ProRealTime SOFTWARE

Programming Guide

Indicators & Basic Functions (ProBuilder)

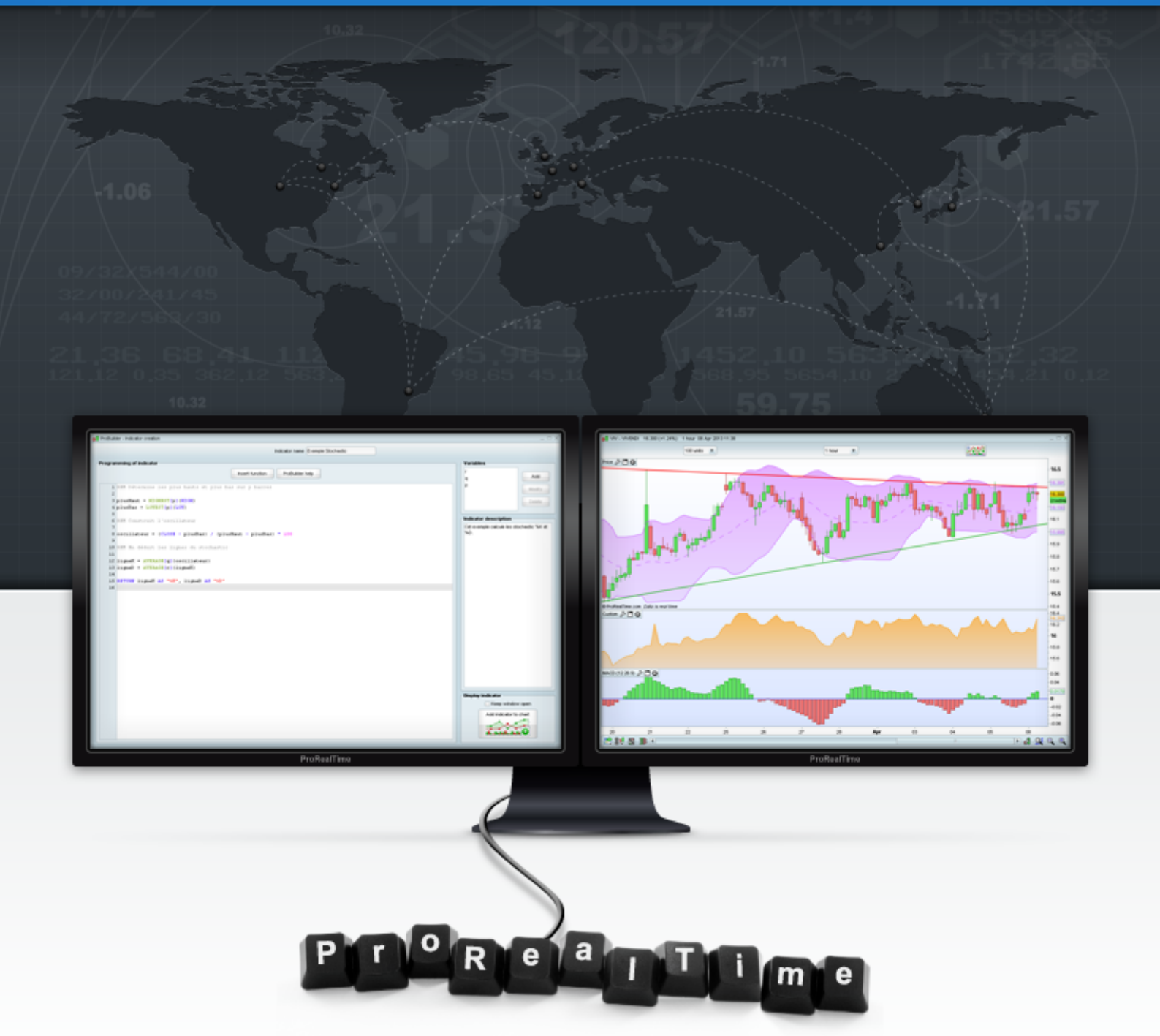

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Table of contents

Introduction to ProBuilder

ProBuilder is ProrealTime's programming language. It allows you to create personalized technical indicators, trading strategies (ProBacktest) or screening programs (ProScreener). A specific manual exists for ProBacktest and ProScreener due to some specifics of each of these modules.

ProBuilder is a BASIC-type programming language, very easy to handle and exhaustive in terms of available possibilities.

You will be able to create your own programs using the quotes from any tool provided by ProRealTime. Some basic available elements include:

- Opening of each bar: Open
- Closing of each bar: Close
- Highest price of each bar: High
- Lowest price of each bar: Low
- Volume of each bar: Volume

Bars or candlesticks are the common charting representations of real time quotes. Of course, ProRealTime offers you the possibility of personalizing the style of the chart. You can use Renko, Kagi, Haikin-Ashi and many other styles.

ProBuilder evaluates the data of each price bar starting with the oldest one to the most recent one, and then executes the formula developed in the language in order to determine the value of the indicators on the current bar.

The indicators coded in ProBuilder can be displayed either in the price chart or in an individual one.

In this document, you will learn, step by step, how to use the available commands necessary to program in this language thanks to a clear theoretical overview and concrete examples.

In the end of the manual, you will find a Glossary which will give you an overall view of all the ProBuilder commands, pre-existing indicators and other functions completing what you would have learned after reading the previous parts.

Users more confident in their programming skills can skip directly to chapter II or just refer to the Glossary to quickly find the information they want.

For those who are less confident, we recommend to watch the video tutorials entitled "**Programming simple and dynamic indicators**" and read the whole manual. Very accurate and guiding as well as highly practically oriented, we are certain that you will master this programming language in no time.

Wishing you the best, good reading!

Chapter I: Fundamentals

Using ProBuilder

Indicator creation quick tutorial

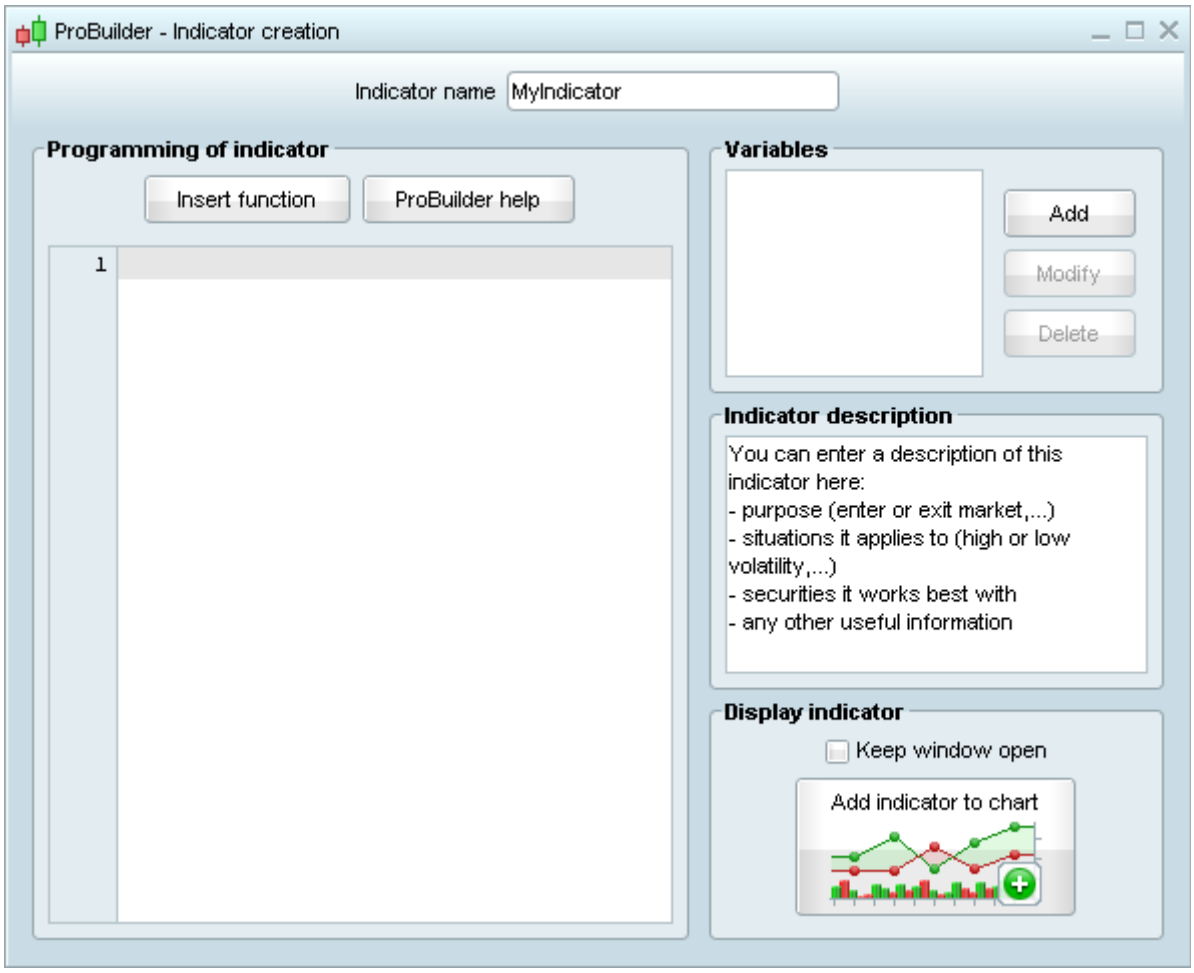
The programming zone of an indicator is available by clicking the button "Indicator/Backtest" which can be found in the upper right corner of each graphic of the ProRealTime platform.

The indicators management window will be displayed. You will then be able to:

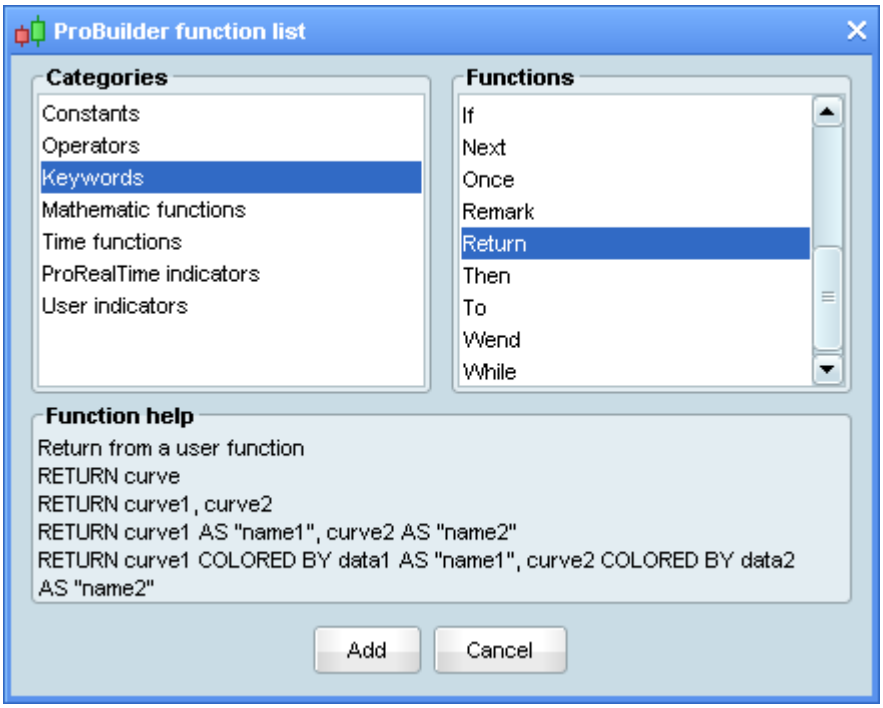
- Display a pre-existing indicator
- Create a personalized indicator, which can be used afterwards on any security

If you choose the second possibility, click on "New indicator" to access the programming window.
At that time, you will be able to choose between:

- programming directly an indicator in the text zone designed for writing code or
- use the help function by clicking on "Insert Function". This will open a new window in which you can find all the functions available. This library is separated in 7 categories, to give you constant assistance while programming.



Let's take for example the first specific ProBuilder element: the "**RETURN**" function (available in the "Keywords" category (see the image below).



Select the word "**RETURN**" and click on "Add". The command will be added to the programming zone.

RETURN allows you to display the result

Suppose we want to create an indicator displaying the Volume. If you have already inserted the function "**RETURN**", then you just need to click one more time on "Insert function". Next, click on "Constants" in the "Categories" section, then in the right side of the window, in the section named "Functions", click on "**Volume**". Finally, click on "Add".

Before clicking on "Validate program", you need to enter the name of your indicator. Here, we named it "Volume DAX". To finish, click on "Validate program" and you will see your indicator displayed below the price chart.

Programming window keyboard shortcuts

The programming window has a number of useful features that can be accessed by keyboard shortcuts starting with ProRealTime version 10:

- Select all (Ctrl + A): Select all text in the programming window
- Copy (Ctrl + C): Copy the selected text
- Paste (Ctrl + X): Paste copied text
- Undo (Ctrl + Z): Undo the last action in the programming window
- Redo (Ctrl + Y): Redo the last action in the programming window
- Find / Replace (Ctrl + F): Find a text in the programming window / replace a text in the programming window (this feature is case-sensitive)
- Comment / Uncomment (Ctrl + R): Comment the selected code / Uncomment the selected code (commented code will be preceded by "//" or "REM" and colored gray. It will not be taken into account when the code is executed).

For Mac users, the same keyboard shortcuts can be accessed with the "Apple" key in place of the "Ctrl" key. Most of these features can also be accessed by right-clicking in the programming window.

Specificities of ProBuilder programming language

Specificities

The ProBuilder language allows you to use many classic commands as well as sophisticated tools which are specific to technical analysis. These commands will be used to program from simple to very complex indicators.

The main ideas to know in the ProBuilder language are:

- It is **not necessary to declare variables**
- It is **not necessary to type variables**
- There is **no difference between capital letters and small letters** (but, as we will see later, there is one exception)
- **We use the same symbol "=" for mathematic equality and to attribute a value to a variable**

What does that mean ?

- Declare a variable X means indicating its existence. In ProBuilder, you can directly use X without having to declare it. Let's take an example:

  With declaration: let be variable X, we attribute to X the value 5

  Without declaration: We attribute to X the value 5 (therefore, implicitly, X exists and the value 5 is attributed to it)

  In ProBuilder you just need to write: X=5

- Type a variable means defining its nature. For example: is the variable a natural number (ex: 3; 8; 21; 643; …), a whole number which can be negative or positive (ex: 3; 632; -37; …), a decimal number (ex: 1.76453534535…), a boolean (RIGHT=1, WRONG=0),…?

- In ProBuilder, you can write your command with capital letters or small letters. For example, the group of commands IF / THEN / ELSE / ENDIF can be written iF / tHeN / ELse / endIf (and many other possibilities!)

  Exception: When you decide to create a variable and re-use it later in the program, you must not contradict the spelling you used during its creation. If you started to name your variable: "vARiaBLe" and wish to re-use it in your program, then you must refer to it as "vARiaBLe", not as "variable" not anything else.

- Affect a value to a variable means give the variable a value. In order to understand this principle, you must assimilate a variable with an empty box which you can fill with an expression (ex: a number). The following diagram illustrate the Affectation Rule with the Volume value affected to the variable X:

X ⟵ Volume

As you can see, we must read from right to left: Volume is affected to X.

If you want to write it under ProBuilder, you just need to replace the arrow with an equal sign:

X = Volume

The same = symbol is used:

- For the affectation of a variable (like the previous example)
- As the mathematical binary operator (1+ 1= 2 is equivalent to 2 = 1 + 1).

Financial constants

Before coding your personal indicators, you must examine the elements you need to write your code such as the opening price, the closing price, etc.

These are the "fundamentals" of technical analysis and the main things to know for coding indicators.

You will then be able to combine them in order to draw out some information provided by financial markets. We can group them together in 5 categories:

Price and volume constants adapted to the timeframe of the chart

These are the "classical" constants and also the ones used the most. They report by default the value of the current bar (whatever the timeframe used).

- **Open:** Opening price of each bar
- **High:** Highest price of each bar
- **Low:** Lowest price of each bar
- **Close:** Closing price of each bar
- **Volume:** The number of securities or contracts exchanged at each bar

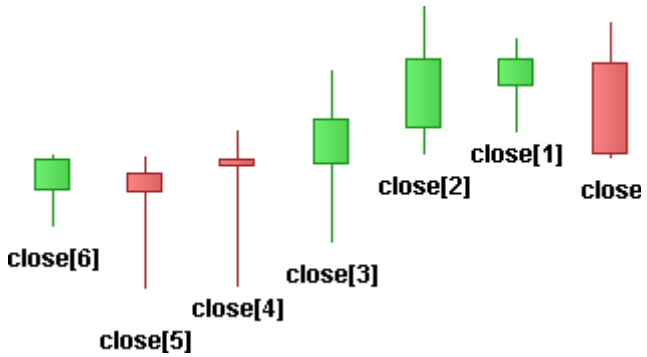
Example: Range of the current bar

```
a = High
b = Low
MyRange = a - b
RETURN MyRange
```

If you want to use the information of previous bars rather than the current bar, you just need to add between square brackets the number of bars that you want to go back into the past.

Let's take for example the closing price constant:

Value of the closing price of the current bar:	*Close*
Value of the closing price preceding the current bar:	*Close[1]*
Value of the closing price preceding the nth bar preceding the current one:	*Close [n]*



This rule is valid for any constant. For example, the opening price of the 2nd bar preceding the current can be expressed as: Open[2].

The reported value will depend on the displayed timeframe of the chart.

Daily price constants

Contrary to the constants adapted to the timeframe of the chart, the daily price constants refer to the value of the day, regardless the timeframe of the chart.

Another difference between Daily price constants and constants adapted to the timeframe of the chart is that the daily price constants use brackets and not square brackets to call the values of previous bars.

- **DOpen(n):** Opening price of the nth day before the one of the current bar
- **DHigh(n):** Highest price of the nth day before the one of the current bar
- **DLow(n):** Lowest price of the nth day before the one of the current bar
- **DClose(n):** Closing price of the nth day before the one of the current bar

Note: "n" can be equal to 0 if we want to call the value for today as shown in the example below.

Day-traders know the importance of the close of the day before and of the open that is a moment of emotion when the novices enter or exit the market.

The high and low of the previous days can indicate the price changes of the next day.

Example: Daily Range

```
a = DHigh(0)
b = DLow(0)
MyRange = a - b
RETURN MyRange
```

The constants adapted to the timeframe of the chart use square brackets while the daily price constants use brackets.

`Close[3]` ➡ The closing price 3 periods ago

`Dclose(3)` ➡ The closing price 3 days ago

Temporal constants

Time is often a neglected component of technical analysis. However traders know very well the importance of some time periods in the day or dates in the year. It is possible in your programs to take into account time and date and improve the efficiency of your indicators. The Temporal constants are described hereafter:

- **Date:** indicates the date of the close of each bar in the format YearMonthDay (YYYYMMDD)

Temporal constants are considered by ProBuilder as whole numbers. The Date constant, for example, must be used as one number made up of 8 figures.

Let's write down the program:

```
RETURN Date
```

Suppose today is the 4th of July 2008, the program above will return the value 20080704 for today and 20080703 for yesterday and so on for previous days.

Date under ProBuilder is then based on the following scale of value:

- One millennium is equivalent to 10 000 000 date units
- One century is equivalent to 1 000 000 date units
- One decade is equivalent to 100 000 date units
- One year is equivalent to 10 000 date units
- Ten months are equivalent to 1 000 date units (do not exceed 12 months)
- One month is equivalent to 100 date units (do not exceed 12 months)
- Ten days are equivalent to10 date units (do not exceed 31 seconds)
- One day is equivalent to 1 date unit (do not exceed 31 seconds)

- **Time:** indicates the hour of the closing price of each bar in the format HourMinuteSecond (HHMMSS)

Example:

```
RETURN Time
```

This indicator shows us the closing time of each bar in the format HHMMSS:

It is also possible to use **Time** and **Date** in the same indicator to do analysis or display results at a precise moment. In the following example, we want to limit our indicator to the date of October 1st at precisely 9am and 1 second:

```
a = (Date = 20081001)
b = (Time = 090001)
RETURN (a AND b)
```

Similar to Date, Time uses the following scale of value:

- Ten hours are equivalent to 100 000 time units (do not exceed 23 hours)
- One hour is equivalent to 10 000 units (do not exceed 23 hours)
- Ten minutes are equivalent to 1 000 time units (do not exceed 59 minutes)
- One minute is equivalent to 100 time units (do not exceed 59 minutes)
- Ten seconds are equivalent to 10 time units (do not exceed 59 seconds)
- One second is equivalent to 1 time unit (do not exceed 59 seconds)

The following constants work the same way:

- **Minute:** Minute of the close of each bar (from 0 to 59): Only for intraday charts.
- **Hour:** Hour of the close of each bar (from 0 to 23): Only for intraday charts.
- **Day:** Day of the months of the closing price of each bar (from 1 to 28 or 29 or 30 or 31)
- **Month:** Month of the closing price of each bar (from 1 to 12)
- **Year:** Year of the closing price of each bar
- **DayOfWeek:** Day of the Week of the close of each bar (does not use weekend days) (1=Monday, 2=Tuesday, 3=Wednesday, 4=Thursday, 5=Friday)

Example:

```
a = (Hour > 170000)
b = (Day = 30)
RETURN (a AND b)
```

- **CurrentHour:** Current Hour (of the local market)
- **CurrentMinute:** Current Minute (of the local market)
- **CurrentMonth:** Current Month (of the local market)
- **CurrentSecond:** Current Second (of the local market)
- **Today:** Current Date (of the local market)
- **CurrentTime:** Current HourMinuteSecond (of the local market)
- **CurrentYear:** Current Year (of the local market)
- **CurrentDayOfWeek:** Current Day of the week with the market time zone as a reference

The difference between the "Current" constants and the "non-Current" constants presented above is the "Current" aspect.

The following picture brings to light that difference (applied on the **CurrentTime** and **Time** constants). We can highlight the fact that for "Current" constants, we must set aside the time axis and only take in consideration the displayed value (the value of the current time is displayed over the whole history of the chart).

Time indicates the closing time of each bar.

CurrentTime indicates the current market time.

If you want to set up your indicators with counters (number of days passed, number of bars passed etc…), you can use the Days, BarIndex and IntradayBarIndex constants.

- **Days:** Counter of days since 1900

This constant is quite useful when you want to know the number of days that have passed. It is particularly relevant when you work with an (x) tick or (x) volume view.

The following example shows you the number of days passed since 1900.

```
RETURN Days
```

- **BarIndex:** Counter of bars since the beginning of the displayed historical data

The counter starts from left to right and counts each bar, including the current bar. The first bar loaded is considered bar number 0. Most of the time, **BarIndex** is used with the **IF** instruction presented later in the manual.

- **IntradayBarIndex:** Counter of intraday bars

The counter displays the number of bars since the beginning of the day and then resets to zero at the beginning of every new day. The first bar of the counter is considered bar number 0.

Let's compare the two counter constants with two separated indicators:

```
RETURN BarIndex
```

and

```
RETURN IntradayBarIndex
```

We can clearly see the difference between them: **IntradayBarIndex** reset itself to zero at the beginning of every new day.

Constants derived from price

These constants allows you to get more complete information compared to **Open**, **High**, **Low** and **Close**, since they combine those prices so to emphasize some aspects of the financial market psychology shown on the current bar.

- **Range:** difference between High and Low.
- **TypicalPrice:** average between High, Low and Close
- **WeightedClose:** weighted average of High (weight 1), Low (weight 1) and Close (weight 2)
- **MedianPrice:** average between High and Low
- **TotalPrice:** average between Open, High, Low and Close

Le **Range** shows the volatility of the current bar, which is an estimation of how nervous investors are.

You can create an indicator with one of the constants above only by creating a one-line indicator "RETURN Range" for example or use the constants to create a more complicated indicator.

The **WeightedClose** focuses on the importance of the closing price bar (even more important when applied to daily bars or weekly bars).

The **TypicalPrice** and **TotalPrice** emphasize intraday financial market psychology since they take 3 or 4 predominant prices of the current bar into account (see above).

MedianPrice uses the Median concept (the middle number) instead of the Average concept which is quite useful when trying to create theoretical models that don't take investors psychology into account.

Range in %:

```
MyRange = Range
Calcul = (MyRange / MyRange[1] - 1) * 100
RETURN Calcul
```

The Undefined constant

The keyword **Undefined** allows you to indicate to the software not to display the value of the indicator.

- **Undefined:** undefined data (equivalent to an empty box)

You can find an example later in the manual.

How to use pre-existing indicators?

Up until now, we have described you the possibilities offered by ProBuilder concerning constants and how to call values of bars of the past using these constants. Pre-existing indicators (the ones already programmed in ProRealTime) function the same way and so do the indicators you will code.

ProBuilder indicators are made up of three elements which syntax is:

NameOfFunction [calculated over n periods] (applied to which price or indicator)

When using the "Insert Function" button to look for a ProBuilder function and then enter it into your program, default values are given for both the period and the price or indicator argument.

Average[20](Close)

We can of course modify these values according to our preferences; for example, we can replace the 20 bars defined by default with 100 bars. In the same way, we can change the price argument "Close" with "Open" or "**DOpen(6)**" – the open of the daily bar 6 days ago:

Average[20](Dopen(6))

Here are some sample programs:

Program calculating the exponential moving average over 20 periods applied to the closing price:

```
RETURN ExponentialAverage[20](Close)
```

Program calculating the weighted moving average over 20 bars applied to the typical price

```
mm = WeightedAverage[20](TypicalPrice)
RETURN mm
```

Program calculating the Wilder average over 100 candlesticks applied to the Volume

```
mm = WilderAverage[100](Volume)
RETURN mm
```

Program calculating the MACD (histogram) applied to the closing price. The MACD is built with the difference between the 12-period exponential moving average (EMA) minus the 26-period EMA. Then, we make a smoothing with an exponential moving average over 9 periods and applied to the MACD line to get the Signal line. Finally, the MACD is the difference between the MACD line and the Signal line.

```
REM Calculation of the MACD line
MACDLine = ExponentialAverage[12](Close) - ExponentialAverage[26](Close)
REM Calculation of the MACD Signal line
MACDSignalLine = ExponentialAverage[9](MACDLine)
REM Calculation of the difference between the MACD line and its Signal
MACDHistogramme = MACDLine - MACDSignalLine
RETURN MACDHistogramme
```

Variables

When you code an indicator, you may want to introduce variables. The variables option in the upper-right corner of the window allows you to attribute a default value to an undefined variable and manipulate it in the "settings" window of the indicator without modifying the code of your program.

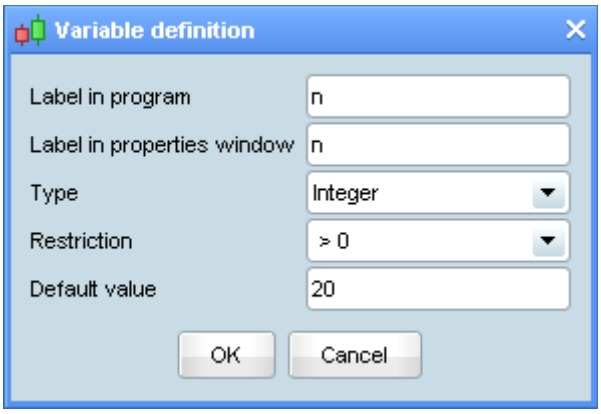
Let's calculate a simple moving average on 20 periods:

```
RETURN Average[20](Close)
```

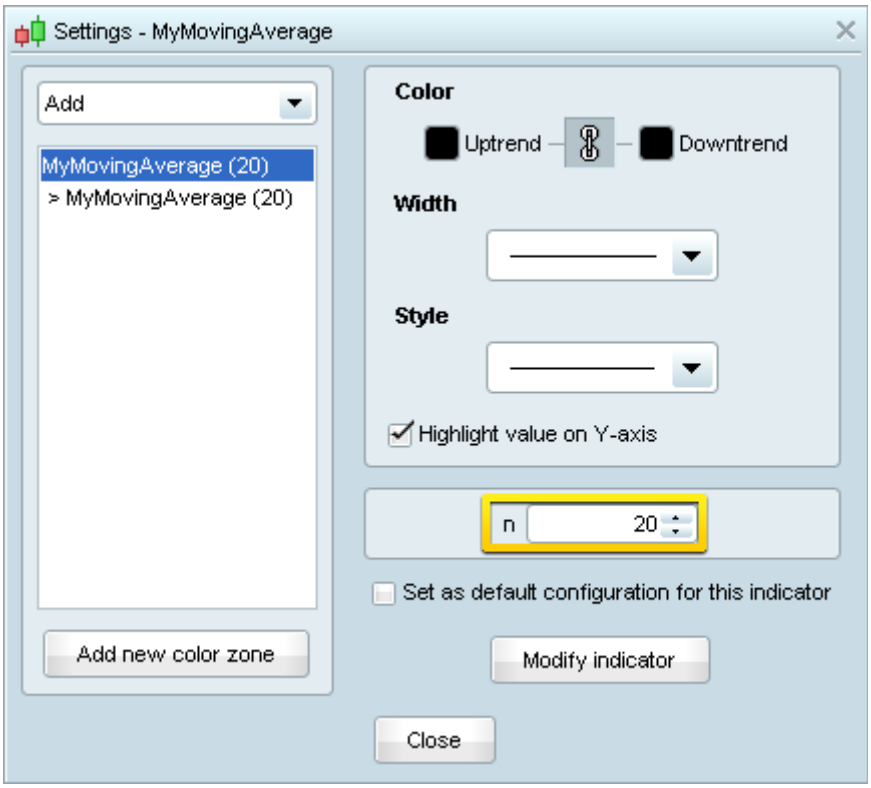
In order to modify the number of periods for the calculation directly from the indicator "Settings" interface, replace 20 with the variable "n":

```
RETURN Average[n](Close)
```

Then, click on "Add" in "Variables" and another window named "Variable definition" will be displayed. Fill it in as follows:



Click on the "OK" button. Then, in the "Settings" window (in this case "Settings MyMovingAverage") you will see a new parameter which will allow you to modify the number of periods in the calculation of the moving average:



Of course, it is possible to do the same with many variables giving you the possibility to manipulate multiple parameters at the same time for the same indicator.

Chapter II: Math Functions and ProBuilder instructions

Control Structures

Conditional IF instruction

The **IF** instruction is used to make a conditioned action, meaning executing the action if one or more conditions is met.

The structure is made up of the instructions **IF**, **THEN**, **ELSE**, **ELSIF**, **ENDIF**, which are used depending on the complexity of the conditions you defined.

One condition, one result (IF THEN ENDIF)

We can look for a condition and define an action if that condition is true. On the other hand, if the condition is not valid, then nothing will happen (By default, Result = 0).

In this example, if current price is greater than the 20-period moving average, then we display: Result = 1 and display this on the chart.

```
IF Close > Average[20](Close) THEN      IF Price > 20-period moving average then
   Result = 1                           Result = 1, otherwise Result =0
ENDIF                                   end of the IF condition
RETURN Result                           Display the value of result on the chart
```

RETURN must always be followed with the storage variable containing the result in order to display the result on the chart (in the last example we use the variable "Result").

One condition, two results (IF THEN ELSE ENDIF)

We can also define a different result if the condition is not true. Let us go back to the previous example: if the price is greater than the moving average on 20 periods, then display 1, else, displays -1.

```
IF Close > Average[20](Close) THEN
   Result = 1
ELSE
   Result = -1
ENDIF
RETURN Result
```

NB: We have created a binary indicator. For more information, see the section on binary and ternary indicators later in this manual.

Sequential IF conditions

You can create sub-c

onditions after the validation of the main condition, meaning conditions which must be validated one after another. For that, you need to build a sequence of **IF** structures, one included in the other. You should be careful to insert in the code as many **ENDIF** as **IF**. Example:

Double conditions on moving averages:

```
IF (Average[12](Close) - Average[20](Close) > 0) THEN
   IF ExponentialAverage[12](Close) - ExponentialAverage[20](Close) > 0 THEN
      Result = 1
   ELSE
      Result = -1
   ENDIF
ENDIF
RETURN Result
```

Multiple conditions (IF THEN ELSE ELSIF ENDIF)

You can define a specific result for a specific condition. The indicator reports many states: if Condition 1 is valid then do Action1; else, if Condition 2 is valid, then do Action 2 …if none of the previously mentioned conditions are valid then do Action n.

This structure uses the following instructions: **IF**, **THEN**, **ELSIF**, **THEN**.... **ELSE**, **ENDIF**.

The syntax is:

```
IF (Condition1) THEN
   (Action1)
ELSIF (Condition2) THEN
   (Action2)
ELSIF (Condition3) THEN
   (Action3)
...
...
...
ELSE
   (Action n)
ENDIF
```

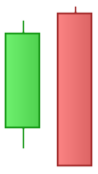
You can also replace **ELSIF** with **ELSE IF** but your program will take longer to write. Of course, you will have to end the loop with as many instance of **ENDIF** as **IF**. If you want to make multiple conditions in your program, we advise you to use **ELSIF** rather than **ELSE IF** for this reason.

Example: detection of bearish and bullish engulfing lines using the Elsif instruction

This indicator displays 1 if a bullish engulfing line is detected, -1 if a bearish engulfing line is detected, and 0 if neither of them is detected.

```
// Detection of a bullish engulfing line
Condition1 = Close[1] < Open[1]
Condition2 = Open < Close[1]
Condition3 = Close > Open[1]
Condition4 = Open < Close
```

```
// Detection of a bearish engulfing line
Condition5 = Close[1] > Open[1]
Condition6 = Close < Open
Condition7 = Open > Close[1]
Condition8 = Close < Open[1]
```



```
IF Condition1 AND Condition2 AND Condition3 AND Condition4 THEN
   a = 1
ELSIF Condition5 AND Condition6 AND Condition7 AND Condition8 THEN
   a = -1
ELSE
   a = 0
ENDIF
RETURN a
```

Example: Resistance Demarks pivot

```
IF DClose(1) > DOpen(1) THEN
   Phigh = DHigh(1) + (DClose(1) - DLow(1)) / 2
   Plow = (DClose(1) + DLow(1)) / 2
ELSIF DClose(1) < DOpen(1) THEN
   Phigh = (DHigh(1) + DClose(1)) / 2
   Plow = DLow(1) - (DHigh(1) - DClose(1)) / 2
ELSE
   Phigh = DClose(1) + (DHigh(1) - DLow(1)) / 2
   Plow = DClose(1) - (DHigh(1) - DLow(1)) / 2
ENDIF
RETURN Phigh , Plow
```

Example: BarIndex

In the chapter I of our manual, we presented **BarIndex** as a counter of bars loaded. **BarIndex** is often used with **IF**. For example, if we want to know if the number of bars in your chart exceeds 23 bars, then we will write:

```
IF BarIndex <= 23 THEN
   a = 0
ELSIF BarIndex > 23 THEN
   a = 1
ENDIF
RETURN a
```

Iterative FOR Loop

FOR is used when we want to exploit a finite series of elements. This series must be made up of whole numbers (ex: 1, 2, 3, etc…) and ordered.

Its structure is formed of **FOR**, **TO**, **DOWNTO**, **DO**, **NEXT**. **TO** and **DOWNTO** are used depending on the order of appearance in the series of the elements (ascending order or descending order). We also highlight the fact that what is between **FOR** and **DO** are the extremities of the interval to scan.

Ascending (FOR, TO, DO, NEXT)

```
FOR (Variable = BeginningValueOfTheSeries) TO EndingValueOfTheSeries DO
   (Action)
NEXT
```

Example: Smoothing of a 12-period moving average

Let's create a storage variable (Result) which will sum the 11, 12 and 13-period moving averages.

```
Result = 0
FOR Variable = 11 TO 13 DO
   Result = Average[Variable](Close) + Result
NEXT
REM Let's create a storage variable (AverageResult) which will divide Result by 3 and
display average result. Average result is a smoothing of the 12-period moving average.
AverageResult = Result / 3
RETURN AverageResult
```

Let's see step by step how the program does the calculation:
Mathematically, we want to calculate the average of the moving averages calculated on 11, 12 and 13 periods.
Period will then get successively the values 11, 12 and 13 (FOR always works with whole numbers only).
Result = 0
When Period = 11: The new Result = the 11 - period moving average + the previous value of result (0).
The counter receives its next value
When Period = 12: The new Result = the 12 - period moving average + the previous value of result.
The counter receives its next value
When Period = 13: The new Result = the 13 - period moving average + the previous value of result.
13 is the last value of the counter.
We end the "**FOR**" loop with the "**NEXT**" instruction.
We then display AverageResult

To sum it up, variable will, first of all, get the beginning value of the series, then variable will receive the next one (the last one + 1) and so on until the very last value of the series. To finish, we end the loop.

Example: Average of the highest price over the 20 last bars

```
Mahigh = 0
SUMhigh = 0
IF BarIndex < 20 THEN                  If there are not yet 20 periods displayed
   MAhigh = Undefined                  Then we attribute to MAhigh value "Undefined" (not displayed)
ELSE                                   ELSE
   FOR i = 0 TO 20 DO                  FOR values of i between 1 to 20
      SUMhigh = High[i]+SUMhigh        We sum the 20 last "High" values
   NEXT
ENDIF
MAhigh = SUMhigh / 20                  We calculate the average for the last 20 periods and
                                       store the result in MAhigh
RETURN MAhigh                          We display MAhigh
```

Descending (FOR, DOWNTO, DO, NEXT)

To make a descending loop, we use: **FOR**, **DOWNTO**, **DO**, **NEXT**.
Its syntax is:

```
FOR (Variable = EndingValueOfTheSeries) DOWNTO BeginningValueOfTheSeries DO
   (Action)
NEXT
```

Let us go back to the previous example (the 20-period moving average of "High"):
We can notice that we have just inverted the extremities of the scanned interval.

```
Mahigh = 0
SUMhigh = 0
IF BarIndex = 0 THEN
   Mahigh = Undefined
ELSE
   FOR i = 20 DOWNTO 1 DO
      SUMhigh = High[i] + SUMhigh
   NEXT
ENDIF
Mahigh = SUMhigh / 20
RETURN Mahigh
```

Conditional WHILE Loop

WHILE is used to keep doing an action while a condition remains true. You will see that this instruction is very similar to the simple conditional instruction **IF**/**THEN**/**ENDIF**.

This structure uses the following instructions: **WHILE**, (**DO** optional), **WEND** (end **WHILE**)

Its syntax is:

```
WHILE (Condition) DO
    (Action 1)
    …
    (Action n)
WEND
```

Example:

```
Result = 0
WHILE Close > Average[20](Close) DO
   Result = 1
WEND
RETURN Result
```

Example: indicator calculating the number of consecutive increases

```
Increase = (Close > Close[1])
Count = 0
WHILE Increase[Count] DO
   Count = Count + 1
WEND
RETURN Count
```

*General comment on the conditional instruction **WHILE***

*Similarly to **IF**, the program will not process the conditional loop if the condition is unknown.*

For example:

```
Count = 0
WHILE i <> 11 DO
   i = i + 1
   Count = Count + 1
WEND
RETURN Count
```

The **WHILE** instruction does not recognize the value of i. Therefore, it cannot test whether i is equal to 10 or not and the loop will not be processed, hence the count is equal to 0.

The correct code would be:

```
i = 0
Count = 0
WHILE i <> 11 DO
   i = i + 1
   Count = Count + 1
WEND
RETURN Count
```

In this code, i is initialized. The loop will then work correctly since the condition for beginning the loop is valid.

BREAK

The **BREAK** instruction allows you to make a forced exit out of a **WHILE** loop or a **FOR** loop. Combinations are possible with the **IF** command, inside a **WHILE** loop or a **FOR** loop.

With WHILE

When we try to get out of a conditional **WHILE** loop without waiting for a situation where the condition is not valid, we use **BREAK**.

Its syntax is:

```
WHILE (Condition) DO
    (Action)
    BREAK
WEND
```

Let's take for example an indicator showing increases of the price:

```
REM Trend indicator: indicates increases
REM When the indicator is equal to 1 then an increase is detected, else, the indicator is equal to 0.
Increase = (Close - Close[1]) > 0
Indicator = 0
i = 0
WHILE Increase[i] DO
    Indicator = Indicator + 1
    i = i + 1
    BREAK
WEND
RETURN Indicator
```

In this code, if **BREAK** wasn't used, the loop would have resumed and the result would be another trend indicator which would have cumulated increases.

With FOR

When we try to get out of an iterative **FOR** loop, without reaching the last (or first) value of the series, we use **BREAK**.

```
FOR (Variable = BeginningValueOfTheSeries) TO EndingValueOfTheSeries DO
    (Action)
    BREAK
NEXT
```

Let's take for example an indicator cumulating increases of the volume of the last 19 periods. This indicator will be equal to 0 if the volume decreases.

```
Count = 0
FOR i = 0 TO 19 DO
    IF (Volume[i] > Volume[i + 1]) THEN
        Count = Count + 1
    ELSE
        BREAK
    ENDIF
NEXT
RETURN Count
```

In this code, if **BREAK** weren't used, the loop would have continued until 19 (last element of the series) even if the condition count is not valid.

However, with **BREAK**, as soon as the condition is valid, the result becomes 0.

CONTINUE

The **CONTINUE** instruction allows you to resume the program reader at the line where **WHILE** or **FOR** is written, thus without restarting completely the loop (any incremented counter will thus keep its value and not be reset to 0). This command is often used with **BREAK**, either to leave the loop (**BREAK**) or to stay in the loop (**CONTINUE**).

With WHILE

Let's create a program counting the number of candlesticks whose close and open are greater than those of the candlestick preceding them. If the condition is not valid, then the counter will be reset to 0.

```
Increase = Close > Close[1]
Count = 0
WHILE Open < Open[1] DO
   IF Increase[Count] THEN
      Count = Count + 1
      CONTINUE
   ENDIF
BREAK
WEND
RETURN Count
```

When using **CONTINUE**, if the **IF** condition is not valid, then the **WHILE** loop is not ended. This allows us to count the number of patterns detected with this condition. Without the **CONTINUE** instruction, the program would leave the loop, even if the **IF** condition is validated. Then, we would not be able to continue counting the number of patterns detected and the result would be binary (1, 0).

With FOR

Let's create a program counting the number of candlesticks whose close and open are greater than those of the candlestick preceding them. If the condition is not valid, then the counter will be reset to 0.

```
Increase = Close > Close[1]
Count = 0
FOR i = 1 TO BarIndex DO
   IF Increase[Count] THEN
      Count = Count + 1
      CONTINUE
   ENDIF
BREAK
NEXT
RETURN Count
```

FOR gives you the possibility to test the condition over all the data loaded. When used with **CONTINUE**, if the **IF** condition is validated, then we do not leave the **FOR** loop and resume it with the next value of i. This is how we count the number of patterns detected by this condition.

Without **CONTINUE**, the program would leave the loop, even if the **IF** condition is validated. Then, we would not be able to count the number of patterns detected and the result would be binary (1, 0).

ONCE

The **ONCE** instruction is used to initialize a variable at a certain value "**only ONE TIME**".

Knowing that for the whole program, the language will read the code for each bar displayed on the chart before returning the result, you must then keep in mind that **ONCE**:

- Is processed only one time by the program including the second reading.
- During the second reading of the program, it will stock the values calculated in the previous reading.

To fully understand how this command works, you need to perceive how the language processes the code, hence the usefulness of the next example.

These are two programs returning respectively 0 and 15 and which only difference is the ONCE command added:

Program 1

```
1 Count = 0
2 i = 0
3 IF i <= 5 THEN
4    Count = Count + i
5    i = i + 1
6 ENDIF
7 RETURN Count
```

Program 2

```
1 ONCE Count = 0
2 ONCE i = 0
3 IF i <= 5 THEN
4    Count = Count + i
5    i = i + 1
6 ENDIF
7 RETURN Count
```

Let's see how the language read the code.

Program 1:

For the first bar, the language will read line 1 (L1: Count = 0; i = 0), then L2, L3, L4, L5 and L6 (Count = 0; i = 1). For the next bar, the program starts at the beginning and both i and count are set to 0, so count will always return 0 for every bar.

Program 2:

For the first bar, the language will read L1 (Count = 0; i = 0), then L2, L3, L4, L5, L6 (Count = 0; i = 1). When it arrives at the line "**RETURN**", it restarts the loop to calculate the value of the next bar starting from L3 (**the lines with ONCE are processed only one time**), L4, L5, L6 (Count = 1; i = 2), then go back again (Count = 3; i = 3) and so forth to (Count = 15; i = 6). Arrived at this result, the **IF** loop is not processed anymore because the condition is not valid anymore; the only line left to read is L7, hence the result is 15 for the remaining bars loaded.

Mathematical Functions

Common unary and binary Functions

Let's focus now on the Mathematical Functions. You will find in ProBuilder the main functions known in mathematics. Please note that a and b are examples and can be numbers or any other variable in your program.

- **MIN**(a, b): calculate the minimum of a and b
- **MAX**(a, b): calculate the maximum of a and b
- **ROUND**(a): round a to the nearest whole number
- **ABS**(a): calculate the absolute value of a
- **SGN**(a): shows the sign of a (1 if positive, -1 if negative)
- **SQUARE**(a): calculate a squared
- **SQRT**(a): calculate the square root of a
- **LOG**(a): calculate the Neperian logarithm of a
- **EXP**(a): calculate the exponent of a
- **COS**(a): calculate the cosine of a
- **SIN**(a): calculate the sine of a
- **TAN**(a): calculate the tangent of a
- **ATAN**(a): calculate the arc-tangent of a

Let's code the example of the normal distribution in mathematics. It's interesting because it use the square function, the square root function and the exponential function at the same time:

```
REM Normal Law applied to x = 10, StandardDeviation = 6 and MathExpectation = 8
REM Let's define the following variables in the variable option:
StandardDeviation = 6
MathExpectation = 8
x = 10
Indicator = EXP((1 / 2) * (SQUARE(x - MathExpectation) / Ecarttype)) / (StandardDeviation
* SQRT(2 / 3.14))
RETURN Indicator
```

Common mathematical operators

- **a < b:** a is strictly less than b
- **a <= b or a =< b:** a is less than or equal to b
- **a > b:** a is strictly greater than b
- **a >= b ou a => b:** a is greater than or equal to b
- **a = b:** a is equal to b (or b is attributed to a)
- **a <> b:** a is different from b

Charting comparison functions

- **a CROSSES OVER b:** the a curve crosses over the b curve
- **a CROSSES UNDER b:** the a curve crosses under the b curve

Summation functions

- **cumsum:** Calculates the sum of a price or indicator over all bars loaded on the chart

The syntax of cumsum is:

```
cumsum (price or indicator)
```

Ex: `cumsum(Close)` calculates the sum of the close of all the bars loaded on the chart.

- **summation:** Calculates the sum of a price or indicator over the last n bars

The sum is calculated starting from the most recent value (from right to left)

The syntax of **summation** is:

```
summation[number of bars]((price or indicator)
```

Ex: `summation[20](Open)` calculates the sum of the open of the last 20 bars.

Statistical functions

The syntax of all these functions is the same as the syntax for the Summation function, that is:

```
lowest[number of bars](price or indicator)
```

- **lowest:** displays the lowest value of the price or indicator written between brackets, over the number of periods defined
- **highest:** displays the highest value of the price or indicator written between brackets, over the number of periods defined
- **STD:** displays the standard deviation of a price or indicator, over the number of periods defined
- **STE:** displays the standard error of a price or indicator, over the number of periods defined

Logical operators

As any programming language, it is necessary to have at our disposal some Logical Operators to create relevant indicators. These are the 4 Logical Operators of ProBuilder:

- **NOT**(a): logical NO
- a **OR** b: logical OR
- a **AND** b: logical AND
- a **XOR** b: exclusive OR

Calculation of the trend indicator: On Balance Volume (OBV):

```
IF NOT((Close > Close[1]) OR (Close = Close[1])) THEN
   MyOBV = MyOBV - Volume
ELSE
   MyOBV = MyOBV + Volume
ENDIF
RETURN MyOBV
```

ProBuilder instructions

- **RETURN:** displays the result
- **CustomClose:** displays a customizable price value; by default, this price is "Close"
- **CALL:** calls another ProBuilder indicator to use in your current program
- **AS:** names the result displayed
- **COLOURED:** colors the displayed curve in with the color of your choice

RETURN

We have already seen in chapter I how important the **RETURN** instruction was. It has some specific properties we need to know to avoid programming errors.
The main points to keep in mind when using **RETURN** in order to write a program correctly are that Return is used:

- One and only one time in each ProBuilder program
- Always at the last line of code
- Optionally with other functions such as AS and COLOURED
- To display many results; we write RETURN followed with what we want to display and separated with a comma (example: RETURN a,b)

REM or //

REM allows you to write remarks or comments inside the code. They are mainly useful to remember how a function you coded works. These remarks will be read but of course not processed by the program. Let's illustrate the concept with the following example:

```
REM This program returns the simple moving average over 20 periods applied to the closing price
RETURN Average[20](Close)
```

Don't use special characters (examples: é,ù,ç,ê…) in ProBuilder, even in the **REM** section

CustomClose

CustomClose is a constant allowing you to display the **Close**, **Open**, **High**, **Low** constants and many others, which can be customized in the Settings window of the indicator.

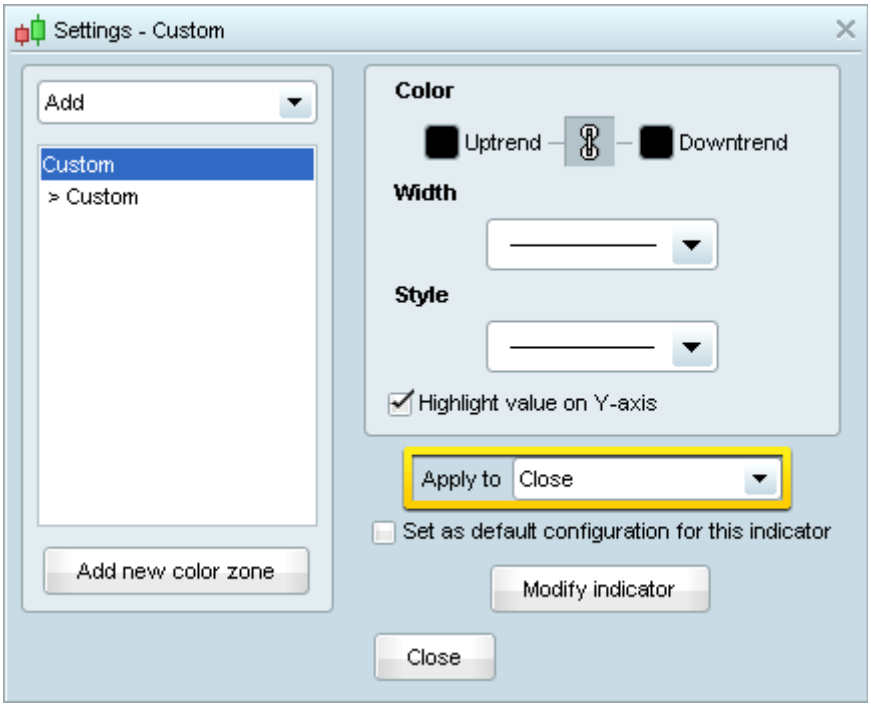
Its syntax is the same as the one of the constants adapted to the timeframe of the chart:

```
CustomClose[n]
```

Example:

```
// Displays the average over 20 periods applied to CustomClose
RETURN CustomClose[2]
```

By clicking on the wrench in the upper left corner of the chart, you will see that it is possible to customize the prices used in the calculation (on the diagram, circled in yellow).



CALL

CALL allows you to use a personal indicator you have coded before in the platform.

The quickest method is to click “Insert Function” then select the "User Indicators" category and then select the name of the indicator you want to use and click "Add".

For example, imagine you have coded the Histogram MACD and named it HistoMACD.

Select your indicator and click on "Add". You will see in the programming zone:

```
myHistoMACD = CALL HistoMACD
```

The software gave the name "myHistoMACD" to the indicator "HistoMACD".

This means that for the rest of your program, if you want to use the HistoMACD indicator, you will have to call it "myHistoMACD".

AS

The keyword **AS** allows you to name the different results displayed. This instruction is used with **RETURN** and its syntax is:

```
RETURN Result1 AS "Curve Name", Result2 AS "Curve Name", …
```

The advantage of this command is that it makes it easier to identify the different curves on your chart.

Example:

```
a = ExponentialAverage[200](Close)
b = WeightedAverage[200](Close)
c = Average[200](Close)
RETURN a AS "Exponential Average", b AS "Weighted Average", c AS "Arithmetical Average"
```

COLOURED

COLOURED is used after the **RETURN** command to color the curve displayed with the color of your choice, defined with the RGB norm (red, green, blue). These are the main colors of this norm:

COLOR	RGB VALUE (RED, GREEN, BLUE)	ENGLISH
	(0, 0, 0)	Black
	(255, 255, 255)	White
	(255, 0, 0)	Red
	(0, 255, 0)	Green
	(0, 0, 255)	Blue
	(255, 255, 0)	Yellow
	(0, 255, 255)	Cyan
	(255, 0, 255)	Magenta

The syntax of the Coloured command is:

```
RETURN Indicator COLOURED(Red, Green, Blue)
```

The **AS** command can be associated with the **COLOURED**(. , . , .) command. This association must be used in this order:

```
RETURN Indicator COLOURED(Red, Green, Blue) AS "Name Of The Curve"
```

Let's go back to the previous example and insert **COLOURED** in the "**RETURN**" line.

```
a = ExponentialAverage[200](Close)
b = WeightedAverage[200](Close)
c = Average[200](Close)
RETURN a COLOURED(255, 0, 0) AS "Exponential Moving Average", b COLOURED(0, 255, 0) AS "WeightedMoving Average", c COLOURED(0, 0, 255) AS "Simple Moving Average"
```

This picture shows you the color customization of the result.

Chapter III: Practical aspects

Why and how to create binary or ternary indicators

A binary or ternary indicator is an indicator which returns only two or three possible results (usually 0, 1 or -1). Its main purpose in a trading context is to identify very quickly the pattern or conditions you defined in your indicator with a visual signal.

Purpose of a binary or ternary indicator:

- Detect the main candlestick patterns (ex: Harami, Morning Stars, Hammers, …)
- Make it easier to read the chart when trying to identify specific conditions
- Place simple 1-condition alerts on an indicator which includes several conditions ➡ you will have more alerts at your disposal!
- Detect complex conditions on historical data loaded
- Make it easier to create a backtest

Furthermore, you can find in the ProBacktest manual many examples of stops to be inserted in investment strategies.

Binary or ternary indicators are built essentially with IF structures. We advise you to read the IF section before continuing your reading.

Lets look at an example of a binary and ternary indicator:

Binary Indicator: hammer detection hammer

```
Hammer = Close>Open AND High = Close AND (Open-Low) >= 3*(Close-Open)
IF Hammer THEN
   Result = 1
ELSE
   Result = 0
ENDIF
RETURN Result AS "Hammer"
```

Ternary Indicator: Golden Cross and Death Cross detection

```
a = ExponentialAverage[10](Close)
b = ExponentialAverage[20](Close)
c = 0
// Golden Cross detection
IF a CROSSES OVER b THEN
   c = 1
ENDIF
// Death Cross detection
IF a CROSSES UNDER b THEN
   c = -1
ENDIF
RETURN c
```

Note: we have displayed the exponential moving average over 10 and 20 periods both applied to the close in order to highlight the results of the indicator.

You can find other candlestick pattern indicators in the "Exercises" chapter later in this manual.

Creating stop indicators to follow a position

It is possible to create STOP indicators, meaning potential places to exit the market defined by personalized parameters.

With the backtesting module ProBacktest, which is the subject of another programming manual, you can also define the stop levels of a backtest. However, programming a stop as an indicator is interesting because:

- It allows to visualize the stop as a line which updates in real-time on the chart (ex: trailing stop)
- It is possible to place real-time alerts to be immediately informed of the situation
- It is not necessary to create long or short orders (contrary to ProBacktest)

Programming Stops is also a means to master the commands you saw in the previous chapters.

These are the 4 categories of stop we will focus on:

- **StaticTake Profit STOP**
- **Static STOP Loss**
- **Inactivity STOP**
- **Trailing STOP (trailing stop loss or trailing take profit)**

The indicators presented in the following examples are possible codes to create stop indicators. You will most probably personalize them using the instructions you learned in the previous chapters.

StaticTake Profit STOP

A *Static Take-Profit* designates a level that if price reaches it, we plan to close our position and exit with gains. By definition, this STOP is a fixed level (horizontal line). The user of this kind of STOP will exit his position and take his profit when this level is reached.

The indicator coded below indicates two levels and “StartingTime” is the moment you entered your position:

- If you are a buyer, you will take into account the higher curve, representing a 10% profit (110% of the price when you took your long position).
- If you are a seller, you will take into account the lower curve, representing a10% profit (90% of the price when you took your short position).

```
// We define in the variable option:
// StartingTime = 100000 (this is an example for 10 am; set this to the time you entered your position)
// Price= Price when you took your position
// You can look at StopLONG if looking at a long position and StopShort if you are looking at a short position. You can also remove StopLONG or StopSHORT if you only work with long positions or only work with short positions.
// AmplitudeUp represents the variation rate of Price used to draw the Take Profit for long position (default: 1.1)
// AmplitudeDown represents the variation rate of Price used to draw the Take Profit for short position (default: 0.9)
IF Time = StartingTime THEN
   StopLONG = AmplitudeUp * Price
   StopSHORT = AmplitudeDown * Price
ENDIF
RETURN StopLONG COLOURED(0, 0, 0) AS "TakeProfit LONG 10%", StopSHORT COLOURED(0, 255, 0) AS "TakeProfit SHORT 10%"
```

Static STOP loss

A *Static STOP* Loss is the contrary of a *Static Take-Profit STOP*, meaning if price reaches it, we plan to close our position and exit with losses. This STOP is very useful when you are losing money and try exit the market to limit your losses to the minimum. Just like the *Static Take-Profit*, this STOP defines a fixed level, but this time, the user will exit his position and cut his losses when this level is reached.

The indicator coded below indicates two levels and “StartingTime” is the moment you entered your position:

- If you are a buyer, you will take into account the lower curve, representing a 10% loss (90% of the price when you took your long position).
- If you are a seller, you will take into account the higher curve, representing a 10% loss (110% of the price when you took your short position).

The code of this indicator is:

```
// We define in the variable option:
// StartingTime = 100000 (this is an example for 10 am; set this to the time you entered your position)
// Price= Price when you took your position
// You can look at StopLONG if looking at a long position and StopShort if you are looking at a short position. You can also remove StopLONG or StopSHORT if you only work with long positions or only work with short positions.
// AmplitudeUp represents the variation rate of Price used to draw the Stop Loss for short position (default: 0.9)
// AmplitudeDown represents the variation rate of Price used to draw the Tsop Loss for long position (default: 1.1)
IF Time = StartingTime THEN
   StopLONG = AmplitudeUp * Price
   StopSHORT = AmplitudeDown * Price
ENDIF
RETURN StopLONG COLOURED(0, 0, 0) AS "StopLoss LONG 10%", StopSHORT COLOURED(0, 255, 0) AS "StopLoss SHORT 10%"
```

Inactivity STOP

An inactivity STOP closes the position when the gains have not obtained a certain objective (defined in % or in points) over a certain period (defined in number of bars).

Remember to define the variables in the "Variables" section.

Example of Inactivity Stop on Intraday Charts:

This stop must be used with those two indicators:

- The first indicator juxtaposed to the curve of the price
- The second indicator must be displayed in a separated chart

Indicator1

```
// We define in the variable option:
// MyVolatility = 0.01 represents variation rate between the each part of the range and the close
IF IntradayBarIndex = 0 THEN
   ShortTarget = (1 - MyVolatility) * Close
   LongTarget = (1 + MyVolatility) * Close
ENDIF
RETURN ShortTarget AS "ShortTarget", LongTarget AS "LongTarget"
```

Indicator2

```
// We define in the variable option:
REM We supposed that you take an "On Market Price" position
// MyVolatility = 0.01 represents variation rate between the each part of the range and the close
// NumberOfBars=20: the close can fluctuate within the range defined during a maximum of NumberOfBars before the position is cut (Result = 1)
Result = 0
Cpt = 0
IF IntradayBarIndex = 0 THEN
   ShortTarget = (1 - MyVolatility) * Close
   LongTarget = (1 + MyVolatility) * Close
ENDIF
FOR i = IntradayBarIndex DOWNTO 1 DO
   IF Close[i] >= ShortTarget AND Close[i] <= LongTarget THEN
      Cpt = Cpt + 1
   ELSE
      Cpt = 0
   ENDIF
   IF Cpt = NumberOfBars THEN
      Result = 1
   ENDIF
NEXT
RETURN Result
```

Trailing Stop

A *trailing STOP* follows the evolution of the price dynamically and indicates when to close a position.

We suggest you two ways to code the trailing STOP, the first one representing a Dynamic Trailing Stop Loss, and the other one a Dynamic Trailing Take Profit.

Dynamic Trailing STOP LOSS (to be used in intraday trading)

```
// Define the following variables in the variable section:
// StartingTime = 090000 (this is an example for 9 am; set this to the time you entered your position)
REM We supposed that you take an "On Market Price" position
// Amplitude represents the variation rate of the "Cut" curve compared to the "Lowest" curves (for example, we can take Amplitude = 0.95)
IF Time = StartingTime THEN
   IF lowest[5](Close) < 1.2 * Low THEN
      IF lowest[5](Close) >= Close THEN
         Cut = Amplitude * lowest[5](Close)
      ELSE
         Cut = Amplitude * lowest[20](Close)
      ENDIF
   ELSE
      Cut = Amplitude * lowest[20](Close)
   ENDIF
ENDIF
RETURN Cut AS "Trailing Stop Loss"
```

Dynamic Trailing STOP Profit (to be used in intraday trading)

```
// Define the following variables in the variable section:
// StartingTime = 090000 (this is an example for 9 am; set this to the time you entered your position)
REM You take an "On Market Price" position
// Amplitude represents the variation rate of the "Cut" curve compared to the "Lowest" curves (for example, we can take Amplitude = 1.015)
IF Time = StartingTime THEN
   StartingPrice = Close
ENDIF
Price = StartingPrice - AverageTrueRange[10]
TrailingStop = Amplitude * highest[15](Price)
RETURN TrailingStop COLOURED (255, 0, 0) AS "Trailing take profit"
```

Chapter IV: Exercises

Candlesticks patterns

- **GAP UP or DOWN**

The candlesticks can be either black or white

A gap is defined by these two conditions:

- (the current low is strictly greater than the high of the previous bar) or (the current high is strictly lesser than the low of the previous bar)
- the absolute value of ((the current low – the high of the previous bar)/the high of the previous bar) is strictly greater than amplitude) or ((the current high – the low of the previous bar)/the low of the previous bar) is strictly greater than amplitude)

```
// Initialization of Amplitude
Amplitude = 0.001
// Initialization of detector
Detector = 0
// Gap Up
// 1st condition of the existence of a gap
IF Low > High[1] THEN
   // 2nd condition of the existence of a gap
   IF ABS((Low - High[1]) / High[1]) > Amplitude THEN
      // Behavior of the detector
      Detector = 1
   ENDIF
ENDIF
// Gap Down
// 1st condition of the existence of a gap
IF High < Low[1] THEN
   // 2nd condition of the existence of a gap
   IF ABS((High - Low[1]) / Low[1]) > Amplitude THEN
      // Behavior of the detector
      Detector = -1
   ENDIF
ENDIF
// Result display
RETURN Detector AS "Gap detection"
```

- **Doji (flexible version)**

In this code, we define a doji to be a candlestick with a range (High – Close) is greater than 5 times the absolute value of (Open – Close).

```
Doji = Range > ABS(Open - Close) * 5
RETURN Doji AS "Doji"
```

- **Doji (strict version)**

We define the doji with a Close equal to its Open.

```
Doji = (Open = Close)
RETURN Doji AS "Doji"
```

Indicators

- **BODY MOMENTUM**

The Body Momentum is mathematically defined by:
BodyMomentum = 100 * BodyUp / (BodyUp + BodyDown)
BodyUp is a counter of bars for which close is greater than open during a certain number of periods.
BodyDown is a counter of bars for which open is greater than close during a certain number of periods.

```
Periods = 14
b = Close - Open
IF BarIndex > Periods THEN
   Bup = 0
   Bdn = 0
   FOR i = 1 TO Periods
      IF b[i] > 0 THEN
         Bup = Bup + 1
      ELSIF b[i] < 0 THEN
         Bdn = Bdn + 1
      ENDIF
   NEXT
   BM = (Bup / (Bup + Bdn)) * 100
ELSE
   BM = Undefined
ENDIF
RETURN BM AS "Body Momentum"
```

ELLIOT WAVE OSCILLATOR

The Elliot wave oscillator shows the difference between two moving averages.

Parameters:

a: short MA periods (5 by default)

b: long MA periods (35 by default)

This oscillator permits to distinguish between wave 3 and wave 5 using Elliot wave theory.

The short MA shows short-term price action whereas the long MA shows the longer term trend.

When the prices form wave 3, the prices climb strongly which shows a high value of the Elliot Wave Oscillator.

In wave 5, the prices climb more slowly, and the oscillator will show a lower value.

```
RETURN Average[5](MedianPrice) - Average[35](MedianPrice) AS "Elliot Wave Oscillator"
```

Williams %R

This is an indicator very similar to the Stochastic oscillator. To draw it, we define 2 curves:

1) The curve of the highest of high over 14 periods

2) The curve of the lowest of low over 14 periods

The %R curve is defined by this formula: (Close – Lowest Low) / (Highest High – Lowest Low) * 100

```
HighestH = highest[14](High)
LowestL = lowest[14](Low)
MyWilliams = (Close - LowestL) / (HighestH - LowestL) * 100
RETURN MyWilliams AS "Williams %R"
```

Bollinger Bands

The middle band is a simple 20-period moving average applied to close.

The upper band is the middle band plus 2 times the standard deviation over 20 periods applied to close.

The lower band is the middle band minus 2 times the standard deviation over 20 periods applied to close.

```
a = Average[20](Close)
// We define the standard deviation.
StdDeviation = STD[20](Close)
Bsup = a + 2 * StdDeviation
Binf = a - 2 * StdDeviation
RETURN a AS "Average", Bsup AS "Bollinger Up", Binf AS "Bollinger Down"
```

Glossary

A

CODE	SYNTAX	FUNCTION
ABS	ABS(a)	Mathematical function "Absolute Value" of a
AccumDistr	AccumDistr(price)	Classical Accumulation/Distribution indicator
ADX	ADX[N]	Indicator Average Directional Index or "ADX" of n periods
ADXR	ADXR[N]	Indicator Average Directional Index Rate or "ADXR" of n periods
AND	a AND b	Logical AND Operator
AroonDown	AroonDown[P]	Aroon Down indicator of n periods
AroonUp	AroonUp[P]	Aroon Up indicator of n periods
ATAN	ATAN(a)	Mathematical function "Arctangent" of a
AS	RETURN Result AS "ResultName"	Instruction used to name a line or indicator displayed on chart. Used with "RETURN"
Average	Average[N](price)	Simple Moving Average of n periods
AverageTrueRange	AverageTrueRange[N](price)	"Average True Range" - True Range smoothed with the Wilder method

B

CODE	SYNTAX	FUNCTION
BarIndex	BarIndex	Number of bars since the beginning of data loaded (in a chart in the case of a ProBuilder indicator or for a trading system in the case of ProBacktest or ProOrder)
BollingerBandWidth	BollingerBandWidth[N](price)	Bollinger Bandwidth indicator
BollingerDown	BollingerDown[N](price)	Lower Bollinger band
BollingerUp	BollingerUp[N](price)	Upper Bollinger band
BREAK	(FOR...DO...BREAK...NEXT) or (WHILE...DO...BREAK...WEND)	Instruction forcing the exit of FOR loop or WHILE loop

C

CODE	SYNTAX	FUNCTION
CALL	myResult=CALL myFunction	Calls a user indicator to be used in the program you are coding
CCI	CCI[N](price) or CCI[N]	Commodity Channel Index indicator
ChaikinOsc	ChaikinOsc[Ch1, Ch2](price)	Chaikin oscillator
Chandle	Chandle[N](price)	Chande Momentum Oscillator
ChandeKrollStopUp	ChandeKrollStopUp[Pp, Qq, X]	Chande and Kroll Protection Stop on long positions
ChandeKrollStopDown	ChandeKrollStopDown[Pp, Qq, X]	Chande and Kroll Protection Stop on short positions
Close	Close[N]	Closing price of the current bar or of the n-th last bar
COLOURED	RETURN x COLOURED(R,G,B)	Colors a curve with the color you defined using the RGB convention
COS	COS(a)	Cosine Function
CROSSES OVER	a CROSSES OVER b	Boolean Operator checking whether a curve has crossed over another one
CROSSES UNDER	a CROSSES UNDER b	Boolean Operator checking whether a curve has crossed under another one
cumsum	cumsum(price)	Sums a certain price on the whole data loaded
CurrentDayOfWeek	CurrentDayOfWeek	Represents the current day of the week
CurrentHour	CurrentHour	Represents the current hour
CurrentMinute	CurrentMinute	Represents the current minute
CurrentMonth	CurrentMonth	Represents the current month
CurrentSecond	CurrentSecond	Represents the current second
CurrentTime	CurrentTime	Represents the current time (HHMMSS)
CurrentYear	CurrentYear	Represents the current year
CustomClose	CustomClose[N]	Constant which is customizable in the settings window of the chart (default: Close)
Cycle	Cycle(price)	Cycle Indicator

D

CODE	SYNTAX	FUNCTION
Date	Date[N]	Reports the date of each bar loaded on the chart
Day	Day[N]	Reports the day of each bar loaded in the chart
Days	Days[N]	Counter of days since 1900
DayOfWeek	DayOfWeek[N]	Day of the week of each bar
DClose	DClose(N)	Close of the n-th day before the current one
DEMA	DEMA[N](price)	Double Exponential Moving Average
DHigh	DHigh(N)	High of the n-th bar before the current bar
DI	DI[N](price)	Represents DI+ minus DI-
DIminus	DIminus[N](price)	Represents the DI- indicator
DIplus	DIplus[N](price)	Represents the DI+ indicator
DLow	DLow(N)	Low of the n-th day before the current one
DO	See FOR and WHILE	Optional instruction in FOR loop and WHILE loop to define the loop action
DOpen	DOpen(N)	Open of the n-th day before the current one
DOWNTO	See FOR	Instruction used in FOR loop to process the loop with a descending order
DPO	DPO[N](price)	Detrented Price Oscillator

E

CODE	SYNTAX	FUNCTION
EaseOfMovement	EaseOfMovement[I]	Ease of Movement indicator
ELSE	See IF/THEN/ELSE/ENDIF	Instruction used to call the second condition of If-conditional statements
ELSEIF	See IF/THEN/ELSIF/ELSE/ENDIF	Stands for Else If (to be used inside of conditional loop)
EMV	EMV[N]	Ease of Movement Value indicator
ENDIF	See IF/THEN/ELSE/ENDIF	Ending Instruction of IF-conditional statement
EndPointAverage	EndPointAverage[N](price)	End Point Moving Average of a
EXP	EXP(a)	Mathematical Function "Exponential"
ExponentialAverage	ExponentialAverage[N](price)	Exponential Moving Average

F - G

CODE	SYNTAX	FUNCTION
FOR/TO/NEXT	FOR i=a TO b DO a NEXT	FOR loop (processes all the values with an ascending (TO) or a descending order (DOWNTO))
ForceIndex	ForceIndex(price)	Force Index indicator (determines who controls the market (buyer or seller)

H

CODE	SYNTAX	FUNCTION
High	High[N]	High of the current bar or of the n-th last bar
highest	highest[N](price)	Highest price over a number of bars to be defined
HistoricVolatility	HistoricVolatility[N](price)	Historic Volatility (or statistic volatility)
Hour	Hour[N]	Represents the hour of each bar loaded in the chart

I - J - K

CODE	SYNTAX	FUNCTION
IF/THEN/ENDIF	IF a THEN b ENDIF	Group of conditional instructions without second instruction
IF/THEN/ELSE/ENDIF	IF a THEN b ELSE c ENDIF	Group of conditional instructions
IntradayBarIndex	IntradayBarIndex[N]	Counts how many bars are displayed in one day on the whole data loaded

L

CODE	SYNTAX	FUNCTION
LinearRegression	LinearRegression[N](price)	Linear Regression inidcator
LinearRegressionSlope	LinearRegressionSlope[N] (price)	Slope of the Linear Regression inidcator
LOG	LOG(a)	Mathematical Function "Neperian logarithm" of a
Low	Low[N]	Low of the current bar or of the n-th last bar
lowest	lowest[N](price)	Lowest price over a number of bars to be defined

M

CODE	SYNTAX	FUNCTION
MACD	MACD[S,L,Si](price)	Moving Average Convergence Divergence (MACD) in histogram
MACDline	MACDLine[S,L](price)	MACD line indicator
MassIndex	MassIndex[N]	Mass Index Indicator applied over N bars
MAX	MAX(a,b)	Mathematical Function "Maximum"
MedianPrice	MedianPrice	Average of the high and the low
MIN	MIN(a,b)	Mathematical Function "Minimum"
Minute	Minute	Represents the minute of each bar loaded in the chart
MOD	a MOD b	Mathematical Function "remainder of the division"
Momentum	Momentum[I]	Momentum indicator (close – close of the n-th last bar)
MoneyFlow	MoneyFlow[N](price)	MoneyFlow indicator (result between -1 and 1)
MoneyFlowIndex	MoneyFlowIndex[N]	MoneyFlow Index indicator
Month	Month[N]	Represents the month of each bar loaded in the chart

N

CODE	SYNTAX	FUNCTION
NEXT	See FOR/TO/NEXT	Ending Instruction of FOR loop
NOT	Not A	Logical Operator NOT

O

CODE	SYNTAX	FUNCTION
OBV	OBV(price)	On-Balance-Volume indicator
ONCE	ONCE VariableName = VariableValue	Introduces a definition statement which will be processed only once
Open	Open[N]	Open of the current bar or of the n-th last bar
OR	a OR b	Logical Operator OR

P - Q

CODE	SYNTAX	FUNCTION
PriceOscillator	PriceOscillator[S,L](price)	Percentage Price oscillator
PositiveVolumeIndex	PriceVolumeIndex(price)	Positive Volume Index indicator
PVT	PVT(price)	Price Volume Trend indicator

R

CODE	SYNTAX	FUNCTION
R2	R2[N](price)	R-Squared indicator (error rate of the linear regression on price)
Range	Range[N]	calculates the Range (High minus Low)
REM	REM comment	Introduces a remark (not taken into account by the code)
Repulse	Repulse[N](price)	Repulse indicator (measure the buyers and sellers force for each candlestick)
RETURN	RETURN Result	Instruction returning the result
ROC	ROC[N](price)	Price Rate of Change indicator
RSI	RSI[N](price)	Relative Strength Index indicator
ROUND	ROUND(a)	Mathematical Function "Round a to the nearest whole number"

S

CODE	SYNTAX	FUNCTION
SAR	SAR[At,St,Lim]	Parabolic SAR indicator
SARatdmf	SARatdmf[At,St,Lim](price)	Smoothed Parabolic SAR indicator
SIN	SIN(a)	Mathematical Function "Sine"
SGN	SGN(a)	Mathematical Function "Sign of" a (it is positive or negative)
SMI	SMI[N,SS,DS](price)	Stochastic Momentum Index indicator
SmoothedStochastic	SmoothedStochastic[N,K](price)	Smoothed Stochastic
SQUARE	SQUARE(a)	Mathematical Function "a Squared"
SQRT	SQRT(a)	Mathematical Function "Squared Root" of a
STD	STD[N](price)	Statistical Function "Standard Deviation"
STE	STE[N](price)	Statistical Function "Standard Error"

Stochastic	Stochastic[N,K](price)	%K Line of the Stochastic indicator
summation	summation[N](price)	Sums a certain price over the N last candlesticks
Supertrend	Supertrend[STF,N]	Super Trend indicator

T

CODE	SYNTAX	FUNCTION
TAN	TAN(a)	Mathematical Function "Tangent" of a
TEMA	TEMA[N](price)	Triple Exponential Moving Average
THEN	See IF/THEN/ELSE/ENDIF	Instruction following the first condition of "IF"
Time	Time[N]	Represents the time of each bar loaded in the chart
TimeSeriesAverage	TimeSeriesAverage[N](price)	Temporal series moving average
TO	See FOR/TO/NEXT	Directional Instruction in the "FOR" loop
Today	Today[N]	Date of the bar n-periods before the current bar
TotalPrice	TotalPrice[N]	(Close + Open + High + Low) / 4
TR	TR(price)	True Range indicator
TriangularAverage	TriangularAverage[N](price)	Triangular Moving Average
TRIX	TRIX[N](price)	Triple Smoothed Exponential Moving Average
TypicalPrice	TypicalPrice[N]	Represents the Typical Price (Average of the High, Low and Close)

U

CODE	SYNTAX	FUNCTION
Undefined	a = Undefined	Sets a the value of a variable to undefined

V

CODE	SYNTAX	FUNCTION
Variation	Variation(price)	Difference between the close of the last bar and the close of the current bar in %
Volatility	Volatility[S, L]	Chaikin volatility
Volume	Volume[N]	Volume indicator
VolumeOscillator	VolumeOscillator[S,L]	Volume Oscillator
VolumeROC	VolumeROC[N]	Volume of the Price Rate Of Change

W

CODE	SYNTAX	FUNCTION
WeightedAverage	WeightedAverage[N](price)	Represents the Weighted Moving Average
WeightedClose	WeightedClose[N]	Average of (2 * Close), (1 * High) and (1 * Low)
WEND	See WHILE/DO/WEND	Ending Instruction of WHILE loop
WHILE/DO/WEND	WHILE (condition) DO (action) WEND	WHILE loop
WilderAverage	WilderAverage[N](price)	Represents Wilder Moving Average
Williams	Williams[N](close)	%R de Williams indicator
WilliamsAccumDistr	WilliamsAccumDistr(price)	Accumulation/Distribution of Williams Indicator

X

CODE	SYNTAX	FUNCTION
XOR	a XOR b	Logical Operator eXclusive OR

Y

CODE	SYNTAX	FUNCTION
Year	Year[N]	Year of the bar n periods before the current bar
Yesterday	Yesterday[N]	Date of the day preceeding the bar n periods before the current bar

Z

CODE	SYNTAX	FUNCTION
ZigZag	ZigZag[Zr](price)	Represents the Zig-Zag indicator introduced in the Eliott waves theory
ZigZagPoint	ZigZagPoint[Zp](price)	Represents the Zig-Zag indicator in the Eliott waves theory calculated on Zp points

Other

CODE	FUNCTION	CODE	FUNCTION
+	Addition Operator	<	Strict Inferiority Operator
-	Substraction Operator	>	Strict Superiority Operator
*	Multiplication Operator	<=	Inferiority Operator
/	Division Operator	>=	Superiority Operator
=	Equality Operator	//	Introduces a commentary line
<>	Difference Operator		

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