УДК 336.764.2

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OPTION VALUATION

World option market is enlarging and this phenomenon is proved by statistical data: an amount of option contracts rose from 3.9 billion in 2002 to 9.28 billion in 2008 [1]. This corroborates increasing attention of new members of this market, especially individual investors, because dealing with options gives such facilities as: hedging of risks, increasing cost efficiency, getting higher percentage returns, getting less risk [2].

However, in order to make profitable and effective investment decisions it is essential to operate with accurate option prices. Sometimes lack of theoretical knowledge negatively influences on investor's ability to make a right decision concerning choosing the most appropriate option pricing model and calculate it. That is why the aim of the article is to assess application of existing option valuation models by means of comparative analysis in order to suggest alternative instruments of option valuation for individual investors.

There are three fundamental methodologies and approaches used to calculate an option's value in options analysis:

1. Closed-form models like the Black-Scholes model and its modifications such as the Generalized Black-Scholes model (GBM);
2. Monte Carlo path-dependent simulation methods;
3. Lattices (binomial, trinomial, quadranomial, and multinomial lattices) [3, p. 19].

Limited volume of the article does not allow scrutinizing in details all existing option pricing models, due to this fact only the most widespread models will be analysed.

Before analysing the new facilities of option valuation, simplifying the work of individual investors, it is essential to familiarise with classic option pricing models that are in the basis of option pricing software.

Binomial Option Pricing Model

Binomial (and trinomial) trees can be used to price many types of options, such as plain vanilla options, exotic options (like barrier options, digital options, Asian options) and others. It is possible because of mapping out price movements of the underlying security. Price movements are represented by a grid of equally spaced time steps, with a series of nodes at each step indicating the security's and the option's prices. The security can move up or down by a certain amount at each node, according to a prespecified probability. The price of the option is evaluated, and then discounted back to attain the price at the first node, representing time zero. For many of these trees, the European option price converges to the Black-Scholes price [4, p. 70 — 83]. Valuation of American options is done by estimating whether early exercise at each node in the tree is possible. The benefit of binomial (and trinomial) trees is that they can be used to value any type of option and are very easy to implement. The disadvantage of thus model is that the amount of increase or decrease of the security at each node is usually fixed, as well as the probability of an increase or a decrease. In these models, jumps in asset prices are not permitted [5, p. 707 — 712; 6, p. 205 — 209; 7, p. 80 — 83].

The binomial model assumes that the stock price follows the binomial process, meaning that it can take on only one of two values at the end of any defined period. When the time interval between each price change node is reduced to 1 month, or 1 day, the binomial assumption becomes more plausible and the solution to the binomial process becomes more complex (as is illustrated in Figure 1). The mathematical procedure used to solve the price tree shown in the figure is called the binomial pricing model, which solves for the value of the call today, P0, by working backward through each path shown in Fig. 1 [8, p. 868 — 869].

The primary drawback of the binomial pricing model is that it does not provide an analytical solution to the option's price that can be determined from a formula or hand-held calculator [3, p. 87 — 90; 9, p. 20 — 28; 10, p. 48 — 55; 11, p. 151 — 155]. It is a recursive calculation that generally requires about 30 to 50 time intervals to produce an option price similar to that found in other pricing models. However, the personal computer can easily be programmed to do the calculations [8, p. 869]. Under certain conditions the binomial model gives much more accurate option prices than does the Black-Scholes model described next.

The Black-Scholes Option-Pricing Model

The problem of using a mathematical formula to value an option has been studied extensively since the early 1960s, but the path-breaking work occurred in 1973 when Fisher Black and Myron Scholes published their option pricing model. The Black-Scholes option pricing model quickly became the standard used to evaluate option prices in the fledgling options markets developing on the Chicago Board Options Exchange (CBOE) and American Stock Exchange (AMEX) [8, p. 869]. It is thought to be the most popular option pricing model in the past 30 years, due to its simplicity, closed-form solution, and ease of implementation [4, p. 112]. Since its publication in 1973, significant improvements and extensions have been made to the model, which is used by most professional option traders [8, p. 869].

If binomial option pricing assumed that the stock's continuously compounded rate of returns follows a

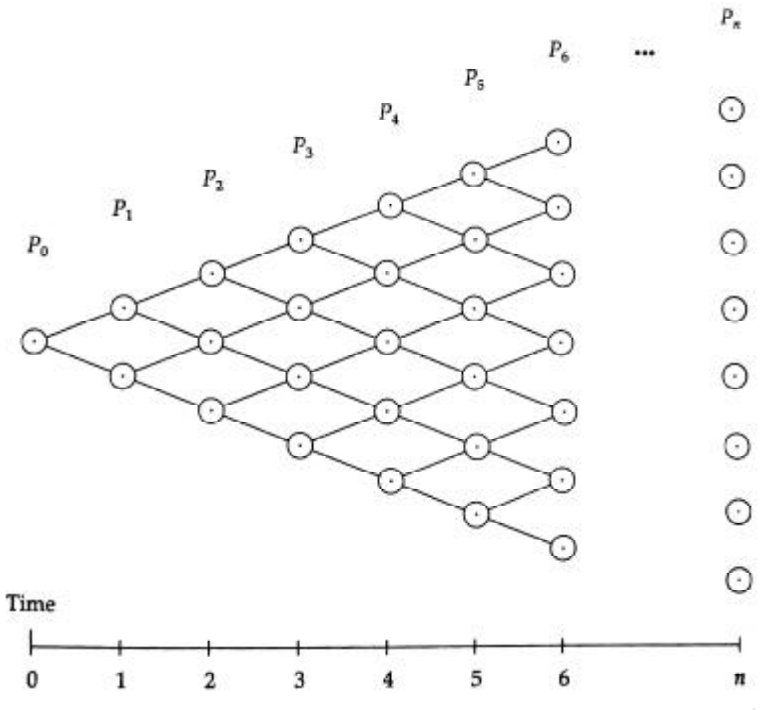

Fig. 1. The Binomial Process for Stock Prices [8, p. 868].

normal distribution, and the time interval between the nodes shown in Figure 1 approaches zero, then the binomial model reduces to the Black-Scholes option pricing model, given as the following equation:

$$C_0 = S_0 N(d_1) - Xe^{-rT} N(d_2) \qquad (1)$$

where

$$d_1 = \frac{\ln(S_0 / X) + (r + s^2 / 2)T}{s\sqrt{T}} \qquad (2)$$

$$d_2 = d_1 - s\sqrt{T} \qquad (3)$$

and where

C_0 = current call value

S_0 = current stock price

N(d) = the probability that a random draw from a standard normal distribution will

be less than d

X = exercise price

e = 2.71828, the base of the natural log function

r = risk-free interest rate (the annualized continuously compounded rate on a safe asset with the same maturity as the expiration of the option, which is to be distinguished from rf, the discrete period interest rate)

T = time to maturity of option, in years

ln = natural logarithm function

s = standard deviation of the annualized continuously compounded rate of return of the stock [5, p. 712 — 713].

It is known that a call can be created with a long position in a fractional share of stock and borrowing. The first term in Equation 1 shows the fractional amount of stock to hold. The value of $N(d_1)$, a cumulative probability, will lie between 0 and 1, and when multiplied by S, it shows the fractional share of stock required to replicate a call. In the second term, the value of $N(d_2)$ will lie between 0 and 1, and the term $X(e^{-rT})N(d_2)$ merely shows the amount, also a cumulative probability, of borrowing necessary to complete the arbitrage portfolio.

If the call is deep-in-money, both $N(d_1)$ and $N(d_2)$ will be near 1.0 and the call's value will approach the current stock price minus the discounted value of the exercise price, $S\text{-}Ee^{-rT}$. for an at-the-money option, $N(d_1)$ will be near .5. $N(d_1)$ also is called the hedge ratio of the option because it indicates the amount of stock necessary to create an arbitrage portfolio for the option. Conversely, its reciprocal, $1/N(d_1)$, indicates the number of option needed to hedge one share of stock [8, p. 870].

Finally, there are several assumptions that must be met to use the model of currency. Most importantly, the model applies only to European-style options on stocks that will not pay a dividend before the option expires. Minor modifications can be made to adjust for dividends for American-style calls, but using the model to price American-style puts can produce incorrect prices [5, p. 712 — 715; 4, p. 112 — 118; 6, p. 77 — 79].

To summarise, the big advantage of the Binomial model in comparison with the Black-Scholes model is that it can be used to accurately American options price.

This is because the Binomial model gives an opportunity to check the possibility of early exercise at every point of option's life (at every step of the binomial tree).The main drawback of the Binomial model is that it takes too much time to calculate option prices [10, p. 55 — 61; 11, p. 73 — 80; 7, p. 75 — 77; 12, p. 285 — 289; 13, p. 99 — 101, 115 — 121].

The benefit of the Black-Scholes model is that it gives an opportunity to investor to calculate variety of option prices in a very short time. The disadvantage of this model is that it cannot be used to accurately price options with an American-style exercise as it only calculates the option price at one point in time — at expiration. It does not consider the steps along the way where there could be the possibility of early exercise of an American option. Various improvements are made to the Black-Scholes price to enable it to approximate American option prices (e.g. the Fischer Black Pseudo-American method), but these only work well within certain limits and they do not really work well for puts. Nevertheless, these models are the basis of modern option valuation opportunities that are scrutinised next [14].

Options software is a computer program facilitating the technical analysis of available market data, which makes it widely preferred by options traders for taking informed decisions for buying or selling options. There are practically two types of options software available in the market, each type is designed for beginners and advanced options traders. Beginners' software includes teaching manuals and tips on creating investing portfolios, using investing techniques and formulating strategies. The software draws from the experience of professional options traders and offers various tools for profit maximization. The data is presented in an easy-to-understand manner and illustrated by charts and graphs. Software meant for advanced options traders tends to be more complex. It comprises professional level tools that facilitate a sound technical analysis of the available data [15].

Further the main facilities of modern software for option valuation will be viewed and made a conclusion, what are benefits and risks of its application for individual investors.

The Option Trader System

Let us assume a new investment proposal of the X-Trade Brokers' company — the Option Trader trading systems. This program is an educational tool enabling the proper understanding of options and the world of instruments characterized by an asymmetric risk profile. It also enables trade on 12 currency pairs and 4 commodities. The Option Trader trading system gives an opportunity of opening and managing an account in EUR/USD/CHF; a standard transaction size is 100 000 units of the base currency (0.1 of a contract). Technically, this is based on opening an option sub account, on which funds are transferred, within the current Contract for Brokerage Services between X-Trade Brokers and the Investor.

Fig. 2 shows the interface of working program Option Trader. It allows the investor to make a single order by choosing the option class (Vanilla, European digital), instrument (12 currency pairs and 4 commodities), strike price, option type, lots and expiry. Selecting the parameters of order, investor has a facility to see the graphical

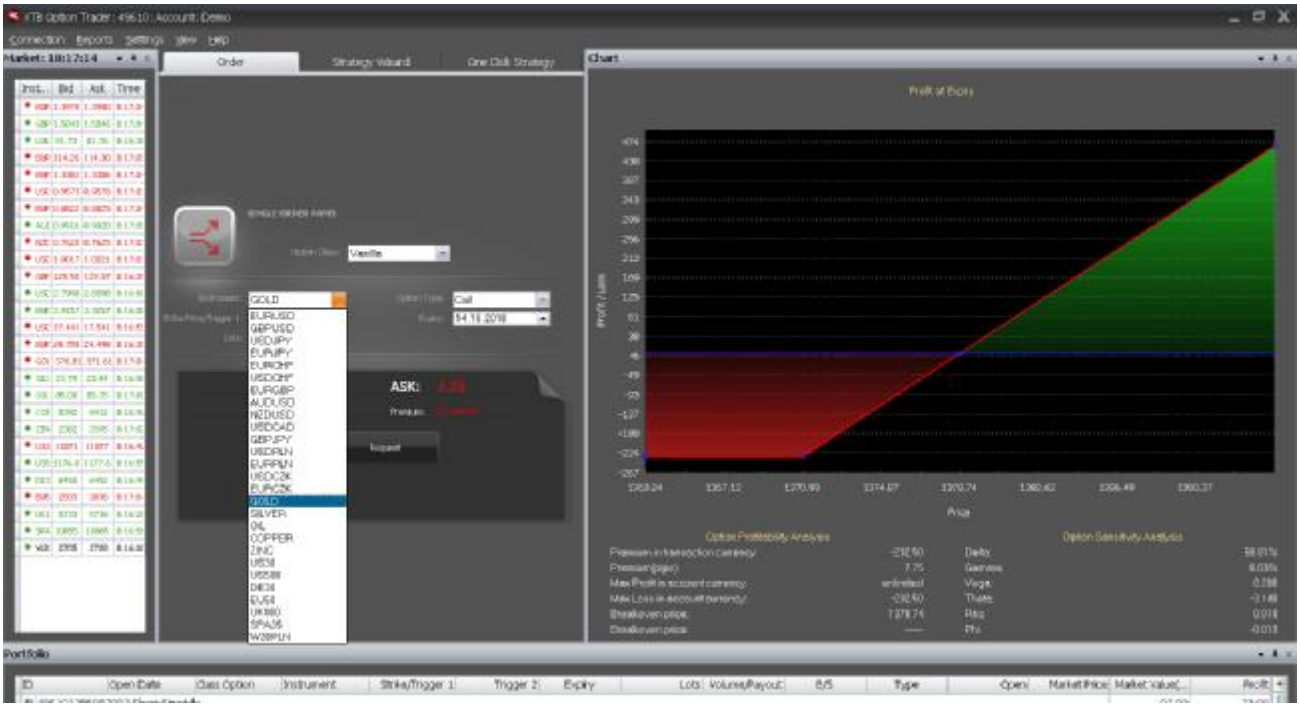

Fig. 2. XTB Option Trader: Demo Account, Making Order

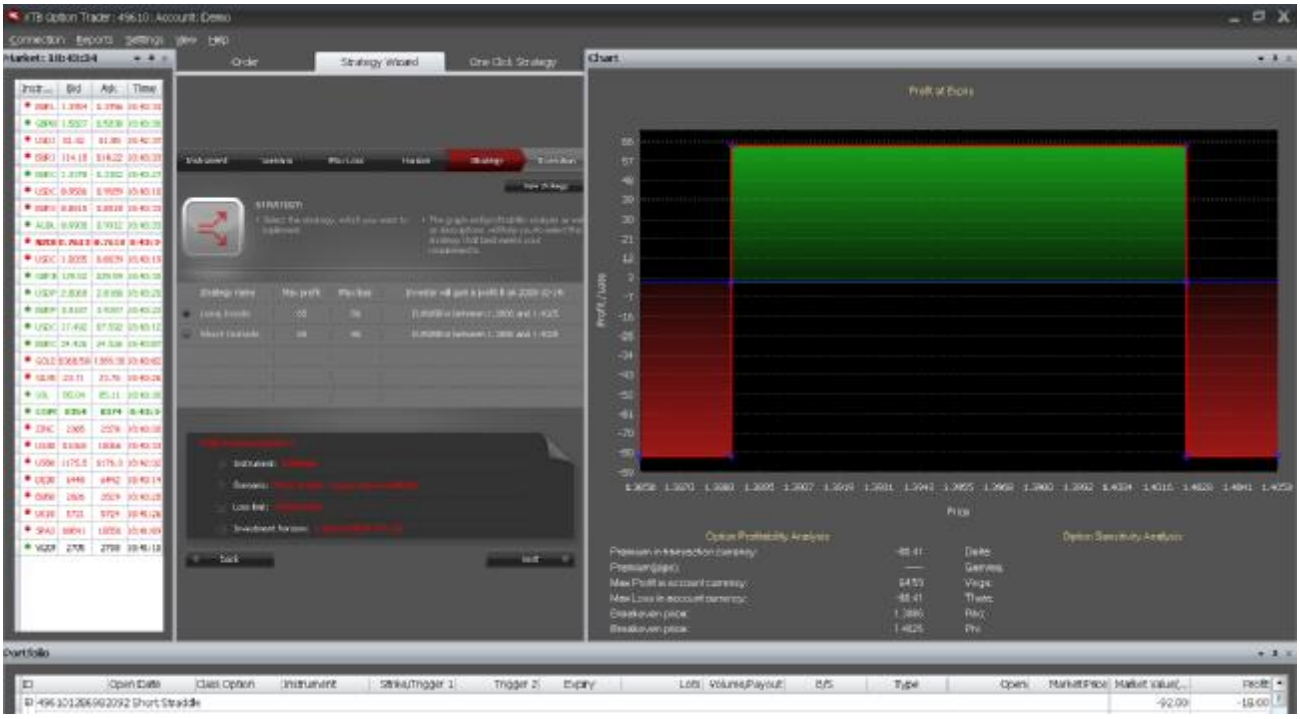

Fig. 3. XTB Option Trader: Demo Account, Making Strategy Wizard

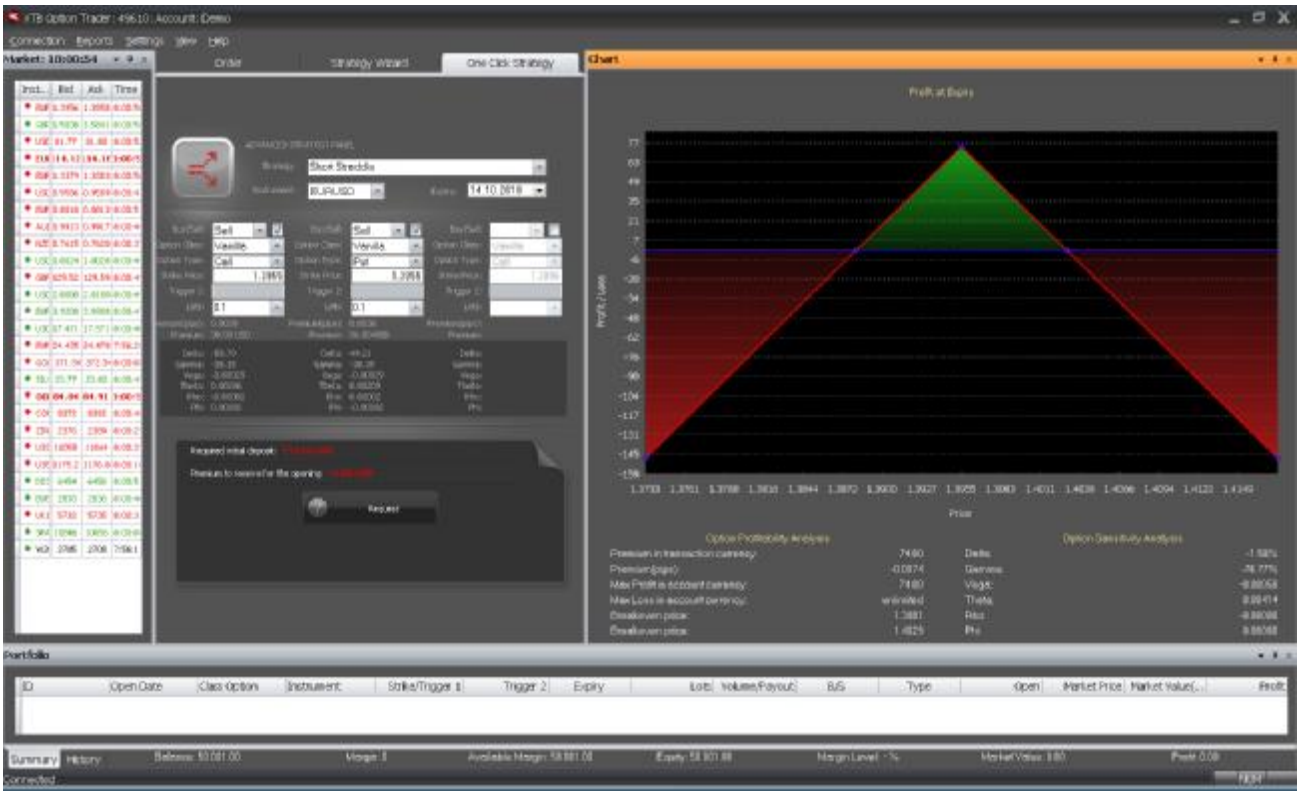

Fig. 4. XTB Option Trader: Demo Account, One Click Strategy: Short Straddle

interpretation of it and one's profit. Fig. 2 illustrates a graphic of Vanilla call option, the instrument chosen is gold, and expiration date is 14.10.2010, strike price — 1371.96.

Alongside it, Option Trader gives also an opportunity to make a Strategy Wizard by instrument, scenario (specification of how in your opinion price of the

underlying instrument will change), loss limits and investment horizon (Fig. 3). Apart from this, investor can use One Click Strategy, which is shown in Fig. 4 (here is Short Straddle strategy). There are 7 already made strategies, it is also possible to create new ones.

The Visual Options Analysis

The second program which was chosen as an example of software for option valuation is the Visual Options program, which lets investor make a thorough analysis of a trade before driving a bargain. This program provides powerful two and three-dimensional charts for analyzing option strategies. The 3D Chart can simultaneously show the relationship between stock price and expiration date versus profit/loss (Fig. 5). The 2D Chart is designed for dynamic analysis, complete with a "Slider" that lets investor vary parameters such as stock price, volatility, days until expiration, and interest rate as well as view the resulting effect on prices and profit/loss for one's portfolio. It is accessible to see how the trade will perform over a range of projected prices [16].

Moreover, this software has 32 of the most popular and effective options strategies built-in. The potential risks and return of a strategy may be visually evaluated. Whenever one change strategies or vary parameters, such as stock volatility or risk-free interest rate, the charts will be redrawn immediately. Besides, it is available to use one of three option pricing models: Black-Scholes, Binominal European and Binominal American.

Alongside it, free options data from CBOE (Chicago Board Options Exchange) for virtually all options listed on the CBOE, AMEX (American Stock Exchange), PHLX (Philadelphia Stock Exchange), PCX or PSE (Pacific Stock Exchange), and ISE (International Securities Exchange) are downloaded by this program. It is also available to build one's own or to modify built-in strategies in two ways: by changing theoretical terms or by selecting option parameters from lists of downloaded option quotes (option chains). Visual Options program also available investor to export the portfolio data and charts directly into Microsoft Excel. This allows easy sharing one's portfolio information with colleagues and partners [16].

From above mentioned, it is possible to make a conclusion that such software as XTB Option Trader and Visual Options Analysis simplify the work of individual investors and gives variety of facilities. However, for effective usage of these programs, investors do not have to be the side-line expert, but to have the main theoretical knowledge of option market.

Authentic option prices are of vital importance for making profitable investment decisions. However, the comparative analysis of the main option valuation methods proved the complexity of practical application of these models and their usage by individual investors. In order to facilitate the process of decision making for individual investors two types of modern software were proposed in this work.

There are some advantages of using options software such as the fact that it is easy to use as it involves a point and click interface, it offers tools to employ various strategic

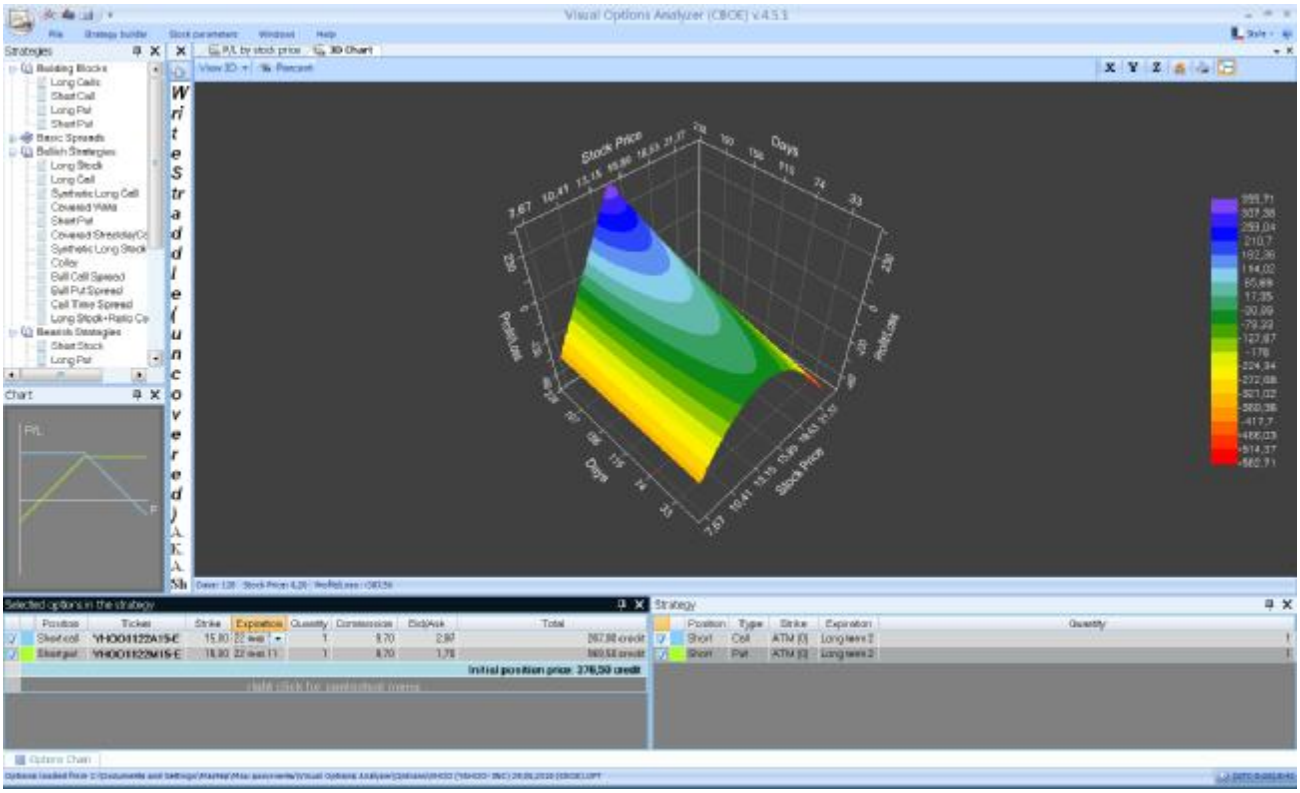

Fig. 5. Visual Options Analysis, Short Straddle strategy

models that are directed towards the maximization of profit and minimization of risks, the complex analysis of a huge database can be carried out in a short span of time. All these opportunities are relevant for Ukraine because its option market is developing (only since 2008).

In spite of all advantages of the option pricing software, investors have to pay attention to its drawbacks such as the fact that options software is expensive, beginners may not be able to fully use all the available features, overdependence on software is risky, as one tends to become overconfident. Nevertheless such software gives investors an opportunity to work regardless of time and location. Apart from this, it also gives new opportunities (especially for Ukrainian people) of extra earning to already working people and students. Such products give facilities to everyone who aspires to work on option market.

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Syniakova N. S. Option Valuation

This paper deals with the problem of option valuation for individual investors because of its complexity. Basing on the comparative analysis of the main option valuation models, their advantages and disadvantages were examined. In order to facilitate the decision making process for individual investors two types of modern option pricing software were proposed and described.

Key words: fund market, option, price, cost.

Синякова Н. С. Оцінка вартості опціонів

Стаття присвячена проблемі оцінки вартості опціонів приватними інвесторами у зв'язку з її складністю. Проведений порівняльний аналіз основних моделей ціноутворення опціонів, на підставі якого виявлено їх переваги та недоліки. З метою спрощення процесу прийняття інвестиційних рішень інвесторами запропоновано розглядати два типи сучасного програмного забезпечення для оцінки вартості опціонів.

Ключові слова: фондовий ринок, опціон, ціна, вартість.

Синякова Н. С. Оценка стоимости опционов

Эта работа посвящена проблеме оценки стоимости опционов частными инвесторами в виду ее сложности. Проведя сравнительный анализ основных моделей ценообразования опционов, были выявлены их преимущества и недостатки. С целью упрощения процесса принятия инвестиционных решений инвесторами предложено к рассмотрению два типа современного программного обеспечения для оценки стоимости опционов.

Ключевые слова: фондовый рынок, опцион, цена, стоимость.

Received by the editors: 14.09.2011
and final form in 25.11.2011