BTS® Derivatives Calculations Manual

Manual

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Index

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1.0 Derivatives Calculations

The BTS® financial library allows users to calculate theoretical (fair) prices, risk ratios or **Greeks** (Gamma, Delta, Rho, Theta, Vega), implied volatility and implied interest rate for derivative instruments on a real-time basis by subscribing to underlying and instrument prices. A specific tool: **Options Calculator** is also available for one-off calculation of the above-mentioned values for any individual option.

1.1 Formulas For Derivative Calculations

Formulas used in real-time and one-off calculations of forwards/futures and options abide by the definitions made available in the following books: **John C. Hull - Options, Futures, and Other Derivatives** (**Fifth Edition), 2003**, **Paul Wilmott** -**Quantitative Financ**e, **2001** and **Patrick Cusatis & Martin Thomas** - **Hedging Instruments & Risk Management, 2005**.

1.1.1 Black-Scholes

The Black-Scholes model has been developed in 1973 to value European options on stocks. Formulas used for call/put options on non-dividend-paying stocks are as follows (refer to chapters 12 and 14 of: **John C. Hull - Options, Futures, and Other Derivatives** (**Fifth Edition**)**, 2003**):

$$c = S_0 N(d_1) - Ke^{-rT} N(d_2)$$

$$p = Ke^{-rT} N(-d_2) - S_0 N(-d_1)$$

with:

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

where:

N(x) is the cumulative probability distribution function for a standardized normal distribution. In other words, it is the probability that a variable with a standard normal distribution will be less than x:

$$N(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{1}{2}z^2} dz \quad ;$$

c is the call price;

p is the put price;

S_0 is the stock price;

K is the strike price;

r is the continuously compounded risk-free rate;

σ is the stock price volatility:

T is the time to maturity of the option.

Risk ratios or ***Greeks*** are:

$$\gamma = \frac{N'(d_1)}{S_0 \sigma \sqrt{T}} \quad \text{with} \quad N'(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}$$

[**Gamma**]

$$\delta_c = N(d_1)$$ [**Delta** for call options]

$$\delta_p = N(d_1) - 1$$ [**Delta** for put options]

$$\theta_c = -\frac{S_0 N'(d_1)\sigma}{2\sqrt{T}} - rKe^{-rT} N(d_2)$$ [**Theta** for call options]

$$\theta_p = -\frac{S_0 N'(d_1)\sigma}{2\sqrt{T}} + rKe^{-rT} N(-d_2)$$ [**Theta** for put options]

$$rho_c = KTe^{-rT} N(d_2)$$ [**Rho** for call options]

$$rho_p = -KTe^{-rT} N(-d_2)$$ [**Rho** for put options]

$$\nu = S_0 \sqrt{T} N'(d_1)$$ [**Vega**]

For a dividend-paying stock with the assumption that the amount and timing of the dividends during the life of the option can be predicted with certainty, the Black-Scholes formula can be used provided that the stock price (spot) is reduced by the present value of all the dividends during the life of the option, the discounting being done from the ex-dividend dates at the risk-free rate. A dividend is counted as being during the life of the option only if its ex-dividend date occurs during the life of the option.

The Black-Scholes formulas for the prices of call/put options on stocks providing a dividend yield at rate **q** are as follows (refer to chapters 13 and 14 of: **John C. Hull - Options, Futures, and Other Derivatives -** (**Fifth Edition**)**, 2003** and chapter 10 of: **Paul Wilmott - Quantitative Finance, 2001**):

$$c = S_0 e^{-qT} N(d_1) - K e^{-rT} N(d_2)$$

$$p = K e^{-rT} N(-d_2) - S_0 e^{-qT} N(-d_1)$$

with:

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - q + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - q - \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

Risk ratios or ***Greeks*** are:

$$\gamma = \frac{N'(d_1) e^{-rT}}{F_0 \sigma \sqrt{T}}$$ [**Gamma**]

$$\delta_c = e^{-qT} N(d_1)$$ [**Delta** for call options]

$$\delta_p = e^{-qT}\left[N(d_1) - 1\right]$$ [**Delta** for put options]

$$\theta_c = -\frac{S_0 N^{'}(d_1)\sigma e^{-qT}}{2\sqrt{T}} + qS_0 N(d_1)e^{-qT} - rKe^{-rT}N(d_2)$$ [**Theta** for call options]

$$\theta_p = -\frac{S_0 N^{'}(d_1)\sigma e^{-qT}}{2\sqrt{T}} - qS_0 N(-d_1)e^{-qT} + rKe^{-rT}N(-d_2)$$ [**Theta** for put options]

$$rho_c = KTe^{-rT}N(d_2)$$ [**Rho** for call options]

$$rho_p = -KTe^{-rT}N(-d_2)$$ [**Rho** for put options]

$$\nu = S_0\sqrt{T}N^{'}(d_1)e^{-qT}$$ [**Vega**]

Since a stock index can be treated as a security paying a known dividend yield, the previous equations can be used to value options on a index with, obviously, $\mathbf{S_0}$ the value of index, $\boldsymbol{\sigma}$ the volatility of the index and **q** the average annualized dividend yield on the index during the life of the option (the calculation of **q** should include only dividends the ex-dividend date of which occurs during the life of the option).

1.1.2 Black-76

The Black-76 model was developed in 1976 to value European options on commodity futures. The prices for a futures option are given by the following formulas (refer to chapters 13 and 14 of: **John C. Hull - Options, Futures, and Other Derivatives -** (**Fifth Edition**)**, 2003**):

$$c = e^{-rT}\left[F_0 N(d_1) - KN(d_2)\right]$$

$$p = e^{-rT}\left[KN(-d_2) - F_0 N(-d_1)\right]$$

With:

$$d_1 = \frac{\ln\left(\frac{F_0}{K}\right) + \frac{1}{2}\sigma^2 T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{\ln\left(\frac{F_0}{K}\right) - \frac{1}{2}\sigma^2 T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

where $\mathbf{F_0}$ is the futures price and $\boldsymbol{\sigma}$ is the volatility of the futures price.

Risk ratios or ***Greeks*** are:

$$\gamma = \frac{N'(d_1)e^{-rT}}{F_0\sigma\sqrt{T}}$$ [**Gamma**]

$$\delta_c = e^{-rT}N(d_1)$$ [**Delta** for call options]

$$\delta_p = e^{-rT}\left[N(d_1) - 1\right]$$ [**Delta** for put options]

$$\theta_c = -\frac{F_0 N'(d_1)\sigma e^{-rT}}{2\sqrt{T}} + rF_0 N(d_1)e^{-rT} - rKe^{-rT}N(d_2)$$ [**Theta** for call options]

$$\theta_p = -\frac{F_0 N'(d_1)\sigma e^{-rT}}{2\sqrt{T}} - rF_0 N(-d_1)e^{-rT} + rKe^{-rT}N(-d_2)$$ [**Theta** for put options]

$$rho_c = -cT$$ [**Rho** for call options]

$$rho_p = -pT$$ [**Rho** for put options]

$$\nu = F_0\sqrt{T}N'(d_1)e^{-rT}$$ [**Vega**]

1.1.3 Binary

Binary options are options with discontinuous payoffs. Cash-or-nothing options are a type of binary options: considering call options, they pay off nothing if the asset price ends up below the strike price at time T and pays a fixed amount (cash amount) if it ends up above the strike price (the contrary if the option is a put). The formulas to value cash-or-nothing options written on a stock providing a dividend yield at rate **q** are per unit of cash amount paid (refer to chapter 10 of: **Paul Wilmott - Quantitative Finance, 2001**):

$$c = e^{-rT} N(d_2)$$

$$p = e^{-rT} N(-d_2)$$

with:

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - q + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - q - \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

Risk ratios or ***Greeks*** are:

$$\gamma_c = -\frac{e^{-rT} d_1 N'(d_2)}{\sigma^2 {S_0}^2 T}$$ [**Gamma** for call options]

$\gamma_p = -\gamma_c$ [**Gamma** for put options]

$$\delta_c = \frac{e^{-rT} N^{'}(d_2)}{\sigma S_0 \sqrt{T}}$$ [**Delta** for call options]

$\delta_p = -\delta_c$ [**Delta** for put options]

$$\theta_c = re^{-rT} N(d_2) + e^{-rT} N^{'}(d_2)\left(\frac{d_1}{2T} - \frac{r-q}{\sigma\sqrt{T}}\right)$$ [**Theta** for call options]

$$\theta_p = re^{-rT} N(-d_2) - e^{-rT} N^{'}(d_2)\left(\frac{d_1}{2T} - \frac{r-q}{\sigma\sqrt{T}}\right)$$ [**Theta** for put options]

$$rho_c = -Te^{-rT} N(d_2) + \frac{\sqrt{T}}{\sigma} e^{-rT} N^{'}(d_2)$$ [**Rho** for call options]

$$rho_p = -Te^{-rT} N(-d_2) - \frac{\sqrt{T}}{\sigma} e^{-rT} N^{'}(d_2)$$ [**Rho** for put options]

$$\nu_c = -e^{-rT} N^{'}(d_2)\left(\sqrt{T} + \frac{d_2}{\sigma}\right)$$ [**Vega** for call options]

$\nu_p = -\nu_c$ [**Vega** for put options]

1.1.4 Binomial

The Binomial Options Pricing Model (BOPM) for pricing American/European stock options involves constructing a binomial tree. This approach was described in an important paper by **J. C. Cox, S. A. Ross and M. Rubinstein, "Option Pricing: A Simplified Approach"** ***Journal Of Financial Economics*****, 7 (October 1979) 229-63**. The BOPM method divides the life of an option into a large number of small time intervals and assumes that at each time interval the stock price (spot) follows a binomial process moving from its initial value S_0 to one of two new values S_0 **u** ("up" movement with probability **p**) and S_0 **d** ("down" movement with probability **1 - p**) where **u** > 1 and **d** < 1. Given this tree of stock prices, the option can be valued by working backwards from maturity (time T) (refer to chapters 10 and 18 of: **John C. Hull - Options, Futures, and Other Derivatives -** (**Fifth Edition**)**, 2003**).

1.1.5 Continuous Compounding

Theoretical prices and implied interest rate for forwards/futures, the underlying assets of which have known cash income (i.e. the asset will provide a perfectly predictable cash income, such as: stocks paying known dividends, coupon-bearing bonds, etc.) with a risk-free interest rate compounded continuously, are calculated as follows (refer to chapter 3 of: **John C. Hull - Options, Futures, and Other Derivatives - (Fifth Edition), 2003 and chapter 6 of: Patrick Cusatis & Martin Thomas - Hedging Instruments & Risk Management, 2005):**

$$F_0 = (S_0 - I) \cdot e^{rT}$$

where:

F_0 is the Forward/Futures price today

S_0 is the price of the asset underlying the forward/futures contract today

I is the present value of income

T is the time until delivery date in the forward/futures contract (in years)

r is the risk-free interest rate per annum, expressed with continuous compounding, for an investment maturing at the delivery date (i.e., in T years).

Implied Interest Rate (IIR) is calculated as:

$$IIR = \frac{\ln\left(\frac{F_0}{S_0 - I}\right)}{T}$$

1.1.6 Annual Compounding

Theoretical prices and implied interest rate for forwards/futures, the underlying assets of which have known cash income (i.e. the asset will provide a perfectly predictable cash income, such as: stocks paying known dividends, coupon-bearing bonds, etc.) with a risk-free interest rate compounded annually, are calculated as follows (refer to chapter 3 of: **John C. Hull - Options, Futures, and Other Derivatives -** (**Fifth Edition**)**, 2003** and chapter 6 of: **Patrick Cusatis & Martin Thomas - Hedging Instruments & Risk Management, 2005**):

$$F_0 = \left(S_0 - I\right) \cdot \left(1 + r\right)^T$$

where:

$\mathbf{F_0}$ is the Forward/Futures price today

$\mathbf{S_0}$ is the price of the asset underlying the forward/futures contract today

I is the present value of income

T is the time until delivery date in the forward/futures contract (in years)

r is the risk-free interest rate compounded annually for an investment maturing at the delivery date (i.e., in T years).

Implied Interest Rate (IIR) is calculated as:

$$IIR = \left(\frac{F_0}{S_0 - I}\right)^{\frac{1}{T}} - 1$$

1.2 Real-Time Calculations

Real-time market data of derivative instruments displayed in the **Price Info** and **Derivatives Price Info** windows can be enriched with some additional fields, namely:

ThPrice	Theoretical (fair) price	Futures/Options
ImplVol	Implied volatility	Options
ImplIntRate	Implied interest rate	Futures
Gamma	Gamma risk ratio	Options
Delta	Delta risk ratio	Options
Theta	Theta risk ratio	Options
Rho	Rho risk ratio	Options
Vega	Vega risk ratio	Options

calculated through several algorithms implemented in the BTS® financial library.
In order to set up the parameters required for real-time calculations the following functions are provided via the **Pricing** menu of the top-level tool bar:

- **Derivatives Settings**
- **Interest Rate**

1.2.1 Derivatives Settings

Parameters required for real-time calculations can be set up by underlying instrument for all expiry dates or, possibly, for a selected one, covering futures and options in either case.

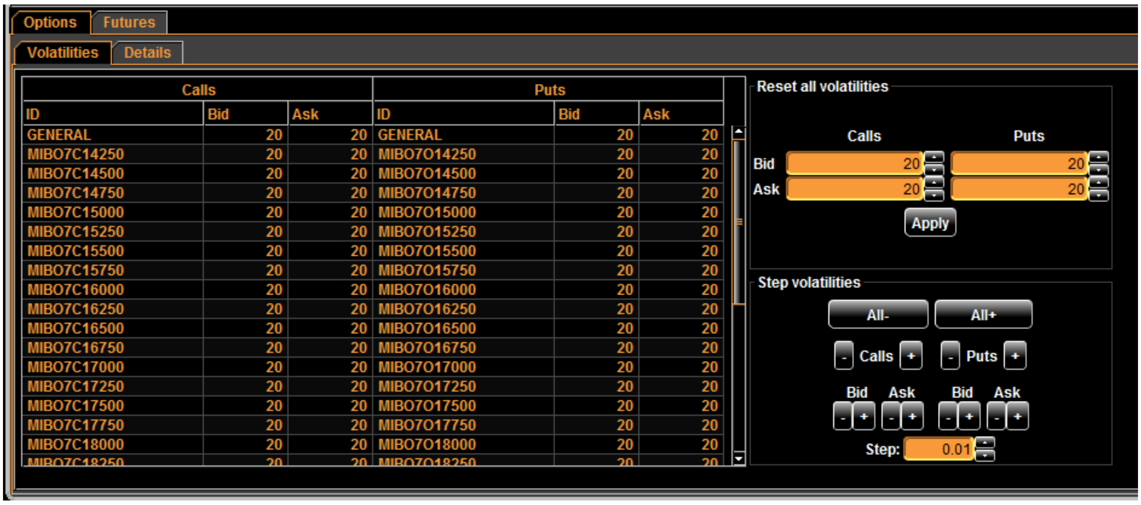
The first step of this process is the selection of an underlying instrument in a given market, possibly for a specific expiry date, which can be confirmed via the Add button and then saved with the Save button or, alternately, removed by pressing the Remove button.

Once an underlying instrument has been added to the top table of the **Derivatives Settings** window the following values can be assigned to it:

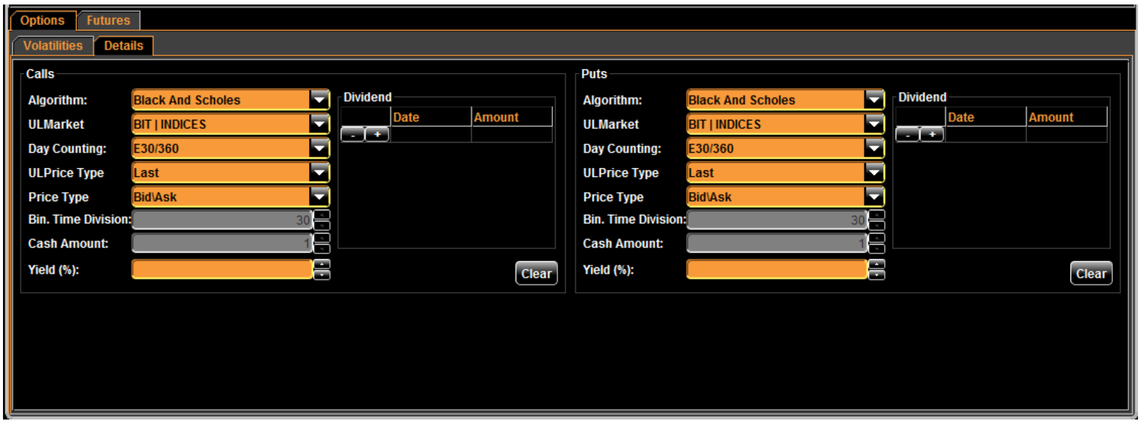
AdjBid	Adjustment to be applied to the bid price of an underlying instrument before calculating the price of any corresponding derivative instrument
AdjAsk	Adjustment to be applied to the ask price of an underlying instrument before calculating the price of any corresponding derivative instrument
OverrideBid	User-defined bid price to override the bid market price of the underlying instrument
OverrideAsk	User-defined bid price to override the ask market price of the underlying instrument

Two panes: **Options** and **Futures** are available, with the former including two sub-panes: **Volatilities** and **Details**.

The **Volatilities** sub-pane allows entering volatility values to be used in the calculation of theoretical (fair) prices for call and put options. Default values to be applied to all derivatives for the current underlying instrument must be assigned to the GENERAL entry, whereas different values can be entered for individual options. A set of commands at the right-hand side of this sub-pane provides a quick way to assign and/or modify volatility values by instrument, option type or side (bid or ask).



The **Details** sub-pane is used to select the algorithm to be applied by the Pricing Service in order to calculate real-time data of all options for the current underlying instrument and enter all the input values required by the specific algorithm.



Here follows a brief description of all the fields displayed in the **Details** sub-pane:

Algorithm	Algorithms to be used for real-time calculation of theoretical price, implied volatility and *Greeks* for options: - **Black And Scholes** - **Black 76** - **Binomial AM** - **Binomial EU** - **Binary**
ULMarket	Market or data vendor whose price feed is to be used for the underlying instrument
Day Counting	Day counting method: - **ACT/365** - **E30/360**
ULPrice Type	Type of spot price of the underlying instrument from market or data vendor feed to be used in calculating theoretical price and *Greeks* for options or theoretical price for forwards/futures contracts: - **Bid/Ask** - **Last** - **Bid** - **Ask** - **Mid**
Price Type	Type of price of the derivative instrument from market or data vendor feed

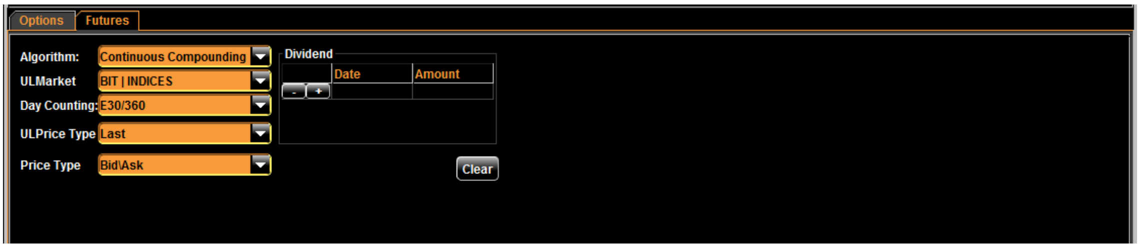
	to be used in calculating its implied volatility for options or implied interest rate for forwards/futures contracts: - **Bid/Ask** - **Last** - **Bid** - **Ask** - **Mid**
Bin. Time Division	Number of steps to be performed in the Binomial AM and Binomial EU algorithms
Cash Amount	Cash amount paid if the spot price ends up above (below) the strike price for a call (put) option
Yield (%)	Dividend yield
Dividends	Dates and amounts of future payments (discrete dividends)

Each algorithm requires a specific set of input values as shown in the following table:

Algorithm	**Black And Scholes**	**Black 76**	**Binomial AM**	**Binomial EU**	**Binary**
ULMarket	X	X	X	X	X
Day Counting	X	X	X	X	X
ULPrice Type	X	X	X	X	X
Price Type	X	X	X	X	X
Bin. Time Division			X	X	
Cash Amount					X
Yield (%)	X		X	X	X
Dividends	X		X		

Parameter values defined for call an/or put options can be removed via the **Clear** button.

The **Futures** pane is used to select the algorithm to be applied by the Pricing Service in order to calculate real-time data of all futures for the current underlying instrument and enter all the input values required by the specific algorithm.



Here follows a brief description of all the fields displayed in the **Futures** pane:

Algorithm	Algorithm to be used for real-time calculation of theoretical price and implied interest rate for forwards/futures contracts: - **Continuous Compounding** - **Annual Compounding**
ULMarket	Market or data vendor the price feed of which is to be used for the underlying instrument
Day Counting	Day counting method: - **ACT/365** - **E30/360**
ULPrice Type	Type of spot price of the underlying instrument from market or data vendor feed to be used in calculating theoretical price for forwards/futures contracts: - **Bid/Ask** - **Last** - **Bid** - **Ask** - **Mid**
Price Type	Type of price of the derivative instrument from market or data vendor feed to be used in calculating its implied interest rate for forwards/futures contracts: - **Bid/Ask** - **Last** - **Bid** - **Ask** - **Mid**
Dividends	Dates and amounts of future payments (discrete dividends)

Each algorithm requires a specific set of input values as shown in the following table:

Algorithm	**Continuous Compounding**	**Annual Compounding**
ULMarket	X	X
Day Counting	X	X
ULPrice Type	X	X
Price Type	X	X
Dividends	X	X

Parameter values defined for futures can be removed via the **Clear** button.

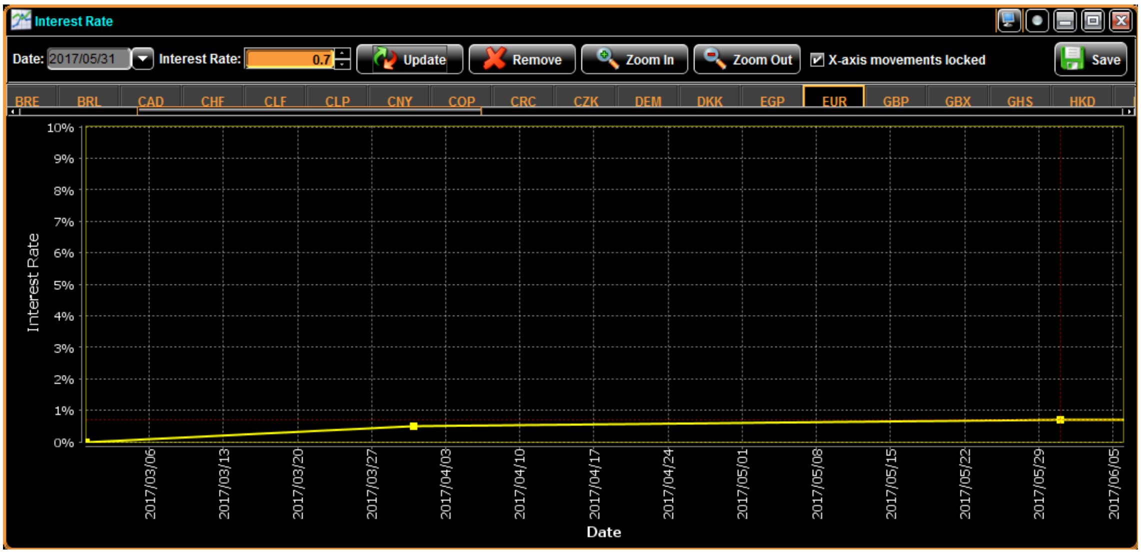
1.2.2 Interest Rate Curve

All the algorithms used in real-time calculations require interest rate curves to be defined for the currencies that derivative instruments are traded in. After selecting a currency by clicking on the corresponding pane tab, users have two options to enter discrete values for interest rate curves:

1) double-click a date in the **Calendar** toolbox and then enter the corresponding rate in the **Interest Rate** field. The value can be set or adjusted via the arrows buttons. In order to confirm the new date-rate pair the Add button must be clicked;

2) double-click the desired value for a given date directly in the chart pane. This will create a new point in the interest rate curve.

The so defined parameters will be graphically displayed in the chart pane of the **Interest Rate** window



Previously-defined curve values can be subsequently modified by using one of the following three options:

1) select the desired curve node within the chart pane then enter a new value in the **Interest Rate** field or update the current one via the arrow buttons and finally press the Update button;

2) left-click a curve node related to a specific date within the chart pane and drag it along the **y-axis** to modify its value. By doing so the user can simultaneously change all the values related to dates placed on the right-side of the selected one, also including this one, by simply moving the selected node on its **y-axis**. Just in case only a single value

related to a specific date needs to be modified (increased or decreased), the user must left-click the desired node and simultaneously press the **Ctrl** key;

3) double-click above or below a specific curve node within the chart pane, along the **y-axis**, to increase or decrease its value.

The **X-axis movements locked** option box placed in the **Interest Rate** window tool bar is checked by default, allowing users to drag curve nodes only in the **interest rate** direction. On the contrary, if the **X-axis movements locked** option box is unchecked, users can drag the curve nodes also in the **date** direction.

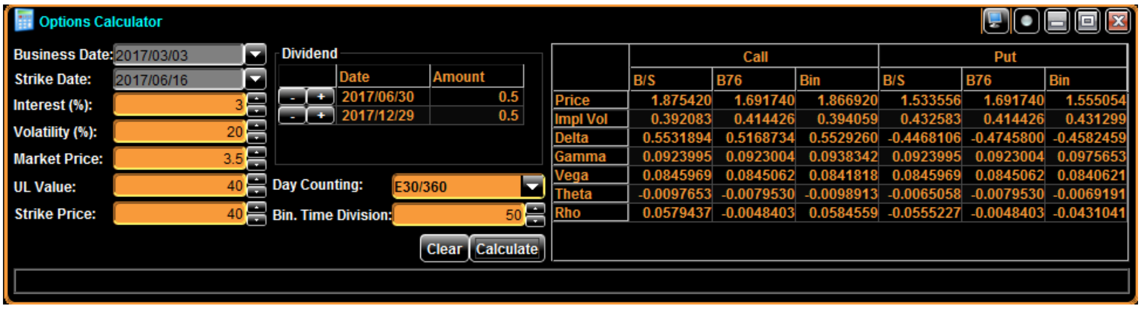
To delete an existing value the user must select the related curve node and then click the Remove button. This procedure has to be repeated for each curve node to be removed.

By default, the curve display area covers a one-month time interval. This time range can be increased by clicking the Zoom Out button, or it can be reduced by clicking the Zoom In button.

The parameters of each single curve related to a specific currency defined and/or modified by the user can be saved in the application database by clicking the Save button. At the end of each trading day all existing curves are moved forward in time by one day.

1.2.3 Options Calculator

The **Options Calculator** window can be used for one-off calculation of theoretical price, risk ratios or ***Greeks*** and implied volatility for any individual option: theoretical prices will always be calculated using **Black-Scholes**, **Black 76** and **Binomial AM** algorithms. It is possible to activate this functionality via the **Market Information** menu of the **BIT Trading Station** platform top-level tool bar by clicking the **Options Calculator** option.



Here follows the list of values to be entered by the user:

Business Date	Business date
Strike Date	Strike (expiration) date
Interest (%)	Risk-free interest rate to be used in the calculation of theoretical price and *Greeks*
Volatility (%)	Volatility of the underlying instrument to be used in the calculation of

	theoretical price and *Greeks*
Market Price	Market price of the derivative instrument to be used in calculating its implied volatility
UL Value	Spot price of the underlying instrument
Strike Price	Strike price
Dividends	Dates and amounts of future payments (discrete dividends)
Day Counting	Day counting method: - **ACT/365** - **E30/360**
Bin. Time Division	Number of steps to be performed in the Binomial AM and Binomial EU algorithms

Calculated values will be displayed in the right-hand table of the window after pressing the **Calculate** button. Moreover, a new set of values can be entered after pressing the **Clear** button.

2.0 Derivatives Price Info

The **Derivatives Price Info** window, as opposed to the **Price Info** one, gives a more compact view of all the derivative instruments linked to the same underlying instrument or index. A tray can be created in the **Derivatives Price Info** window for one underlying instrument, which will contain three panes: **Underlying**, **Futures** and **Options**.

Futures and **Options** panes can be re-sized or moved inside the tray related to an underlying instrument, whereas the fields related to the underlying instrument are locked in the top part of the tray.

Several trays can be opened inside the same **Derivatives Price Info** window for different underlying instruments.

The **Derivatives Price Info** window can be opened by selecting the corresponding command in the **Market Information** menu.

2.1 Menu Bar

A cascading menu appears by clicking the Configuration menu. This menu shows the following commands:

- **Configuration**
  - **Add Tray**
  - **Add Expiry Date Pane**
  - **Show Expiry Date Pane**
  - **Toogle View** [Ctrl-W]

2.2 Tool Bar

The **Derivatives Price Info** window tool bar is located under the menu bar. It gives quick access to the most frequently used commands, which are mapped to specific buttons. Each command can be activated by clicking the corresponding button.

		
Add Tray	**Add Expiry Date Pane**	**Show Expiry Date Pane**

2.3 Underlying Pane

The **Underlying** pane displays real-time data in a single scrollable row for the selected underlying instrument or index.

Here follows a brief description of all the columns making up the **Underlying** pane:

Instr	Instrument description
Symbol	Common «human understood» representation of instrument or index
ISIN	Instrument ISIN code
Mkt	Market code
BidSz	Displayed size of best buy price
Bid	Best buy price
Ask	Best sell price
AskSz	Displayed size of best sell price
Last	Most recent trade price for instrument or more recent value for index
Var	Difference between last trade price and previous day's close
LastSz	Size of the most recent trade
LastTime	Time of the most recent trade
TotVol	Cumulative size of all trades
TotAmt	Cumulative amount of all trades
High	Highest price at which instrument traded or highest value of index
Low	Lowest price at which instrument traded or lowest value of index
Open	Opening price of instrument or opening value of index
Close	Closing price of instrument or closing value of index

2.4 Futures Pane

The **Futures** pane displays real-time data for all the futures on the current underlying instrument the user can sort by every column clicking on them. Fields shown in **blue** are calculated by the **Pricing Service**.

Here follows a brief description of all the columns making up the **Futures** pane:

Instr	Futures contract description
Symbol	Common «human understood» representation of futures contract
ISIN	ISIN code of futures contract
Mkt	Market code
ImpIntB	Implied interest rate related to the best bid price of futures contract
BidSz	Displayed size or best bid price

Bid	Best bid price
Ask	Best ask price
AskSz	Displayed size of best ask price
ImplntA	Implied interest rate related to the best ask price of futures contract
Last	Most recent trade price of futures contract
Var	Difference between last trade price and previous day's close
LastSz	Size of the most recent trade
LastTime	Time of the most recent trade
TotVol	Cumulative size of all trades
TotAmt	Cumulative amount of all trades
High	Highest price at which futures contract traded
Low	Lowest price at which futures contract traded
Open	Opening price of futures contract
Close	Closing price of futures contract

2.5 Options Panes

The **Options panes** display real-time data for all the call and put options on the current underlying instrument. Columns are grouped in 3 sets, the first one for call options, the second one for put options and the third one for calculations with the possibility to move columns within each group. More **Options** panes can be created for the same underlying instrument or index, one per expiry date or one for all expire dates ("All" pane). **Blue** fields are calculated by the **Pricing Service**, whereas **red** fields are entry fields.

Here follows a brief description of all the columns making up the **Call**, **Put** and **Calculations** sub-panes of the **Options** pane.

OPTIONS PANE	
Strike	Strike price of an option
ExpDate	Expiration date of an option
CALL OPTIONS SUBPANE	
Instr	Call option description
Symbol	Common «human understood» representation of call option
ISIN	ISIN code of call option
Mkt	Market code
GammaB	Gamma related to the theoretical bid price
DeltaB	Delta related to the theoretical bid price
RhoB	Rho related to the theoretical bid price
ThetaB	Theta related to the theoretical bid price
VegaB	Vega related to the theoretical bid price
ImpVolB	Implied volatility related to the best bid price of call option
BidSz	Displayed size or best bid price

Bid	Best bid price
Ask	Best ask price
AskSz	Displayed size or best ask price
ImpVolA	Implied volatility related to the best ask price of call option
GammaA	Gamma related to the theoretical ask price
DeltaA	Delta related to the theoretical ask price
RhoA	Rho related to the theoretical ask price
ThetaA	Theta related to the theoretical ask price
VegaA	Vega related to the theoretical ask price
SynthBid	Synthetic short stock price (see below)
Last	Most recent trade price of call option
Var	Difference between last trade price and previous day's close
LastSz	Size of the most recent trade
LastTime	Time of the most recent trade
TotVol	Cumulative size of all trades
TotAmt	Cumulative amount of all trades
High	Highest price at which call option traded
Low	Lowest price at which call option traded
Open	Opening price of call option
Close	Closing price of call option
PUT OPTIONS SUBPANE	
Instr	Put option description
Symbol	Common «human understood» representation of put option
ISIN	ISIN code of put option
Mkt	Market code
SynthAsk	Synthetic long stock price (see below)
GammaB	Delta related to the theoretical bid price
DeltaB	Rho related to the theoretical bid price
RhoB	Theta related to the theoretical bid price
ThetaB	Vega related to the theoretical bid price
VegaB	Implied volatility related to the best bid price of put option
ImpVolB	Implied volatility related to the best bid price of put option
BidSz	Displayed size or best buy price
Bid	Best bid price
Ask	Best ask price
AskSz	Displayed size or best sell price
ImpVolA	Implied volatility related to the best ask price of put option
GammaB	Gamma related to the theoretical ask price
DeltaA	Delta related to the theoretical ask price

RhoA	Rho related to the theoretical ask price
ThetaA	Theta related to the theoretical ask price
VegaA	Vega related to the theoretical ask price
Last	Most recent trade price of put option
Var	Difference between last trade price and previous day's close
LastSz	Size of the most recent trade
LastTime	Time of the most recent trade
TotVol	Cumulative size of all trades
TotAmt	Cumulative amount of all trades
High	Highest price at which put option traded
Low	Lowest price at which put option traded
Open	Opening price of put option
Close	Closing price of put option
CALCULATIONS SUBPANE	
CallBid	Call option bid price entered by the user
CallImpVolB	Implied volatility related to manual bid price of call option calculated by the Pricing System
CallAsk	Call option ask price entered by the user
CallImpVolA	Implied volatility related to manual ask price of call option calculated by the Pricing System
PutBid	Put option bid price entered by the user
PutImpVolB	Implied volatility related to manual bid price of put option calculated by the Pricing System
PutAsk	Put option ask price entered by the user
PutImpVolA	Implied volatility related to manual ask price of put option calculated by the Pricing System

Calculated field values (shown in **blue**) are generated and notified in real-time mode by the **Pricing Service**, which will use parameters values set via the **Derivatives Settings** command in the **Pricing** menu.

As regards the two values: **SynthBid** (Synthetic Bid Price) and **SynthAsk** (Synthetic Ask Price) they are calculated by the GUI client using the following formulas:

- **SynthBid = Strike + CallBid – PutAsk** (both premiums for the same strike price) [**synthetic short stock**]

- **SynthAsk = Strike + CallAsk – PutBid** (both premiums for the same strike price) [**synthetic long stock**]

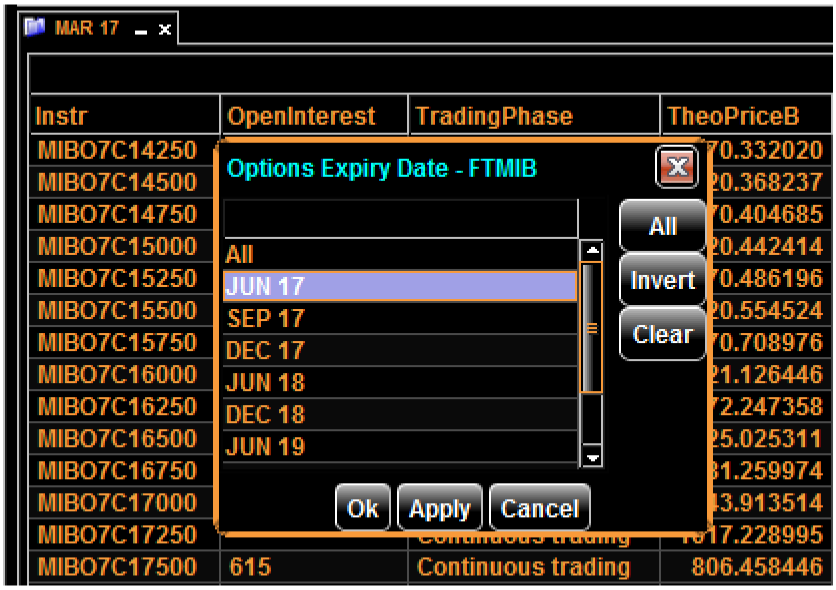
2.6 Select a new underlying instrument/index

It is possible to create a tray for an underlying instrument by selecting the **Add Tray** command in the **Configuration menu** of the **Derivatives Price Info.**

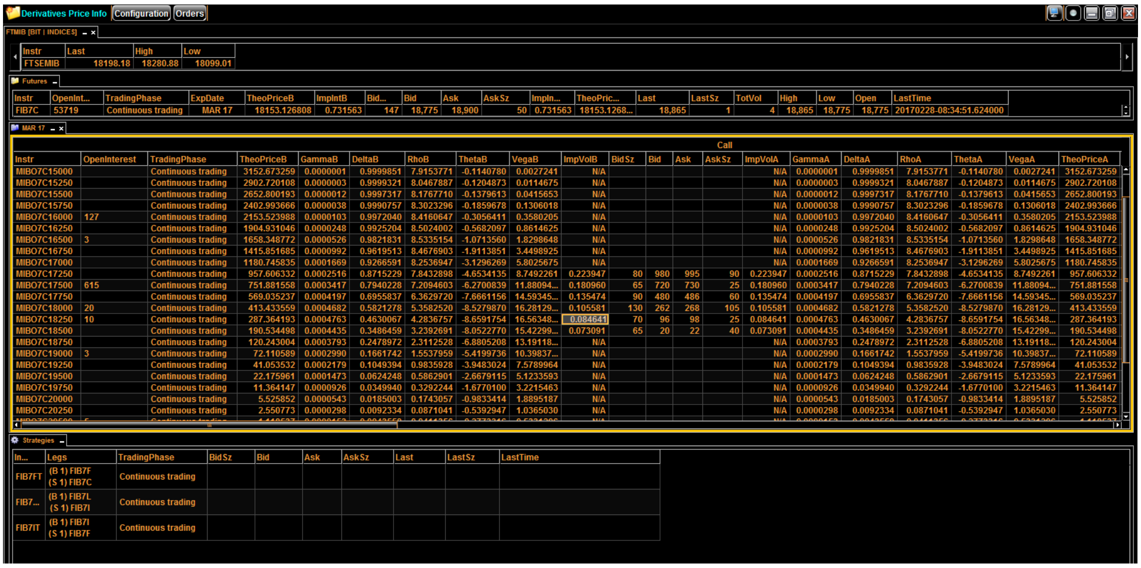
Via the **Ctrl+LeftMouseClick** command on the empty tab of a tray **underlying instrument or index** via a **combo-box** (populated by collecting all the entries in the markets assigned to this tool with a non-null underlying field) or, alternately, in a **free-text** format can be selected

2.7 Adding options by expiry date

Once the underlying instrument or index has been selected, the three above-mentioned panes will be displayed: the **Underlying** and **Futures** panes will be already receiving real-time data from the corresponding markets, whereas one or more expiry dates are to be picked up from a selection list.



The **All** button allows the selection of all the expiry dates in the selection list, thus creating one pane per date, whereas the **All** option in the selection list creates a single pane for all expiry dates.



Options panes for different expiry dates can be added to the current tray in two different ways:

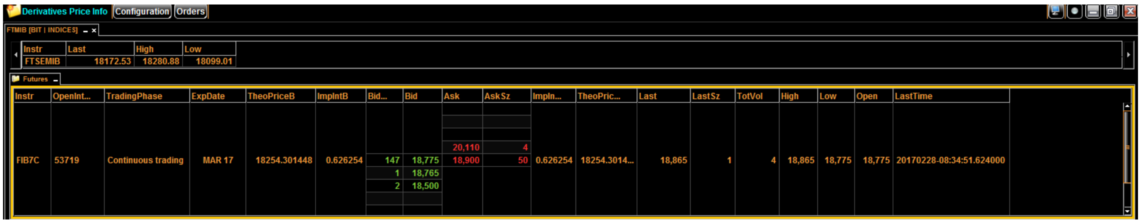
- by selecting the **Show Expiry Date Pane** command in the **Configuration** menu or by right-clicking one of the existing **Options** pane tabs and then running the **Show Expiry Date Pane** command. A multiple selection list will pop up with the remaining expiry dates which the user can select to open one or more option panes
- by selecting the **Add Expiry Date Pane** command in the **Configuration** menu or by right-clicking one of the existing **Options** pane tabs and then running the **Add Expiry Date Pane** command. One pane will be added to the existing ones and the user can assign an expiry date to it by executing the **Ctrl+LeftMouseClick** command on the corresponding tab and then entering a date in the '**MON YY**' format (e.g. 'JUN 17'). The user can also enter the '*****' character to display a single selection list with the remaining expiry dates to choose from.

It is also possible to change the expiry date of an existing **Options** pane by executing the **Ctrl+LeftMouseClick** command on the corresponding tab or via the **Modify Expiry Date** command in the right-click pop-up menu and then entering a date in the '**MON YY**' format (e.g. 'JUN 17'). The user can also enter the '*****' character to display a single selection list with the remaining expiry dates to choose from.

2.8 Embedded Order/Price Depth

An embedded **Order/Price Depth** window can pop-up for each derivative instrument or instrument couple in the **Futures** or **Options** pane by right-clicking on the corresponding row and then selecting the **Order/Price Depth** command or double clicking on:

Futures pane: **Instr**, **Symbol**, **ISIN** and **Mkt** columns.
Options pane: **Instr**, **Symbol**, **ISIN**, **Mkt**, **Strike** and **ExpDate** column



By double clicking on one of the above-mentioned fields of the expanded book it will disappear.

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Contact Details

Borsa Italiana Clients Technology Service Team

Technical Account Management Italy
clients-services@borsaitaliana.it
+39 02 72426348/606/647

Service Desk Italy
service-desk@borsaitaliana.it
Toll Free: 0080026772000
From mobile: +39 02 45411399

London Stock Exchange Group