



Budapest Stock Exchange Co. Ltd.  
Decision No. 54 / 2000 of the Head of the Secretariat  
on the Settlement Price Manual of the  
Budapest Stock Exchange Co. Ltd.

THE BUDAPEST STOCK EXCHANGE LTD.  
MANUAL OF SETTLEMENT PRICES FOR  
FUTURES AND OPTIONS

(integrated text, with the amendments of Decision No. 198/2000, Decision No. 8/2002 Decision No. 79/2002 and Decision No. 95/2002 of the Head of Secretariat of the Budapest Stock Exchange and Decision No. 34/2002 Decision No. 55/2003, Decision No. 81/2003 Decision No. 146/2003, Decision No. 201/2003, Decision No. 27/2004, Decision 286/2004 Decision No. 1/2005, Decision No. 29/2005, Decision Nos. 113/2005, 138/2005, 202/2005, 234/2005, 265/2005, 283/2005, 308/2005, 320/2005, 68/2006, 79/2006, 131/2006, 160/2006, 176/2006, 179/2006 286/2006, 351/2006, 364/2006, 51/2007, 77/2007, 147/2007, 223/2007, 236/2007, 56/2008, 215/2008, 133/2009, 280/2009, 358/2009, 183/2010, 417/2010, 422/2010, 424/2010, 441/2010, 33/2011, 64/2011, 171/2011, 218/2011, 284/2011, 311/2011, 356/2011, 363/2011, 454/2011, 525/2011, 527/2011, 537/2011, 90/2012, 137/2012, 156/2012, 263/2013, 163/2013, 311/2013, 376/2013, 374/2013, 456/2013, 456/2013, 546/2013, 10/2014, 87/2014, 227/2014, 292/2014, 470/2014, 563/2014, 172/2015, 196/2015, 261/2015, 398/2015, 11/2016, 140/2016, 262/2016, 27/2017, 57/2017, 138/2017, 234/2017, 333/2017, 359/2017, 405/2017, 431/2017, 8/2018, 125/2018, 207/2018, 232/2018, 91/2019, 32/2020, 36/2020, 152/2020 of the Chief Executive Officer of the Budapest Stock Exchange Co. Ltd. and Decision No. 11/2021, 224/2022, 312/2022 415/2022, 39/2023 and 129/2023 of the Budapest Stock Exchange Co. Ltd.

# I.Introduction

The primary aim of the Settlement Price Manual (hereafter Manual) is to set forward the principles and methods required for the calculation of End-of-day and intraday clearing settlement price.

The Manual stipulates on the theoretical model based on which the Theoretical Settlement Price of a derivative product can be determined, and the so called Market Settlement Price determined by orders and trades. Furthermore, it determines for each product type the calculation method of the End-of-day Settlement Price, derived from the comparison of the Theoretical Settlement Price and the Market Settlement Price.

## I.1 Futures products included in the List of Products on the BSE

### I.1.1 Index-based futures products

- BUX maturities
- BUMIX maturities

### I.1.2 Equity-based futures products

- 4iG maturities
- AKKO Invest maturities
- ALTEO maturities
- Appeninn maturities
- Állami Nyomda maturities
- AutoWallis maturities
- BIF maturities
- BUX ETF maturities
- CIG Pannónia maturities
- Delta Technologies maturities
- DUNA HOUSE HOLDING maturities
- ENEFI maturities
- Forrás „A” maturities
- Forrás „B” maturities
- Konzum maturities
- Magyar Telekom maturities
- MASTERPLAST maturities
- MBH Mortgage Bank maturities
- MOL maturities
- NUTEX maturities
- Opus maturities
- OTP maturities
- PannErgy maturities
- Rába maturities
- Richter maturities
- WABERER’S maturities
- Zwack maturities

### I.1.3 Foreign currency based futures products

- CAD/HUF maturities
- CHF/HUF maturities
- CZK/HUF maturities
- EURO/HUF maturities
- GBP/HUF maturities
- JPY/HUF maturities
- NOK/HUF maturities
- PLN/HUF maturities
- TRY/HUF maturities

USD/HUF maturities  
EURO/USD (with forint settlement) maturities  
EURO/JPY (with forint settlement) maturities  
EURO/CHF (with forint settlement) maturities  
EURO/GBP (with forint settlement) maturities  
USD/JPY (with forint settlement) maturities  
USD/CHF (with forint settlement) maturities  
GBP/USD (with forint settlement) maturities  
GBP/JPY (with forint settlement) maturities  
GBP/CHF (with forint settlement) maturities  
CHF/JPY (with forint settlement) maturities  
EURO/SEK (with forint settlement) maturities  
EURO/NOK (with forint settlement) maturities  
EURO/PLN (with forint settlement) maturities  
EURO/CZK (with forint settlement) maturities  
USD/SEK (with forint settlement) maturities  
USD/NOK (with forint settlement) maturities  
USD/PLN (with forint settlement) maturities  
USD/CZK (with forint settlement) maturities  
GBP/SEK (with forint settlement) maturities  
EURO/TRY (with forint settlement) maturities  
EURO/RON (with forint settlement) maturities  
USD/TRY (with forint settlement) maturities  
AUD/USD (with forint settlement) maturities  
USD/CAD (with forint settlement) maturities  
CAD/JPY (with forint settlement) maturities  
EUR/RUB (with forint settlement) maturities  
USD/RUB (with forint settlement) maturities  
USD/BRL (with forint settlement) maturities  
USD/MXN (with forint settlement) maturities  
EUR/CSD (with forint settlement) maturities  
USD/UAH (with forint settlement) maturities  
AUD/JPY (with forint settlement) maturities  
NZD/JPY (with forint settlement) maturities  
GBP/AUD (with forint settlement) maturities  
GBP/PLN (with forint settlement) maturities  
CHF/PLN (with forint settlement) maturities  
AUD/CAD (with forint settlement) maturities  
AUD/CHF (with forint settlement) maturities  
GBP/CAD (with forint settlement) maturities  
EUR/AUD (with forint settlement) maturities  
EUR/CAD (with forint settlement) maturities  
CAD/CHF (with forint settlement) maturities  
GBP/TRY (with forint settlement) maturities  
USD/HUF (one-week) maturities  
GBP/HUF (one-week) maturities  
EURO/HUF (one-week) maturities  
CHF/HUF (one-week) maturities  
TRY/HUF (one-week) maturities  
EURO/USD (one-week) maturities  
EURO/JPY (one-week) maturities  
EURO/GBP (one-week) maturities  
EURO/PLN (one-week) maturities  
EURO/CZK (one-week) maturities  
USD/JPY (one-week) maturities  
USD/CHF (one-week) maturities  
GBP/USD (one-week) maturities  
GBP/JPY (one-week) maturities

GBP/CHF (one-week) maturities  
AUD/USD (one-week) maturities  
USD/CAD (one-week) maturities  
USD/PLN (one-week) maturities  
GBP/AUD (one-week) maturities  
GBP/PLN (one-week) maturities  
CHF/PLN (one-week) maturities  
AUD/CAD (one-week) maturities  
AUD/CHF (one-week) maturities  
GBP/CAD (one-week) maturities  
EUR/CHF (one-week) maturities  
EUR/AUD (one-week) maturities  
EUR/CAD (one-week) maturities  
CAD/CHF (one-week) maturities  
AUD/JPY (one-week) maturities  
EURO/TRY (one-week) maturities  
GBP/TRY (one-week) maturities  
USD/TRY (one-week) maturities

#### **I.1.4 Commodity-based futures products**

Euro wheat maturities  
Feed barley maturities  
High oil content sunflower seed maturities  
ISCC NUTS II sustainable feed corn maturities  
ISCC NUTS II sustainable feed wheat maturities  
ISCC NUTS II sustainable high oil content rapeseed maturities

## **I.2 Options products included in the List of Products on the BSE**

#### **I.2.1 Index-based (European style) options product(s)**

BUX index option (PUT and CALL types, European style) maturities

#### **I.2.2 Equity-based (American and European style) options products**

Magyar Telekom share option (PUT and CALL types, American style) maturities  
MOL share option (PUT and CALL types, American style) maturities  
MOL share option (PUT and CALL types, European style) maturities  
OTP share option (PUT and CALL types, American style) maturities  
OTP share option (PUT and CALL types, European style) maturities

#### **I.2.3 Currency-based (European style) options products**

EURO/HUF option (PUT and CALL types) maturities  
USD/HUF option (PUT and CALL types) maturities  
CHF/HUF option (PUT and CALL types) maturities  
JPY/HUF option (PUT and CALL types) maturities  
TRY/HUF option (PUT and CALL types) maturities  
AUD/USD option (PUT and CALL types, with HUF settlement) maturities  
CAD/JPY option (PUT and CALL types, with HUF settlement) maturities  
EURO/CHF option (PUT and CALL types, with HUF settlement) maturities  
EURO/CZK option (PUT and CALL types, with HUF settlement) maturities  
EURO/JPY option (PUT and CALL types, with HUF settlement) maturities  
EURO/PLN option (PUT and CALL types, with HUF settlement) maturities  
EURO/RON option (PUT and CALL types, with HUF settlement) maturities  
EURO/TRY option (PUT and CALL types, with HUF settlement) maturities  
EURO/USD option (PUT and CALL types, with HUF settlement) maturities  
GBP/CHF option (PUT and CALL types, with HUF settlement) maturities

GBP/JPY option (PUT and CALL types, with HUF settlement) maturities  
GBP/USD option (PUT and CALL types, with HUF settlement) maturities  
USD/CAD option (PUT and CALL types, with HUF settlement) maturities  
USD/CHF option (PUT and CALL types, with HUF settlement) maturities  
USD/JPY option (PUT and CALL types, with HUF settlement) maturities  
USD/TRY option (PUT and CALL types, with HUF settlement) maturities

#### **I.2.4 Commodity-based (American style) options contracts**

Euro wheat option maturities (PUT and CALL types)  
High oil content sunflower seed option maturities (PUT and CALL types)  
ISCC NUTS II sustainable high oil content rapeseed option maturities (PUT and CALL types)  
ISCC NUTS II sustainable feed barley option maturities (PUT and CALL types)  
ISCC NUTS II sustainable feed corn option maturities (PUT and CALL types)  
ISCC NUTS II sustainable feed wheat option maturities (PUT and CALL types)

## II. Establishment of the End-of-day Settlement Prices

### II.1 Basic terms

Theoretical Settlement Price: The price of options and futures contracts calculated using the theoretical model defined for each product, set forth in the Manual.

Acceptance Range (Theoretical Spread): A range set respective to the Theoretical Settlement Price aiding the determination of the End-of-day Settlement Price which is set by comparison of the Theoretical Settlement Price and the Market Settlement Price.

Market Settlement Price: The price of options and futures contracts calculated using the procedure defined for each product, set forth in the Manual.

End-of-day Settlement Price: Unless specified otherwise, the settlement price determined by comparison of the Theoretical Settlement Price and the Market Settlement Price.

### II.2 Currency-based futures contracts

#### II.2.1 The Theoretical Settlement Price

**The formula for maturities below one year:**

$$f_t = S_t * [(1 + r * t/360) / (1 + r' * t/360)]$$

**The formula for maturities over one year:**

$$f_t = S_t * [(1 + r) / (1 + r')]^{t/360}$$

**The meaning of the different parameters in the formula:**

$f_t$  = futures price of the maturity falling due in t days  
 $s_t$  = spot exchange rate  
 $r$  = domestic interest rate  
 $r'$  = foreign interest rate  
 $t$  = days remaining to maturity

#### II.2.2 Details of the different parameters:

**Spot exchange rate:**

- In the case of the currency-based EUR/HUF forint contract, cross-currency contracts against the euro and USD/BRL the average of the bid – ask values of the Reuters quotes at 17:00;
- In the case of the currency-based forint contracts other than EUR/HUF, the price created by dividing the average of the bid – ask values of the Reuters quotes at 17:00 for EUR/HUF and the average of the bid – ask values of the Reuters quotes of the respective cross contract against the euro at 17:00;
- In the case of cross contracts that are not against the euro (except of USD/BRL), the spot market price is obtained by dividing the respective euro/currency rates, established in accordance with the above.

## Domestic and foreign interest rates

The domestic interest rate always indicates the interest rate of the currency mentioned as second in the name of a given contract (representing the legal tender), while the foreign interest rate indicates the interest rate of the currency mentioned as first in the name of a given contract (representing the product) based on Reuters data as follows:

### HUF interest rate:

#### **0- to 135-day term remaining to maturity:**

- the 3-month reference yield published by ÁKK, calculated on the basis of 360 days
- in the absence of the above, the average yield of the last 3-month discount treasury bill auction, calculated on the basis of 360 days

#### **136- to 270-day term remaining to maturity:**

- the 6-month reference yield published by ÁKK, calculated on the basis of 360 days
- in the absence of the above, the average yield of the last 6-month discount treasury bill auction, calculated on the basis of 360 days

#### **271+ day term remaining to maturity:**

- the 1-year reference yield published by ÁKK, calculated on the basis of 360 days
- in the absence of the above, the average yield of the last 12-month discount treasury bill auction, calculated on the basis of 360 days

### Interest rates of other currencies:

#### **0- to 60-day term remaining to maturity:**

in the case of EUR, the average of the bid – ask values of the 1-month EURD at 17:00

in the case of USD, the average of the bid – ask values of the 1-month USDD at 17:00

in the case of GBP, the average of the bid – ask values of the 1-month GBPD at 17:00

in the case of CHF, the average of the bid – ask values of the 1-month CHFD at 17:00

in the case of JPY, the average of the bid – ask values of the 1-month JPYD at 17:00

in the case of SEK, the average of the bid – ask values of the 1-month SEKD at 17:00

in the case of NOK, the value of the of the previous day's 1-month NIBOR

in the case of PLN, the average of the bid – ask values of the 1-month PLND at 17:00

in the case of CZK, the value of the previous day's 1-month PRIBOR

in the case of RON, the value of the 1-month ROBOR at 17:00

in the case of TRY, the value of TLREF for the given day

in the case of RUB, the value of the 1-month MOSPRIME for the given day at 17:00

in the case of BRL, the average of the bid – ask values of the 1-month BRLID at 17:00

in the case of MXN, the average of the bid – ask values of the 1-month MXNID at 17:00

in the case of RSD, the average of the bid – ask values of the 1-month RSDD at 17:00

in the case of UAH, the average of the bid – ask values of the 1-month UAHD at 17:00

in the case of NZD, the average of the bid – ask values of the 1-month NZDD at 17:00

in the case of AUD, the average of the bid – ask values of the 1-month AUDID at 17:00

in the case of CAD, the average of the bid – ask values of the 1-month CADID at 17:00

#### **61- to 135-day term remaining to maturity:**

in the case of EUR, the average of the bid – ask values of the 3-month EURD at 17:00

in the case of USD, the average of the bid – ask values of the 3-month USDD at 17:00

in the case of GBP, the average of the bid – ask values of the 3-month GBPD at 17:00

in the case of CHF, the average of the bid – ask values of the 3-month CHFD at 17:00

in the case of JPY, the average of the bid – ask values of the 3-month JPYD at 17:00

in the case of SEK, the average of the bid – ask values of the 3-month SEKD at 17:00

in the case of NOK, the value of the of the previous day's 3-month NIBOR

in the case of PLN, the average of the bid – ask values of the 3-month PLND at 17:00

in the case of CZK, the value of the previous day's 3-month PRIBOR

in the case of RON, the value of the 3-month ROBOR at 17:00

in the case of TRY, the value of TLREF for the given day



in the case of RUB, the value of the 3-month MOSPRIME for the given day at 17:00  
in the case of BRL, the average of the bid – ask values of the 3-month BRLID at 17:00  
in the case of MXN, the average of the bid – ask values of the 3-month MXNID at 17:00  
in the case of RSD, the average of the bid – ask values of the 3-month RSDD at 17:00  
in the case of UAH, the average of the bid – ask values of the 3-month UAHD at 17:00  
in the case of NZD, the average of the bid – ask values of the 3-month NZDD at 17:00  
in the case of AUD, the average of the bid – ask values of the 3-month AUDID at 17:00  
in the case of CAD, the average of the bid – ask values of the 3-month CADID at 17:00

**136- to 270-day term remaining to maturity:**

in the case of EUR, the average of the bid – ask values of the 6-month EURD at 17:00  
in the case of USD, the average of the bid – ask values of the 6-month USDD at 17:00  
in the case of GBP, the average of the bid – ask values of the 6-month GBPD at 17:00  
in the case of CHF, the average of the bid – ask values of the 6-month CHFD at 17:00  
in the case of JPY, the average of the bid – ask values of the 6-month JPYD at 17:00  
in the case of SEK, the average of the bid – ask values of the 6-month SEKD at 17:00  
in the case of NOK, the value of the of the previous day's 6-month NIBOR  
in the case of PLN, the average of the bid – ask values of the 6-month PLND at 17:00  
in the case of CZK, the value of the previous day's 6-month PRIBOR  
in the case of RON, the value of the 6-month ROBOR at 17:00  
in the case of TRY, the value of TLREF for the given day  
in the case of RUB, the value of the 6-month MOSPRIME for the given day at 17:00  
in the case of BRL, the average of the bid – ask values of the 6-month BRLID at 17:00  
in the case of MXN, the average of the bid – ask values of the 6-month MXNID at 17:00  
in the case of RSD, the average of the bid – ask values of the 6-month RSDD at 17:00  
in the case of UAH, the average of the bid – ask values of the 6-month UAHD at 17:00  
in the case of NZD, the average of the bid – ask values of the 6-month NZDD at 17:00  
in the case of AUD, the average of the bid – ask values of the 6-month AUDID at 17:00  
in the case of CAD, the average of the bid – ask values of the 6-month CADID at 17:00

**271+ day term remaining to maturity:**

in the case of EUR, the average of the bid – ask values of the 1-year EURD at 17:00  
in the case of USD, the average of the bid – ask values of the 1-year USDD at 17:00  
in the case of GBP, the average of the bid – ask values of the 1-year GBPD at 17:00  
in the case of CHF, the average of the bid – ask values of the 1-year CHFD at 17:00  
in the case of JPY, the average of the bid – ask values of the 1-year JPYD at 17:00  
in the case of SEK, the average of the bid – ask values of the 1-year SEKD at 17:00  
in the case of NOK, the value of the of the previous day's 6-month NIBOR  
in the case of PLN, the average of the bid – ask values of the 1-year PLND at 17:00  
in the case of CZK, the value of the previous day's 1-year PRIBOR  
in the case of RON, the value of the 1-year ROBOR at 17:00  
in the case of TRY, the value of TLREF for the given day  
in the case of RUB, the value of the 6-month MOSPRIME for the given day at 17:00  
in the case of BRL, the average of the bid – ask values of the 1-year BRLID at 17:00  
in the case of MXN, the average of the bid – ask values of the 1-year MXNID at 17:00  
in the case of RSD, the average of the bid – ask values of the 1-year RSDD at 17:00  
in the case of UAH, the average of the bid – ask values of the 1-year UAHD at 17:00  
in the case of NZD, the average of the bid – ask values of the 1-year NZDD at 17:00  
in the case of AUD, the average of the bid – ask values of the 1-year AUDID at 17:00  
in the case of CAD, the average of the bid – ask values of the 1-year CADID at 17:00

### II.2.3 The Theoretical Spread

Theoretical Spread is not calculated for currency-based futures products.

### II.2.4 The Market Settlement Price

Market Settlement Price is not calculated for currency-based futures products.



## II.2.5 The End-of-day Settlement Price

End-of-day Settlement price of currency-based futures products is equal to the Theoretical Settlement Price determined according to section II.2.1.

## II.3 Equity-based futures contracts where the underlying product is traded on BSE's regulated market

### II.3.1 The Theoretical Settlement Price

In a standard case:

$$f_t = s * (1 + t/360 * r)$$

If information is available on the size of the dividend payments and the date of the payout, and the ex-dividend day falls on or before the last trading day of a given maturity, then in the case of the given maturity, the formula used for the establishment of the theoretical settlement prices shall be, in the period lasting from the day when the information became available, up to the ex-dividend day (excluding the ex-dividend day):

$$f_t = (s - \text{DIV} / (1 + r * t_2 / 360)) * (1 + t / 360 * r)$$

**The meaning of the different parameters in the formulae:**

$f_t$  = futures price of the maturity falling due in  $t$  days

$s$  = closing price of that individual equity on the cash market

$r$  = HUF interest rate, according to the interest rate determination method applied for the establishment of the theoretical settlement prices for currencies

$t$  = the number of days remaining until maturity in the case of maturity for which the theoretical price has been set

$t_2$  = days remaining until the starting date of the payment of the dividends

DIV = the size of the dividend announced on the general meeting of that individual equity. On days when DIV exceeds 10% of the cash market price of that equity, only 10% of the cash market price shall be taken into account.

### II.3.2 The Theoretical Spread

**0- to 90-day term remaining to maturity:**

the range marked out by the Theoretical Settlement Price  $\pm$  4.0%

**91-day to 1-year term remaining to maturity:**

the range marked out by the Theoretical Settlement Price  $\pm$  5.0%

From the day when the information about convening the annual general meeting was published, but not more than 30 days prior to the general meeting until the day when details about the payment of dividends were published (whether any will dividends be paid and if yes, what the size and the starting date of the payments will be), the ranges shall be modified as follows:

**0-90 day remaining to maturity:**

the range marked out by the Theoretical Settlement Price +4.0% and -14%

**91-day to 1-year term remaining to maturity:**

the range marked out by the Theoretical Settlement Price +5.0% and -15%

### II.3.3 The Market Settlement Price

The Market Settlement Price of the equity-based futures contracts is determined according to the following principles:

- a) If a transaction is concluded in the closing transaction sub-period, the Market Settlement Price shall be the price of that transaction.
- b) If no transaction is concluded in the closing transaction sub-period, and if an active order exists at the close of trading in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- c) If no active order exists at the close of trading in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the last transaction.
- d) If no transaction is concluded after the determination of the last settlement price, but the order book contains an active order at the close of trading at a better price than that of the last settlement price, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- e) If no transaction is concluded after the determination of the last settlement price and the order book contains no active order at the close of trading at a better price than that of the last settlement price, the Market Settlement Price shall be the last settlement price.

### II.3.4 The End-of-day Settlement Price

The End-of-day Settlement Price is determined by the comparison of the Theoretical Settlement Price, calculated according to principles set forth in section II.3.1, and the Market Settlement Price, calculated according to the guidelines set in section II.3.3:

- a) Provided the value of the Market Settlement Price falls within the Theoretical Spread defined in section II.3.2, then – notwithstanding any provision to the contrary in the Manual – the End-of-day Settlement Price shall be determined as the Market Settlement Price.
- b) Provided the value of the Market Settlement Price falls outside the Theoretical Spread defined in section II.3.2, then – notwithstanding any provision to the contrary in the Manual – the End-of-day Settlement Price shall be determined as the extreme of the Theoretical Spread closer to the Market Settlement Price.
- c) For maturities in which no trades have been concluded since the introduction date the End-of-day Settlement Price shall be determined as the Theoretical Settlement Price, calculated according to principles set forth in section II.3.1.

## II.4 The BUX ETF futures contract

### II.4.1 The Theoretical Settlement Price

$$f_t = s * (1 + t/360 * r)$$

**The meaning of the different parameters in the formula:**

$f_t$  = futures price of the maturity falling due in  $t$  days

$s$  = closing price of the BUX ETF on the cash market

$r$  = HUF interest rate, according to the interest rate determination method applied for the establishment of the Theoretical Settlement Prices for currencies

$t$  = the number of days remaining until maturity in the case of maturity for which the Theoretical Settlement Price has been set

### II.4.2 The Theoretical Spread

**0- to 90-day term remaining to maturity:**

the range marked out by the Theoretical Settlement Price  $\pm$  4.0%

**91-day to 1-year term remaining to maturity:**

the range marked out by the Theoretical Settlement Price  $\pm$  5.0%

**II.4.3 The Market Settlement Price**

The Market Settlement Price of the BUX ETF futures contracts is determined according to the following principles:

- a) If a transaction is concluded in the closing transaction sub-period, the Market Settlement Price shall be the price of that transaction.
- b) If no transaction is concluded in the closing transaction sub-period, and if an active order exists at the close of trading in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- c) If no active order exists at the close of trading in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the last transaction.
- d) If no transaction is concluded after the determination of the last settlement price, but the order book contains an active order at the close of trading at a better price than that of the last settlement price, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- e) If no transaction is concluded after the determination of the last settlement price and the order book contains no active order at the close of trading at a better price than that of the last settlement price, the Market Settlement Price shall be the last settlement price.

**II.4.4 The End-of-day Settlement Price**

The End-of-day Settlement Price is determined by the comparison of the Theoretical Settlement Price, calculated according to principles set forth in section II.4.1, and the Market Settlement Price, calculated according to the guidelines set in section II.4.3:

- a) Provided the value of the Market Settlement Price falls within the Theoretical Spread defined in section II.4.2, then – notwithstanding any provision to the contrary in the Manual – the End-of-day Settlement Price shall be determined as the Market Settlement Price.
- b) Provided the value of the Market Settlement Price falls outside the Theoretical Spread defined in section II.4.2, then – notwithstanding any provision to the contrary in the Manual – the End-of-day Settlement Price shall be determined as the extreme of the Theoretical Spread closer to the Market Settlement Price.
- c) For maturities in which no trades have been concluded since the introduction date the End-of-day Settlement Price shall be determined as the Theoretical Settlement Price, calculated according to principles set forth in section II.4.1.

**II.5 Index-based futures contracts****II.5.1 The Theoretical Settlement Price**

We can state that there is a liquid maturity in an index based futures contract in the case of a maturity (maturities) for which there are more than 90 days remaining to the maturity and where on a given day there were at least 20 deals and transactions with at least 200 daily contracts for the given maturity. If trading in that maturity was suspended for that day until the end of trading, the maturity is considered illiquid. If there are several maturities meeting the above criteria, the maturity serving as the basis for the generation of the theoretical settlement price is the one with the higher number of days remaining to maturity.

**II.5.1.1 The Theoretical Settlement Price if there is liquid maturity**

$$f_t = s * (s_l / s)^{(t/l)}$$

**The meaning of the different parameters in the formula:**

$f_t$  = futures price of the maturity falling due in  $t$  days

$s$  = closing price of the index for that day

$s_l$  = the settlement price of the liquid maturity

$l$  = in the case of a liquid maturity, the number of days remaining until maturity

$t$  = the number of days remaining until maturity in the case of maturity for which the theoretical price has been set

**II.5.1.2 The Theoretical Settlement Price if there is no liquid maturity**

if  $t < 365$ :

$$f_t = s * (1 + t/360 * r)$$

if  $t \geq 365$ :

$$f_t = s * (1 + r)^{t/360}$$

**The meaning of the different parameters in the formula:**

$f_t$  = futures price of the maturity falling due in  $t$  days

$s$  = closing price of the index for that day

$r$  = HUF interest rate, according to the interest rate determination method applied for the establishment of the Theoretical Settlement Prices for currencies

$t$  = the number of days remaining until maturity in the case of maturity for which the Theoretical Settlement Price has been set

**II.5.2 The Theoretical Spread**

**0- to 90-day term remaining to maturity:**

the range marked out by the Theoretical Settlement Price  $\pm$  2.0%

**91-day to 1-year term remaining to maturity:**

the range marked out by the Theoretical Settlement Price  $\pm$  3.0%

**1 year+ term remaining to maturity:**

the range marked out by the Theoretical Settlement Price  $\pm$  3.5%

**II.5.3 The Market Settlement Price**

The Market Settlement Price of the index-based futures contracts is determined according to the following principles:

- a) If a transaction is concluded in the closing transaction sub-period, the Market Settlement Price shall be the price of that transaction.
- b) If no transaction is concluded in the closing transaction sub-period, and if an active order exists at the close of trading in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.

- c) If no active order exists at the close of trading in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the last transaction.
- d) If no transaction is concluded after the determination of the last settlement price, but the order book contains an active order at the close of trading at a better price than that of the last settlement price, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- e) If no transaction is concluded after the determination of the last settlement price and the order book contains no active order at the close of trading at a better price than that of the last settlement price, the Market Settlement Price shall be the last settlement price.

The price of transactions resulting from a SPREAD order matched with another SPREAD order shall be ignored for the purposes of determining the Market Settlement Price.

#### **II.5.4 The End-of-day Settlement Price**

The End-of-day Settlement Price is determined by the comparison of the Theoretical Settlement Price, calculated according to principles set forth in section II.5.1, and the Market Settlement Price, calculated according to the guidelines set in section II.5.3:

- a) Provided the value of the Market Settlement Price falls within the Theoretical Spread defined in section II.5.2, then – notwithstanding any provision to the contrary in the Manual – the End-of-day Settlement Price shall be determined as the Market Settlement Price.
- b) Provided the value of the Market Settlement Price falls outside the Theoretical Spread defined in section II.5.2, and if the number of trades for the given instrument on the given day is at least 20 and the number of contracts concluded is at least 200, then the End-of-day Settlement Price shall be determined as the Market Settlement Price.
- c) Provided the value of the Market Settlement Price falls outside the Theoretical spread defined in section II.5.2, if the number of trades for the given instrument on the given day is less than 20 or the number of contracts concluded is less than 200, then the End-of-day Settlement Price shall be determined as the extreme of the Theoretical Spread closer to the Market Settlement Price.
- d) For maturities in which no trades have been concluded since the introduction date the End-of-day Settlement Price shall be determined as the Theoretical Settlement Price, calculated according to principles set forth in section II.5.1.

## **II.6 Commodity-based futures contracts**

### **II.6.1 The Theoretical Settlement Price**

In case of commodity-based futures contracts no Theoretical Settlement Price is established.

### **II.6.2 The Theoretical Spread**

In case of commodity-based futures contracts no Theoretical Spread is established.

### **II.6.3 The Market Settlement Price**

The Market Settlement Price of the commodity-based futures contracts is determined according to the following principles:

- a) If, at the end of the closing period, the order book contains an active order with a better price than the weighted average price of the transactions concluded in the closing period, then the Market Settlement Price is the price of the highest price bid order or the lowest price ask order.
- b) If, at the end of the closing period, the order book contains no active order with a better price than the weighted average price of the transactions concluded in the closing sub-period, then the Market Settlement Price is the weighted average price of the transactions.
- c) If no trade was concluded in the closing period, and if an active order exists at the end of the closing sub-period in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.

- d) If no active order exists at the end of the closing period in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the last transaction;
- e) If no transaction is concluded after the determination of the most recent settlement price, but the order book contains an active order at the end of the closing sub-period at a better price than that of the last settlement price, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- f) If no transaction is concluded after the determination of the most recent settlement price and the order book contains no active order at the end of the closing sub-period at a better price than that of the last settlement price, the Market Settlement Price shall be the last settlement price.

#### II.6.4 The End-of-day Settlement Price

In the case of commodity-based futures contracts the End-of-day Settlement Price is identical to the Market Settlement Price established in Section II.6.3. In the case of those maturities where since their listing on the market there was no transaction yet, no End-of-day Settlement Price is calculated.

## II.7 The Index-based options contract(s)

### II.7.1 The function used for the establishment of the Theoretical Settlement Price

Public Function Bs(P, x, s, t, r, cal) As Single – as set in the appendix of the Manual

#### Explanation of the input parameters

P = closing price of the BUX index for that day

x = exercise price of the options contract

s =  $\text{root}((59 * S \ln(x_{t+1}/x_t)^2 - (S \ln(x_{t+1}/x_t))^2) / ((58 * 59)) * (250)^{0.5})$ ,  
 where:  $x_t, x_{t+1}$ ; the closing values for days (t → 1...60)

t = days remaining to maturity divided by 365

r = the 1-year reference yield published by ÁKK, calculated on the basis of 360 days, in the case of the absence of such yield, the average yield of the last auction in 12-month discount treasury bills, calculated on a basis of 360 days

cal = if the option is a call option, the parameter is true; if it is a put option, it is false

### II.7.2 The Theoretical Spread

The Theoretical Spread is determined by

1. the range marked out by a  $\pm 15\%$  change in volatility,
2. and the range marked out by the cash market price  $\pm 2\%$ , relative to the Theoretical Settlement Price

as minimum and maximum values.

### II.7.3 The Market Settlement Price

The Market Settlement Price of the index-based options contract is determined according to the following principles:

- a) If an active order exists at the close of trade in the order book at a better price than that of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- b) If no active order exists at the close of trade in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the last transaction.

- c) If no transaction is concluded after the determination of the last settlement price, but the order book contains an active order at the close of trade at a better price than that of the last settlement price, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- d) If no transaction is concluded after the determination of the last settlement price and the order book contains no active order at the close of trade at a better price than that of the last settlement price, the Market Settlement Price shall be the last settlement price.

#### II.7.4 The End-of-day Settlement Price

The End-of-day Settlement Price is determined by the comparison of the Theoretical Settlement Price, calculated according to principles set forth in section II.8.1, and the Market Settlement Price, calculated according to the guidelines set in section II.8.3:

- a) Provided the value of the Market Settlement Price falls within the Theoretical Spread defined in section II.8.2, then – notwithstanding any provision to the contrary in the Manual – the End-of-day Settlement Price shall be determined as the Market Settlement Price.
- b) Provided the value of the Market Settlement Price falls outside the Theoretical Spread defined in section II.8.2, and if the number of trades for the given instrument on the given day is at least 20 and the number of contracts concluded is at least 200, then the End-of-day Settlement Price shall be determined as the Market Settlement Price.
- c) Provided the value of the Market Settlement Price falls outside the Theoretical spread defined in section II.8.2, if the number of trades for the given instrument on the given day is less than 20 or the number of contracts concluded is less than 200, then the End-of-day Settlement Price shall be determined as the extreme of the Theoretical Spread closer to the Market Settlement Price.
- d) For maturities in which no trades have been concluded since the introduction date the End-of-day Settlement Price shall be determined as the Theoretical Settlement Price, calculated according to principles set forth in section II.8.1.

## II.8 Equity-based options contracts

### II.8.1 The function used for the establishment of the Theoretical Settlement Prices

Public Function EqBinom(P, x, s, t, r, cal, N, am, tdex, td, div) As Single – as set in the appendix of the Manual

**The meaning of the different parameters in the formulae:**

P = closing price of the equity for that day

x = exercise price of the options contract

$s = \text{root}((59 \cdot S \ln(x_{t+1}/x_t)^2 - (S \ln(x_{t+1}/x_t))^2) / ((58 \cdot 59)) \cdot (250)^{0.5}$ ,  
 where:  $x_t, x_{t+1}$ : the closing prices for days ( $t \rightarrow 1 \dots 60$ )

t = the number of days remaining to the day which is 3 settlement days prior to the day of maturity divided by 365

r = the 1-year reference yield published by ÁKK, calculated on the basis of 360 days, in the case of the absence of such yield, the average yield of the last auction in 12-month discount treasury bills, calculated on a basis of 360 days

cal = if the option is a call option, the parameter is true; if it is a put option, it is false

N = number of the subtrees of the binomial tree (100)

am = if the option is an American one, the parameter is true; if it is a European one, it is false

tdex = in the case of payments of dividends, the number of days remaining until the Ex-Dividend day corresponding to the payment of dividends divided by 365

td = in the case of payments of dividends, the number of days remaining until the starting day of the payment of dividends divided by 365



div = the size of the planned dividend of the equity, if the start of the payment of dividends is earlier than 3 settlement days prior to the maturity date. On the basis of data published by the company on the size and date of the payment of dividends and, as long as no such announcement has been made, in accordance with data established on the basis of the annual dividend policies of the companies and the dividend payouts of the previous years, in consultation with the Settlement Price Committee.

## II.8.2 The Theoretical Spread

The Theoretical Spread is determined by

1. the range marked out by a  $\pm 15\%$  change in volatility,
2. and the range marked out by the cash market price  $\pm 2\%$ , relative to the Theoretical Settlement Price

as minimum and maximum values.

## II.8.3 The Market Settlement Price

The Market Settlement Price of the equity-based options contract is determined according to the following principles:

- a) If an active order exists at the close of trade in the order book at a better price than that of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- b) If no active order exists at the close of trade in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the last transaction.
- c) If no transaction is concluded after the determination of the last settlement price, but the order book contains an active order at the close of trade at a better price than that of the last settlement price, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- d) If no transaction is concluded after the determination of the last settlement price and the order book contains no active order at the close of trade at a better price than that of the last settlement price, the Market Settlement Price shall be the last settlement price.

## II.8.4 The End-of-day Settlement Price

The End-of-day Settlement Price is determined by the comparison of the Theoretical Settlement Price, calculated according to principles set forth in section II.9.1, and the Market Settlement Price, calculated according to the guidelines set in section II.9.3:

- a) Provided the value of the Market Settlement Price falls within the Theoretical Spread defined in section II.9.2, then – notwithstanding any provision to the contrary in the Manual – the End-of-day Settlement Price shall be determined as the Market Settlement Price.
- b) Provided the value of the Market Settlement Price falls outside the Theoretical Spread defined in section II.9.2, then – notwithstanding any provision to the contrary in the Manual – the End-of-day Settlement Price shall be determined as the extreme of the Theoretical Spread closer to the Market Settlement Price.
- c) For maturities in which no trades have been concluded since the introduction date the End-of-day Settlement Price shall be determined as the Theoretical Settlement Price, calculated according to principles set forth in section II.9.1.

## II.9 Currency-based options contracts

### II.9.1 The function used for the establishment of the Theoretical Settlement Price

Public Function Bs(P, x, s, t, r, q, cal) As Single – as set in the appendix of the Manual

## Explanation of the input parameters

P = the spot exchange rate established according to Section II.2.2.

x = exercise price of the options contract

$s = \text{root}((59 * S \ln(x_{t+1}/x_t)^2 - (S \ln(x_{t+1}/x_t))^2) / ((58) * 59)) * (250)^{0.5}$ ,

where:  $x_t, x_{t+1}$ ; the closing values for days ( $t \rightarrow 1 \dots 60$ )

t = days remaining to maturity divided by 365

r = the value of the reference interest rate corresponding to the 1-year maturity established in Section II.2.2. for the currency mentioned as second in the name of the given contract, at 16:30.

q = the value of the reference interest rate corresponding to the 1-year maturity established in Section II.2.2 for the currency mentioned as first in the name of the given contract, at 16:30.

cal = if the option is a call option, the parameter is true; if it is a put option, it is false

### II.9.2 The Theoretical Spread

Theoretical Spread is not calculated for currency-based futures products.

### II.9.3 The Market Settlement Price

Market Settlement Price is not calculated for currency-based futures products.

### II.9.4 The End-of-day Settlement Price

End-of-day Settlement price of currency-based futures products is equal to the Theoretical Settlement Price determined according to section II.10.1.

## II.10 Commodity-based options contracts

### II.10.1 The function used for the establishment of the Theoretical Settlement Price

Public Function AruBinom(F, X, s, t, r, cal, N) As Single – as set in the appendix of the Manual

## Explanation of the input parameters

F = the End-of-day Settlement Price of the underlying product

x = exercise price of the options contract

$s = \text{root}((59 * S \ln(x_{t+1}/x_t)^2 - (S \ln(x_{t+1}/x_t))^2) / ((58) * 59)) * (250)^{0.5}$ , if backward-looking statistics are available for at least 3 days on the price development of the underlying product,

where:  $x_t, x_{t+1}$ ; the closing values for days ( $t \rightarrow 1 \dots 60$ )

s = 15%, if on the price development of the underlying product backward-looking statistics are available for less than 3 days

t = days remaining to maturity divided by 365

r = the 1-year reference yield published by ÁKK, calculated on the basis of 360 days, in the case of the absence of such yield, the average yield of the last auction in 12-month discount treasury bills, calculated on a basis of 360 days

cal = if the option is a call option, the parameter is true; if it is a put option, it is false

### II.10.2 The Theoretical Spread

The Theoretical Spread is determined by

1. the range marked out by a  $\pm 10\%$  change in volatility,
2. and the range marked out by the cash market price  $\pm 2\%$ , relative to the Theoretical Settlement Price

as minimum and maximum values.

### **II.10.3 The Market Settlement Price**

The Market Settlement Price of the commodity-based options contracts is determined according to the following principles:

- a) If, at the end of the closing period, the order book contains an active order with a better price than the weighted average price of the transactions concluded in the closing period, then the Market Settlement Price is the price of the highest price bid order or the lowest price ask order.
- b) If, at the end of the closing period, the order book contains no active order with a better price than the weighted average price of the transactions concluded in the closing sub-period, then the Market Settlement Price is the weighted average price of the transactions.
- c) If no trade was concluded in the closing period, and if an active order exists at the end of the closing sub-period in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- d) If no active order exists at the end of the closing period in the order book at a better price than the price of the last transaction concluded after the last settlement price was determined, the Market Settlement Price shall be the price of the last transaction;
- e) If no transaction is concluded after the determination of the most recent settlement price, but the order book contains an active order at the end of the closing sub-period at a better price than that of the last settlement price, the Market Settlement Price shall be the price of the highest price bid order or the lowest price ask order.
- f) If no transaction is concluded after the determination of the most recent settlement price and the order book contains no active order at the end of the closing sub-period at a better price than that of the last settlement price, the Market Settlement Price shall be the last settlement price.

### **II.10.4 The End-of-day Settlement Price**

The End-of-day Settlement Price is determined by the comparison of the Theoretical Settlement Price, calculated according to principles set forth in section II.10.1, and the Market Settlement Price, calculated according to the guidelines set in section II.10.3:

- a) Provided the value of the Market Settlement Price falls within the Theoretical Spread defined in section II.10.2, then – notwithstanding any provision to the contrary in the Manual – the End-of-day Settlement Price shall be determined as the Market Settlement Price.
- b) Provided the value of the Market Settlement Price falls outside the Theoretical Spread defined in section II.10.2, and if the number of trades for the given instrument on the given day is at least 20 and the number of contracts concluded is at least 200, then the End-of-day Settlement Price shall be determined as the Market Settlement Price.
- c) Provided the value of the Market Settlement Price falls outside the Theoretical spread defined in section II.10.2, if the number of trades for the given instrument on the given day is less than 20 or the number of contracts concluded is less than 200, then the End-of-day Settlement Price shall be determined as the extreme of the Theoretical Spread closer to the Market Settlement Price.
- d) For maturities in which no trades have been concluded since the introduction date the End-of-day Settlement Price shall be determined as the Theoretical Settlement Price, calculated according to principles set forth in section II.10.1.

## **III. Intraday clearing settlement price in the absence of real-time position valuation**

### **III.1 Derivatives Section**

If in a segment an intraday clearing takes place, the generation of the settlement price occurs as follows:

1. In the case of a maturity where the clearing was initiated, the price of the transaction initiating that clearing.
2. In the case of the other maturities in that segment, if there have been no transactions for that maturity in the 5 minutes preceding the initiation of the clearing, then
  - a) If compared to the price of the last transaction concluded after the determination of the last settlement price but before the halt of trade due to intraday clearing, an active order with a better price exists in the order book at the halt of trade, the intraday clearing settlement price shall be the price of the highest price bid order or the lowest price ask order.
  - b) If compared to the price of the last transaction concluded after the determination of the last settlement price but before the halt of trade due to intraday clearing, no active order with a better price exists in the order book at the halt of trade, the intraday clearing settlement price shall be the price of the last transaction.
3. In the case of the other in that segment, if for that particular maturity there have been no transactions concluded in the 5 minutes preceding the initiation of the clearing, then
  - if there is a market maker in that maturity, then the arithmetical average of the last buy and sell orders are held by the market maker prior to the clearing due to the latter's market making obligation. If for the given maturity there are several market makers who quote their prices, then it is the arithmetical average of the arithmetical averages calculated from the last buy and sell orders of the different market makers prior to the clearing. If a market maker has an only one-sided order obligation due to an order given in the proximity of the price determined by the daily maximum price changes, then the basis for the averaging is the limit price of the daily maximum price changes, in addition to such order.
  - If there is no market maker in the given maturity, the settlement price is generated in way that the price difference between the clearing settlement price of that maturity to the latest previous settlement price shall be identical to the difference between the last transaction price of the most liquid maturity in that contract (which is the one having produced, prior to the ordering of the intraday clearing, the largest number of deals on the given day) and its previous settlement price.
  - If, on the given day, there have been no deals made in any of the of a contract prior to the ordering of the intraday clearing, but there is a market maker in at least one of the of the given contract, then, in the case of the without a market maker, the settlement price is generated in a way that the difference between the clearing settlement price of that maturity and the last previous settlement price shall be identical to the price difference between the settlement price computed, as outlined above, on the basis of the last orders of the market makers in the closest with a market maker, and the last settlement price previous to that.
  - In the case that there have been no deals in any of the of that contract on the given day and there are no market makers in any of the , then
    - a) If no transaction is concluded after the determination of the most recent settlement price but before the halt of trade due to intraday clearing, and the order book contains a better-priced active order at the time trade is halted, the intraday clearing settlement price shall be the price of the highest price bid order or the lowest price ask order.
    - b) If no transaction is concluded after the determination of the most recent settlement price but before the halt of trade due to intraday clearing, and the order book does not contain a better-priced active order at the time trade is halted, the intraday clearing settlement price shall be the previous settlement price.
  - If the clearing settlement price computed on the basis of the above method falls outside the maximum daily price changes, then the respective edge of the maximum daily price change shall be considered the clearing settlement price.

The price of transactions resulting from a SPREAD order matched with another SPREAD order shall be ignored for the purposes of determining the intraday clearing settlement price.

## III.2 Commodities Section

1. The Exchange determines the Settlement Price of Intraday Clearing for each futures Instrument of Grain Products as laid out below:
  - a) If, at the end of the closing period for clearing, the order book contains an active order with a better price than the weighted average price of the transaction(s) concluded in the closing period, then the intraday clearing settlement price is the price of the highest price bid order or the lowest price ask order.
  - b) If, at the end of the closing period for clearing, the order book contains no active order with a better price than the weighted average price of the transaction(s) concluded in the closing period, then the intraday clearing settlement price is the weighted average price of the transaction(s).
  - c) If no trade is concluded in the closing transaction sub-period, and if an active order exists in the order book at the close of trading at a better price than the price of the last transaction concluded after the last settlement price was determined, the intraday clearing settlement price shall be the price of the highest price bid order or the lowest price ask order.
  - d) If no active order exists in the order book at the end of the closing period for clearing at a better price than the price of the last transaction concluded after the last settlement price was determined, the intraday clearing settlement price shall be the price of the last transaction;
  - e) If no transaction is concluded after the determination of the last settlement price, but the order book contains an active order at the end of the closing period for clearing at a better price than that of the last settlement price, the intraday clearing settlement price shall be the price of the highest price bid order or the lowest price ask order.
  - f) If no transaction is concluded after the determination of the last settlement price and the order book contains no active order at the end of the closing period for clearing at a better price than that of the last settlement price, the intraday clearing settlement price shall be the last settlement price.
2. The Settlement Price Committee is entitled to review and to modify, in line with the Settlement Price Committee Procedure, the intraday clearing settlement prices of grain products that evolve pursuant to Point 1 of Section III.2.
3. In the case of an option series, no settlement price shall be determined during intraday clearing.

## IV. Annex

### The code of the Visual Basic applications used for the establishment of the theoretical settlement price of options

#### IV.1 The approximate function of the standard normal distribution function

Public Function STN(x) As Single

```
Dim A, B As Single

If x >= 0 Then
    A = 1 / Sqr(2 * 3.141592) * Exp(-x * x / 2)
    B = 1 / (1 + 0.33267 * x)
    STN = 1 - A * (0.4361836 * B - 0.1201676 * B * B + 0.937298 * B ^ 3)
Else
    A = 1 / Sqr(2 * 3.141592) * Exp(-x * x / 2)
    B = 1 / (1 - 0.33267 * x)
    STN = A * (0.4361836 * B - 0.1201676 * B * B + 0.937298 * B ^ 3)
End If
```

End Function

#### IV.2 Maximum function

Public Function Maximum(x, y) As Double

```
If x > y Then Maximum = x Else Maximum = y
```

End Function

#### IV.3 Black Scholes function for the valuation of European-type options

Public Function Bs(P, x, s, t, r, q, cal) As Single

```
Dim d1, d2, N, c As Single

If t <= 0 Then
    If cal Then
        Bs = Maximum(P - x, 0)
    Else
        Bs = Maximum(x - P, 0)
    End If
Else
    d1 = (Log((Exp(-q*t)*P) / (Exp(-r * t) * x)) + s * s * t / 2) / (s * Sqr(t))
    d2 = d1 - s * Sqr(t)

    c = STN(d1) * (Exp(-q*t) * P) - STN(d2) * (Exp(-r * t) * x)
    If cal Then
        Bs = c
    Else
        Bs = c + Exp(-r * t) * x - (Exp(-q*t)*P)
    End If
End If
```

End Function

#### IV.4 'Implicit volatility from the Black Scholes formula, with the Newton-Raphson procedure

Public Function IMPBS(s0, P, x, c, t, r, q, cal) As Single

```
Dim d1, d2, V, s, c2 As Single
Dim I As Integer
```

```
If Arbitr(P, x, c, t, r, cal) Then
    IMPBS = -999
Else
```

```
s = s0
c2 = Bs(P, x, s, t, r, cal)
While Abs(c2 - c) > 0.0001
    d1 = (Log((Exp(-q*t)*P) / (Exp(-r * t) * x)) + s * s * t / 2) / (s * Sqr(t))
    V = (Exp(-q*t)*P) * Sqr(t) * (1 / Sqr(2 * 3.141592) * Exp(-d1 * d1 / 2))
    s = s - (c2 - c) / V
    c2 = Bs(P, x, s, t, r, cal)
Wend
```

```
IMPBS = s
End If
```

End Function

#### IV.5 'If this function is true, there is no implicit volatility

Public Function Arbitr(P, x, c, t, r, q, cal) As Boolean

```
Arbitr = False
If cal Then
    If c < 0 Or c < (Exp(-q*t)*P) - x * Exp(-r * t) Or c > (Exp(-q*t)*P) Then Arbitr = True
Else
    If c < 0 Or c < x * Exp(-r * t) - (Exp(-q*t)*P) Or c > x * Exp(-r * t) Then Arbitr = True
End If
```

End Function

#### IV.6 'Binomial (Cox-Ross-Rubinstein) model for a European option, with a single payment of dividends

Public Function Binom(P, x, s, t, r, cal, N, tdex, td, div) As Double

```
Dim u, d, Q, y, pvdiv As Single
Dim I As Integer
Dim J As Double
```

```
u = Exp(s * Sqr(t / N))
d = 1 / u
Q = (Exp(r * t / N) - d) / (u - d)
```

```
If Q < 0 Or Q > 1 Then
    MsgBox ("There is arbitrage in the binomial model. Increase the period number or the volatility")
    Exit Function
End If
```

```
Binom = 0
```

```
If tdex > t Or div = 0 Then
    pvdiv = 0
Else
    pvdiv = Exp(-td * r) * div
    P = P - pvdiv
```



```

End If

J = (1 - Q) ^ N
y = Q / (1 - Q)

For I = 0 To N

    If cal Then
        Binom = Binom + J * Maximum(P * u ^ I * d ^ (N - I) - x, 0)
    Else
        Binom = Binom + J * Maximum(x - P * u ^ I * d ^ (N - I), 0)
    End If

    If I < N Then J = J * (N - I) / (I + 1) * y

Next I

Binom = Binom * Exp(-r * t)

End Function

```

## IV.7 'Binomial model for European and American options, with a single payment of dividends

Public Function EqBinom(P, x, s, t, r, cal, N, am, tdex, td, div) As Single

```

Dim u, d, Q, y, pvdiv, df As Single
Dim Rv() As Single
Dim opc() As Single
Dim I, J, K As Integer
Dim zero As Boolean

If am = False Then
    EqBinom = Binom(P, x, s, t, r, cal, N, tdex, td, div)
    Exit Function
End If

ReDim Rv(N + 1, N + 1) As Single
ReDim opc(N + 1, N + 1) As Single

u = Exp(s * Sqr(t / N))
d = 1 / u
Q = (Exp(r * t / N) - d) / (u - d)
df = Exp(-t / N * r)

If Q < 0 Or Q > 1 Then
    MsgBox ("There is arbitrage in the binomial model. Increase the period number or the volatility")
    Exit Function
End If

If tdex > t Or div = 0 Then
    pvdiv = 0
    K = N + 1
    If cal Then
        EqBinom = Binom(P, x, s, t, r, cal, N, tdex, td, div)
        Exit Function
    End If
Else
    pvdiv = Exp(-td * r) * div
    P = P - pvdiv
    K = Int(tdex / t * N) + 1
End If

'Equity tree
For I = 1 To N + 1
    For J = 1 To I
        Rv(J, I) = P * u ^ (I + 1 - 2 * J)
    Next J
Next I

```

```

    If I - 1 < K Then Rv(J, I) = Rv(J, I) + pvdiv * Exp(r * t * (I - 1) / N)
Next J
Next I

'Options tree
For J = 1 To N + 1
    If cal Then
        opc(J, N + 1) = Maximum(0, Rv(J, N + 1) - x)
    Else
        opc(J, N + 1) = Maximum(0, x - Rv(J, N + 1))
    End If
Next J

For I = N To 1 Step -1
    If cal Then
        zero = False
        J = 1
        Do While J < I + 1 And Not (zero)
            opc(J, I) = Maximum(Rv(J, I) - x, df * (Q * opc(J, I + 1) + (1 - Q) * opc(J + 1, I + 1)))
            If (opc(J, I) = 0) Then
                zero = True
            End If
            J = J + 1
        Loop
        If zero And J <> I + 1 Then
            opc(J, I) = 0
        End If
    Else
        zero = False
        J = I
        Do While J > 0 And Not (zero)
            opc(J, I) = Maximum(x - Rv(J, I), df * (Q * opc(J, I + 1) + (1 - Q) * opc(J + 1, I + 1)))
            If (opc(J, I) = 0) Then
                zero = True
            End If
            J = J - 1
        Loop
        If zero And J <> 0 Then
            opc(J, I) = 0
        End If
    End If
Next I

EqBinom = opc(1, 1)

End Function

```

## IV.8 'Binomial model for grain options

Public Function AruBinom(F, X, s, t, r, cal, N) As Single

```

If t = 0 Then t = 1 ' mod Vassa
Dim u, uu, d, Q, Y, df As Single
Dim Rv() As Single
Dim opc() As Single
Dim I, J, K As Integer
Dim nulla As Boolean

```

```

ReDim Rv(N + 1, N + 1) As Single
ReDim opc(N + 1, N + 1) As Single

```

- ' Nem-klasszikus koordinátarendszer
- ' első koord: lefelé mozdulások száma + 1
- ' második koord: eltelt időintervallumok száma + 1

```

uu = Exp(s * s * t / N) + 1
u = (uu + Sqr(uu * uu - 4)) / 2
d = 1 / u
Q = (1 - d) / (u - d)
df = Exp(-t / N * r)

If Q < 0 Or Q > 1 Then
    MsgBox ("Arbitrázs van a binomiális modellben. Emelje meg a periódusszámot, vagy a volatilitást!")
    Exit Function
End If

'Részvényfa
For I = 1 To N + 1
    For J = 1 To I
        Rv(J, I) = F * u ^ (I + 1 - 2 * J)
    Next J
Next I

'Opciófa
For J = 1 To N + 1
    If cal Then
        opc(J, N + 1) = Maximum(0, Rv(J, N + 1) - X)
    Else
        opc(J, N + 1) = Maximum(0, X - Rv(J, N + 1))
    End If
Next J

For I = N To 1 Step -1
    If cal Then
        nulla = False
        J = 1
        Do While J < I + 1 And Not (nulla)
            opc(J, I) = Maximum(Rv(J, I) - X, df * (Q * opc(J, I + 1) + (1 - Q) * opc(J + 1, I + 1)))
            If (opc(J, I)) = 0 Then
                nulla = True
            End If
            J = J + 1
        Loop
        If nulla And J <> I + 1 Then
            Do While J < I + 1
                opc(J, I) = 0
                J = J + 1
            Loop
        End If
    Else
        nulla = False
        J = I
        Do While J > 0 And Not (nulla)
            opc(J, I) = Maximum(X - Rv(J, I), df * (Q * opc(J, I + 1) + (1 - Q) * opc(J + 1, I + 1)))
            If (opc(J, I)) = 0 Then
                nulla = True
            End If
            J = J - 1
        Loop
        If nulla And J <> 0 Then
            Do While J > 0
                opc(J, I) = 0
                J = J - 1
            Loop
        End If
    End If
Next I

AruBinom = opc(1, 1)

End Function

```

## **V. Archiving Procedures and Reproduction**

**V.1** Decisions of the Secretariat of the Exchange and of the Settlement Price Committee relating to the calculation of the theoretical price are filed in the Archives of Decisions.

## **VI. Operation and Competence of the Settlement Price Committee**

**VI.1** The Exchange Board of the BSE established, with its Decision No. 93/1998, a Settlement Price Committee for the establishment of the settlement prices of the Budapest Stock Exchange.

**VI.2** The task of the Committee is to review the settlement prices of the Stock Exchange and their correction, if necessary.

**VI.3** In any issues relating to the Committee, the rules of procedure of the Settlement Price Committee shall provide guidance.