. ISBN 978-0471484851.

BAUER, R., 1994. *Genetic Algorithms and Investment Strategies.* USA: Wiley. ISBN 978-0471576792.

BUDÍK, J. a R. DOSKOČIL, 2011. Využití programu Adaptrade při tvorbě investičního portfolia. *Trendy ekonomiky a managementu.* **5**(8), 11–18. ISSN 1802-8527.

DOSTÁL, P., 2008. *Pokročilé metody analýz a modelování v podnikatelství a veřejné správě (The Advanced Methods of Analyses and Simulation in Business and Public Service in Czech).* Brno: CERM. ISBN 978-80-7204-605-8.

FOREX FACTORY, [b.r.]. *Forex factory data source* [online]. ©2013 Forex Factory, Inc. [citováno 4. 1. 2013]. Dostupný z: http://www.forexfactory.com

JÍLEK, J., 2005. *Finanční a komoditní deriváty.* Praha: GRADA. ISBN 80-247-1099-4.

KANTARDZIC, M., 2002. *Data Mining: Concepts, Models, Methods, and Algorithms.* USA: Wiley-IEEE Press. ISBN 978-0-471-22852-3.

MINER, R., 2008. *High Probability Trading Strategies: Entry to Exit Tactics for the Forex, Futures, and Stock Markets.* USA: Wiley. ISBN 978-0-470-18166-9.

REJNUŠ, O., 2008. *Finanční trhy.* Ostrava: KEY Publishing. ISBN 978-80-87071-87- 8.

RUEY, S., 2001. *Analysis of Financial Time Series.* USA: Wiley-Interscience. ISBN 978-0471415442.

WILLIAMS, L., 1999. *Long-Term Secrets to Short-Term Trading.* USA: Wiley-Interscience. ISBN 0-471-29722-4.

Pokročilá investiční strategie pro obchodování hlavních měnových párů

V tomto příspěvku je popisován jeden z možných přístupů k investování na měnovém trhu, který vychází ze statistické analýzy cenových pohybů hlavních měnových párů. Jde o měnové páry EUR/USD, GBP/USD a USD/JPY, které jsou tvořeny měnami významných světových velmocí. Pro analýzu nejsou použity žádné fundamentální informace typu hodnoty nezaměstnanosti, prodeje, HDP, inflace atd. a jde tedy o čistě technickou analýzu. Navržená investiční strategie pracuje s krátkodobými investicemi, které mají průměrnou délku trvání několik hodin. Logika použité strategie vychází z psychologické reakce investorů na předešlé obchodní seance a jejich budoucí očekávání. Pro navýšení efektivity použité strategie je použita finanční páka. Tento typ investování vyžaduje precizní dodržení pravidel pro řízení rizika. Z důvodu diversifikace je navržená strategie aplikována na více měnových párech a je dosaženo stabilnějšího nárůstu kapitálu. Z důvodu výpočetně náročné optimalizační úlohy byly použity genetické algoritmy, které dokáží efektivně řešit právě tento typ úlohy. Navržené investiční portfolio je aplikováno v časovém úseku leden 2010 až leden 2012 a vykazuje dlouhodobě stabilní zisk.

Klíčová slova: portfolio, měna, optimalizace, zisk, investiční strategie, genetický algoritmus

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