UNIVERSITY OF CAMBRIDGE

CENTER-TBI

ICM+® Users' Meeting

Extending ICM+ with Python scripts with examples using CENTER-TBI data sets

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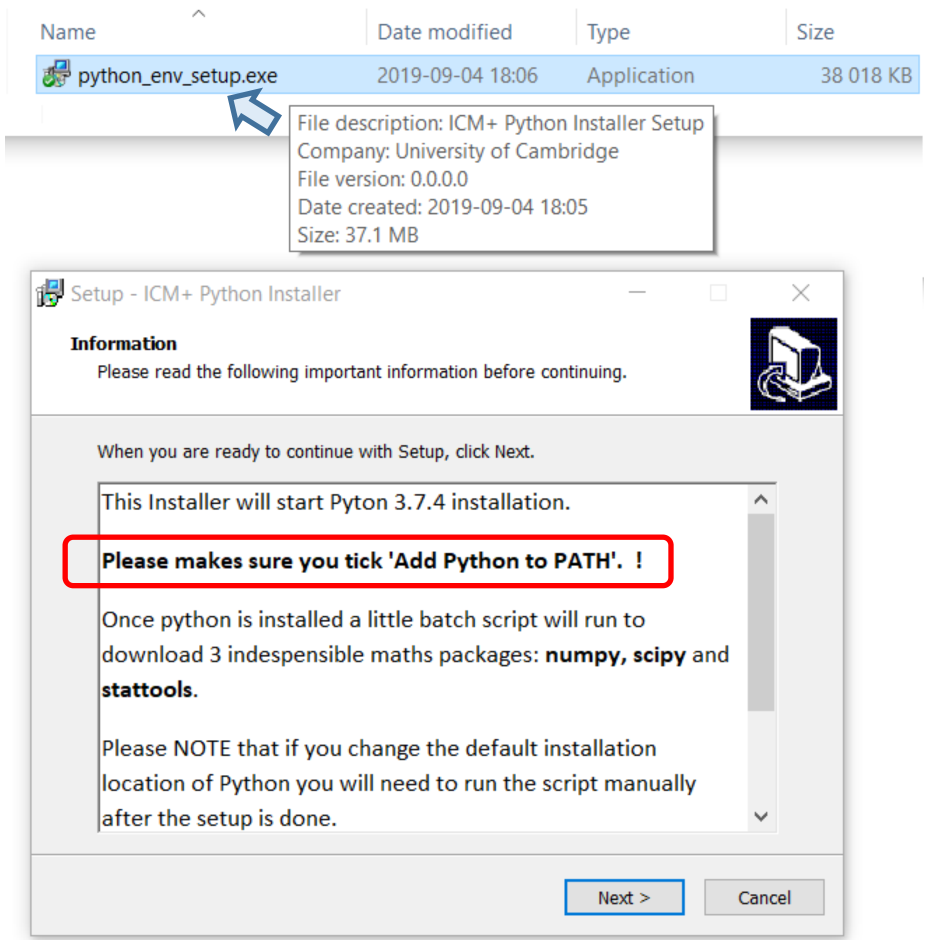
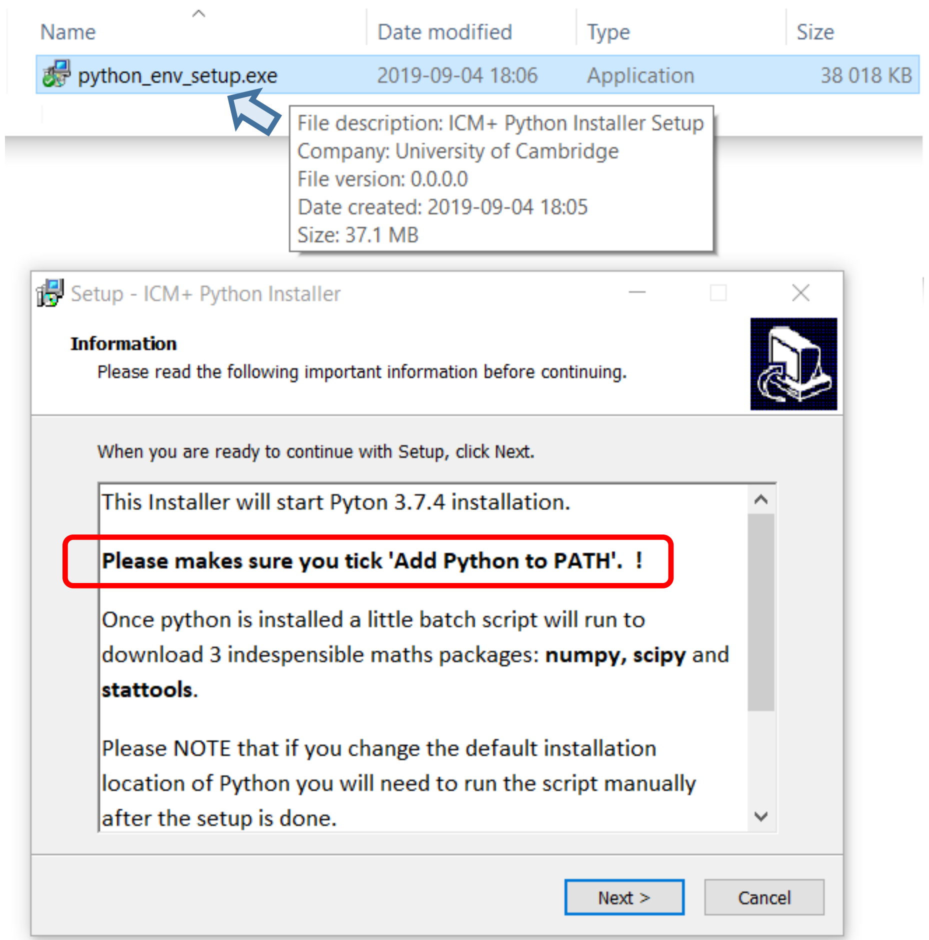
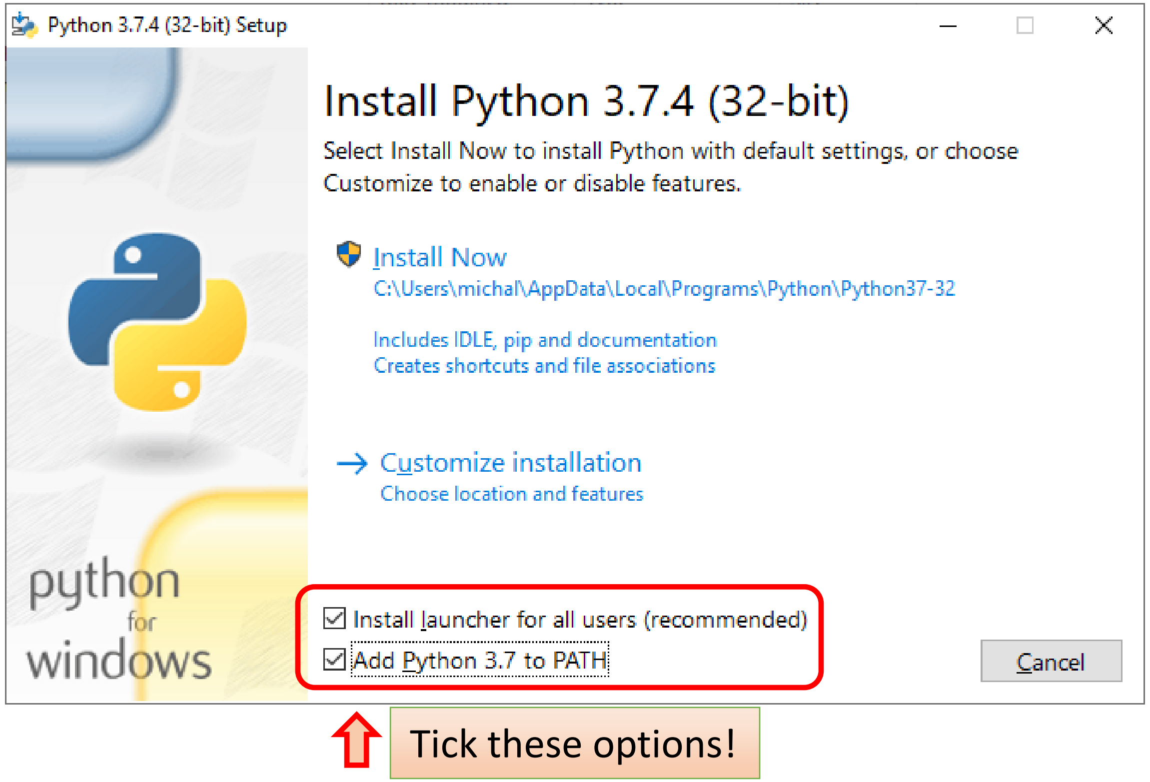
Division of Neurosurgery, Department of Clinical Neurosciences

Python for ICM+ installation



Python for ICM+ installation





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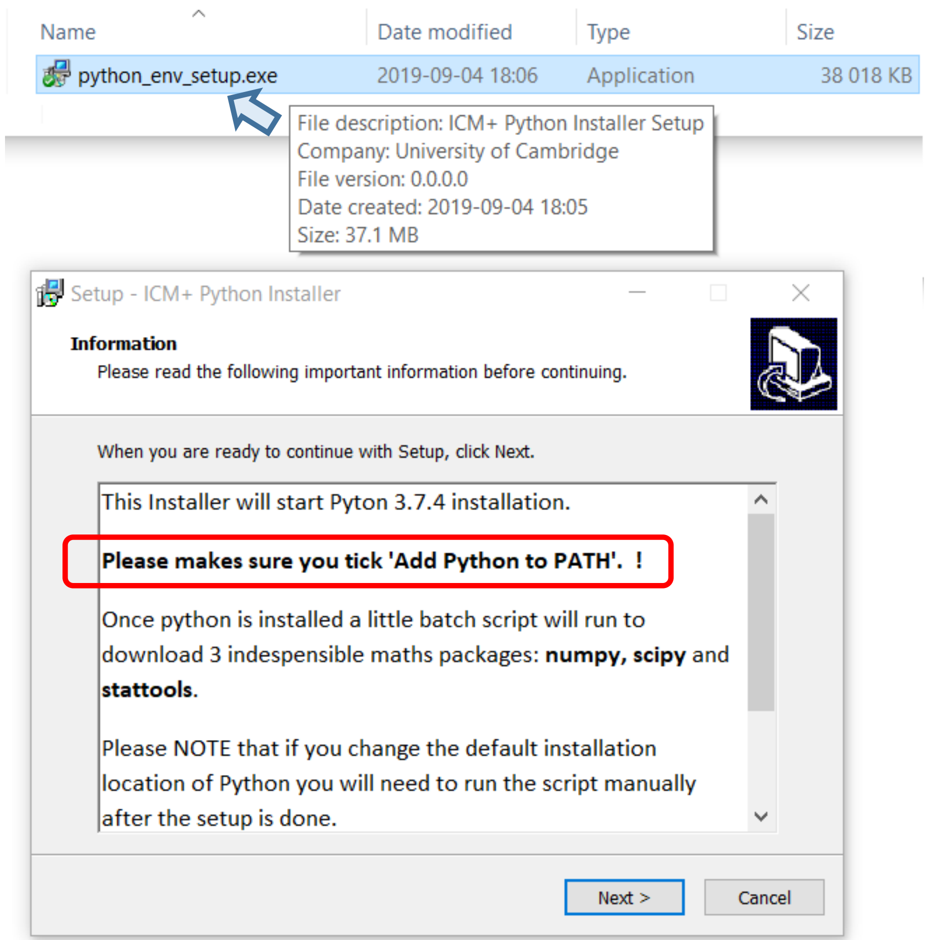
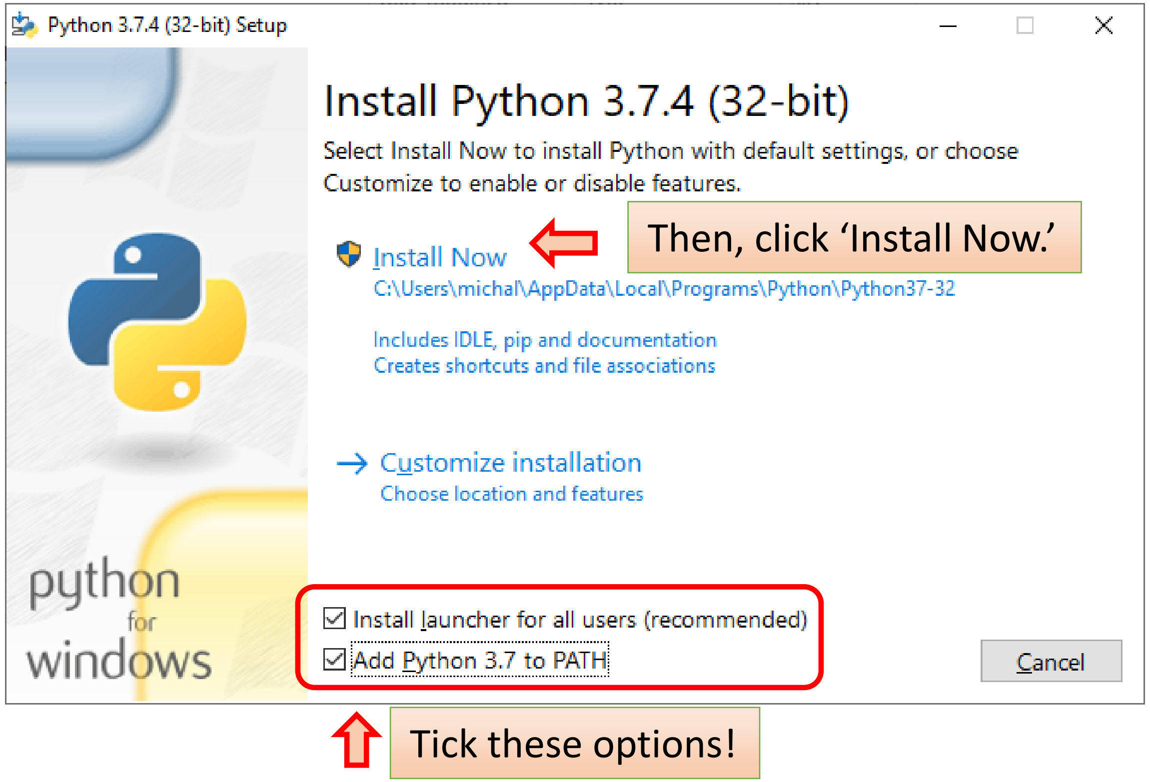
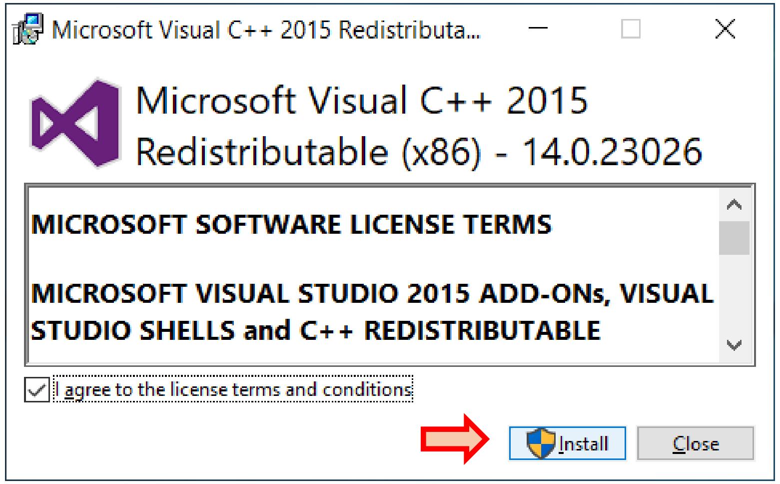
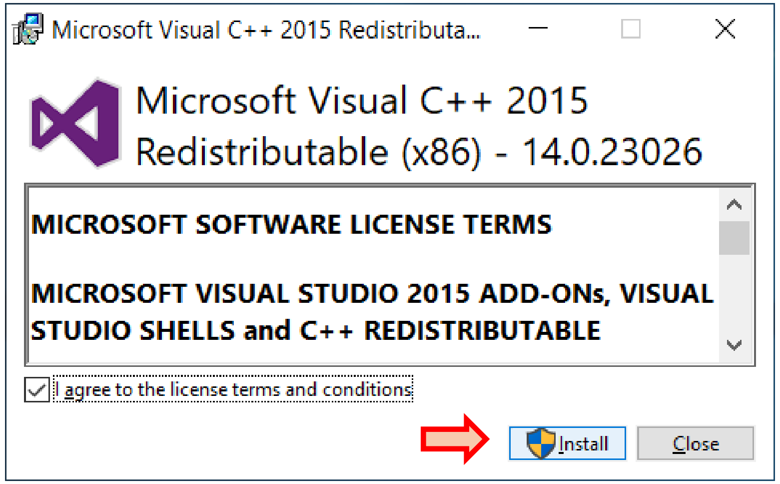


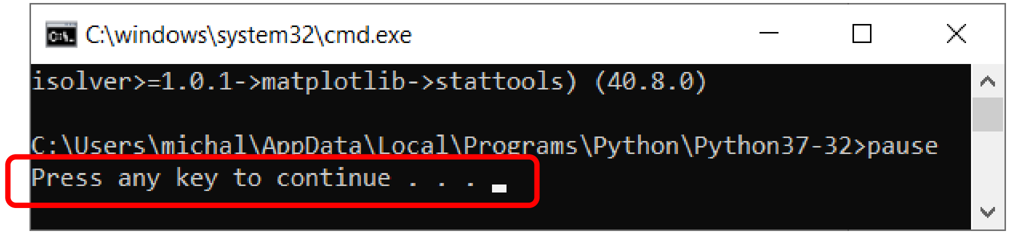


Python for ICM+ installation: cont'd



Python for ICM+ installation: cont'd





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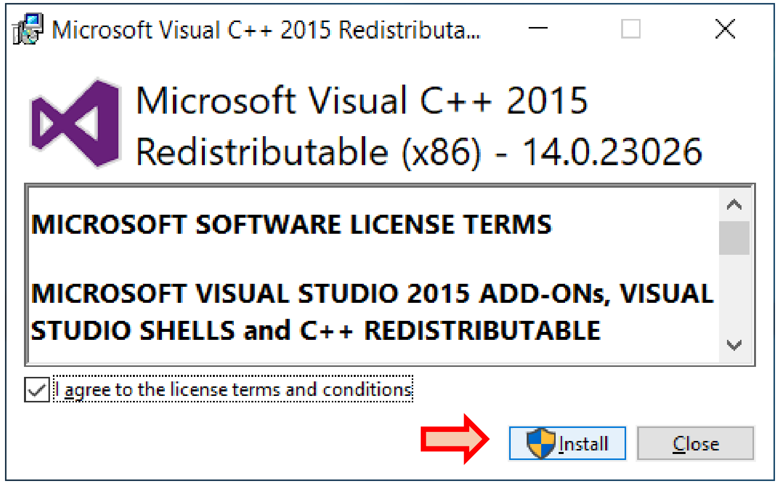
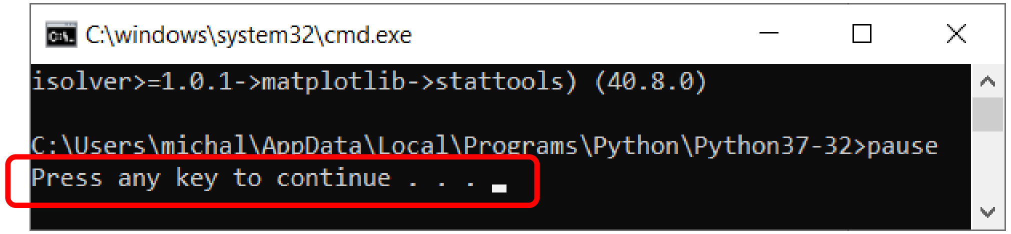
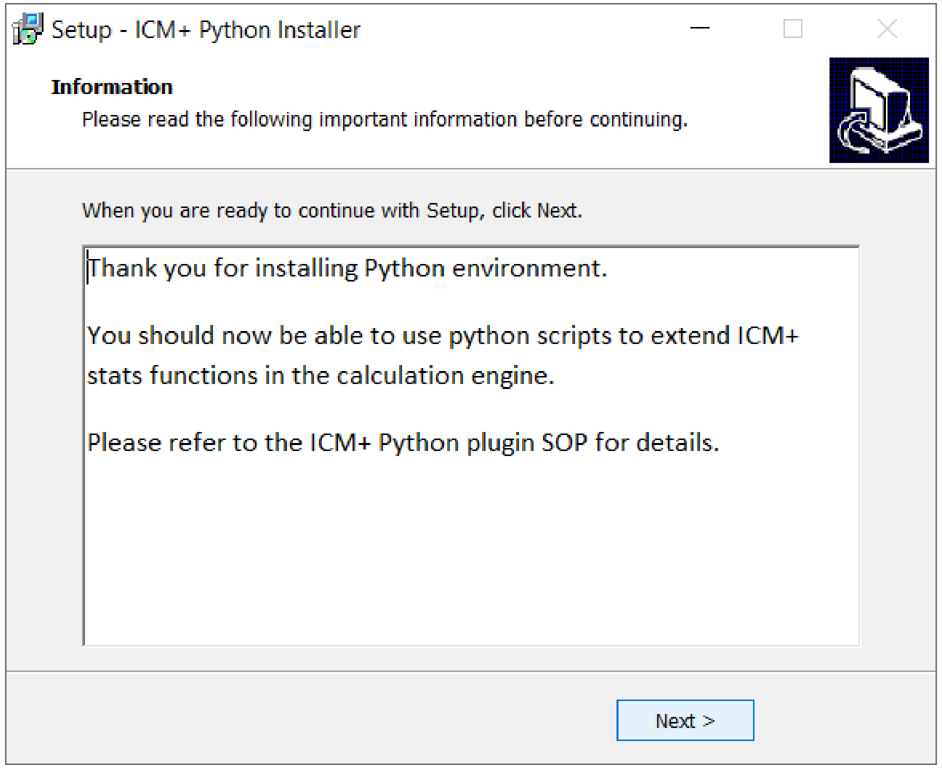
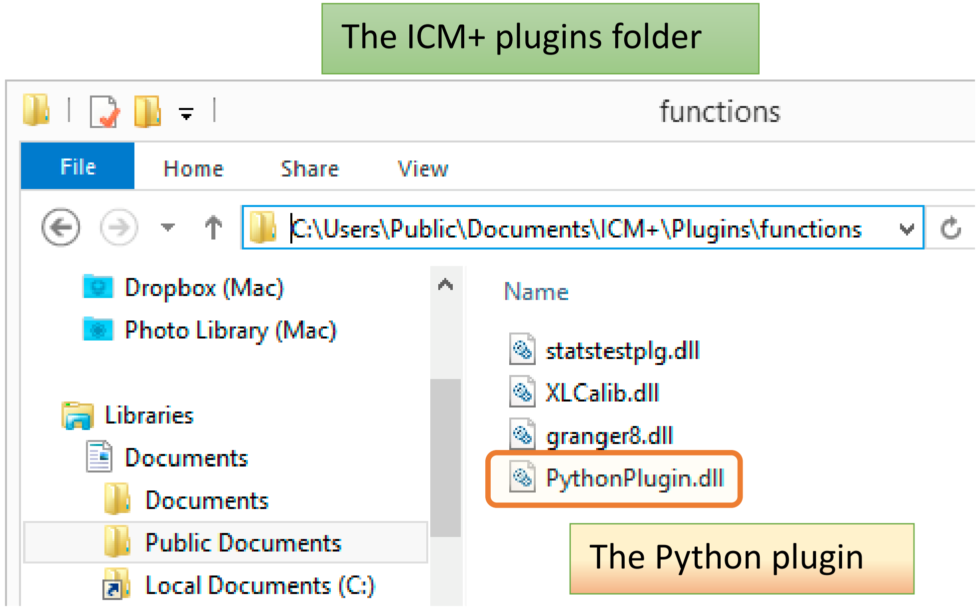




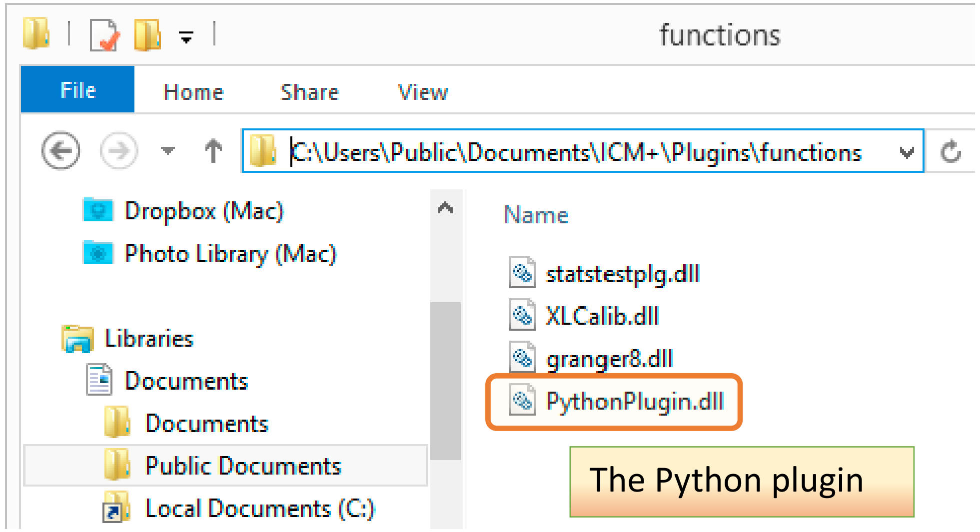


Python Plugin important directories



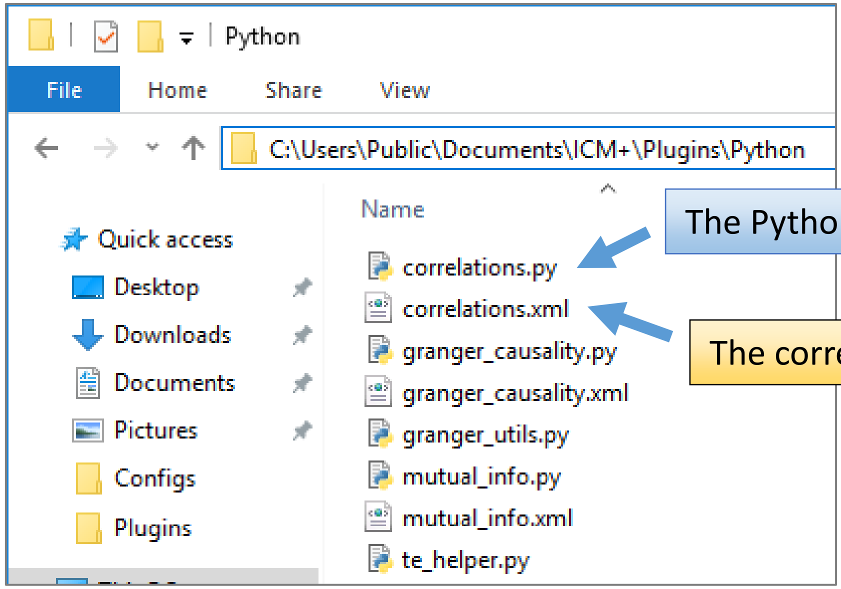
Python Plugin important directories

The ICM+ plugins folder



The Python plugin

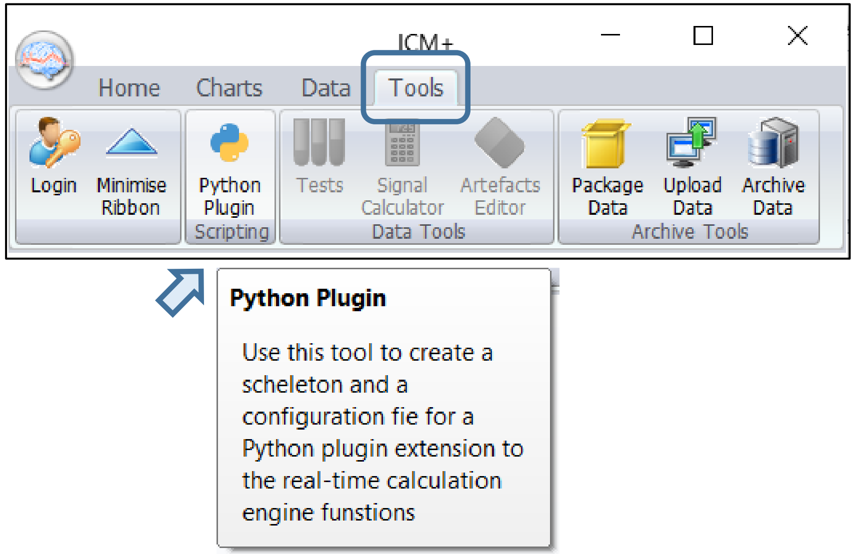
The ICM+ Python plugin folder



The Python script

The corresponding config file

The ICM+ Tool for a Python template and its config file creation



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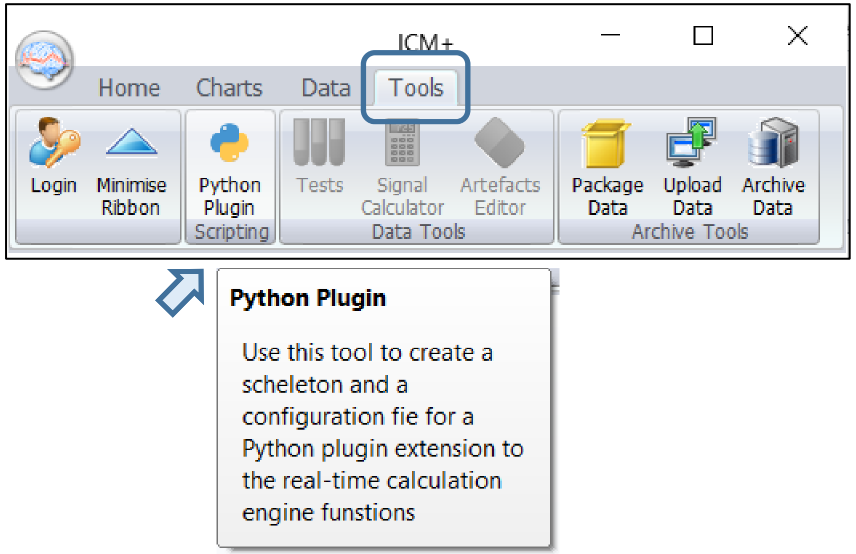

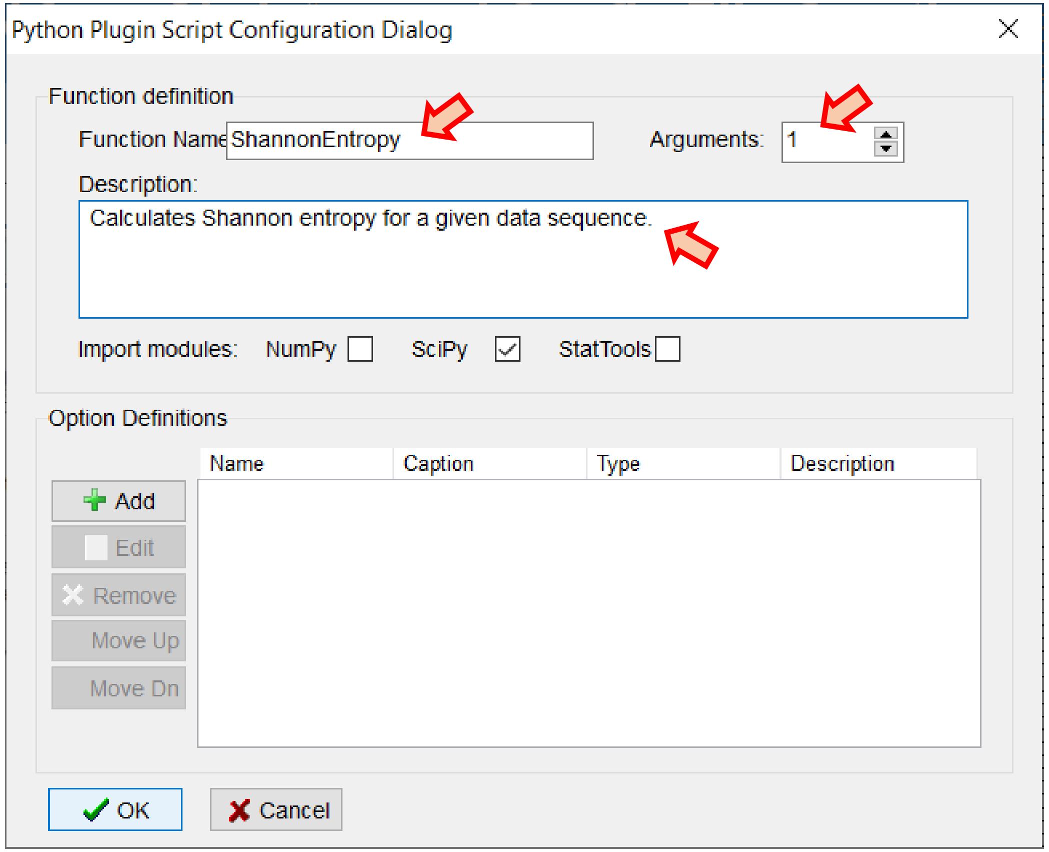

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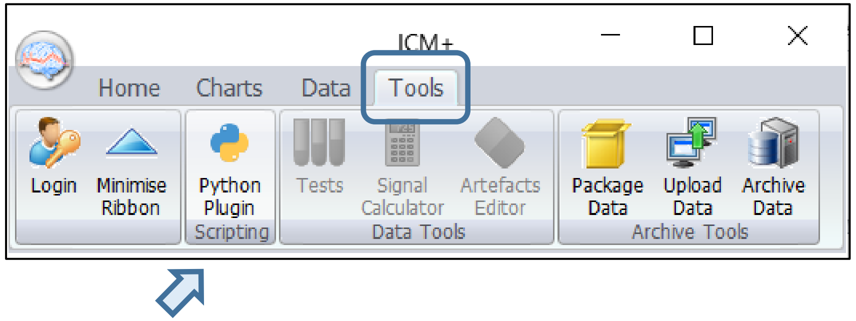

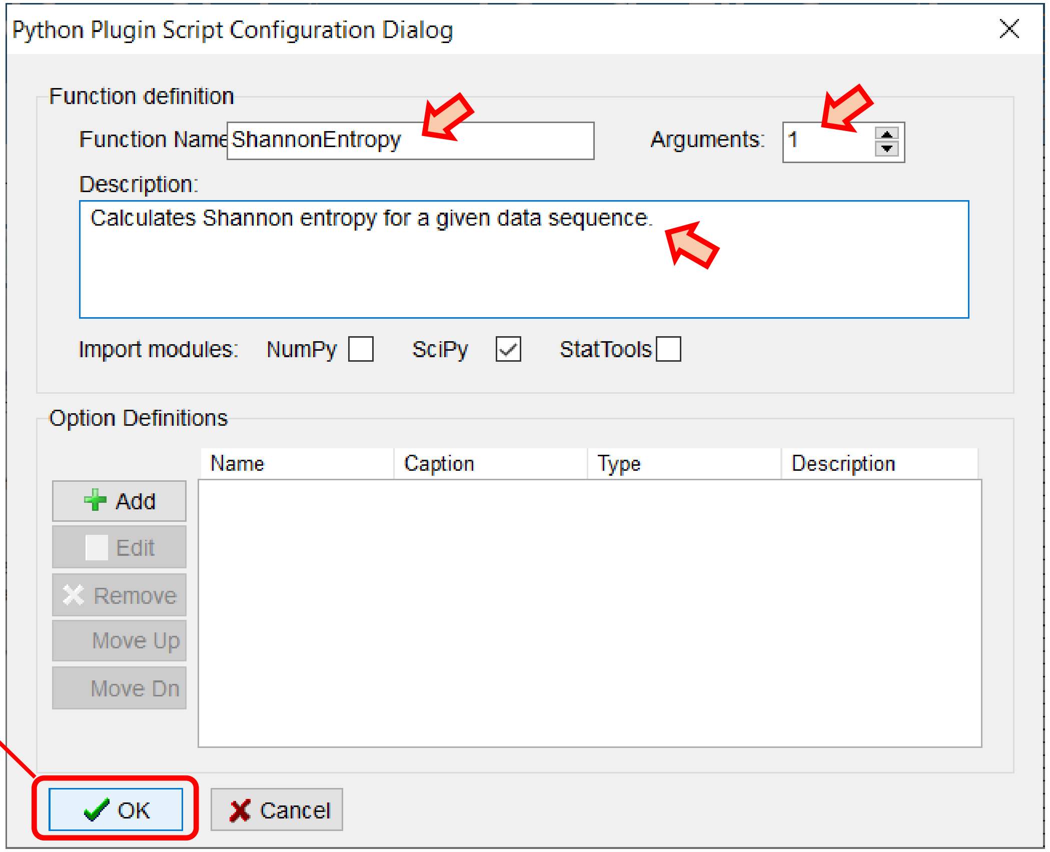

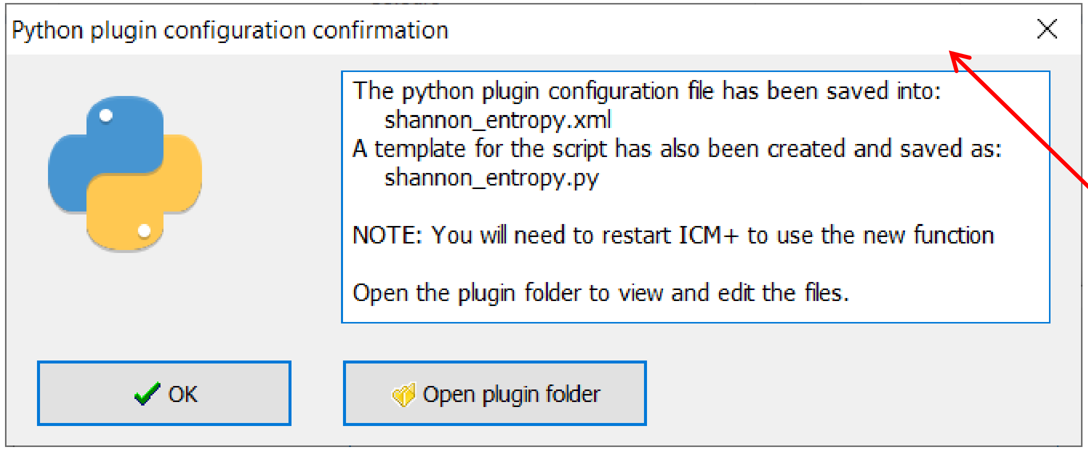

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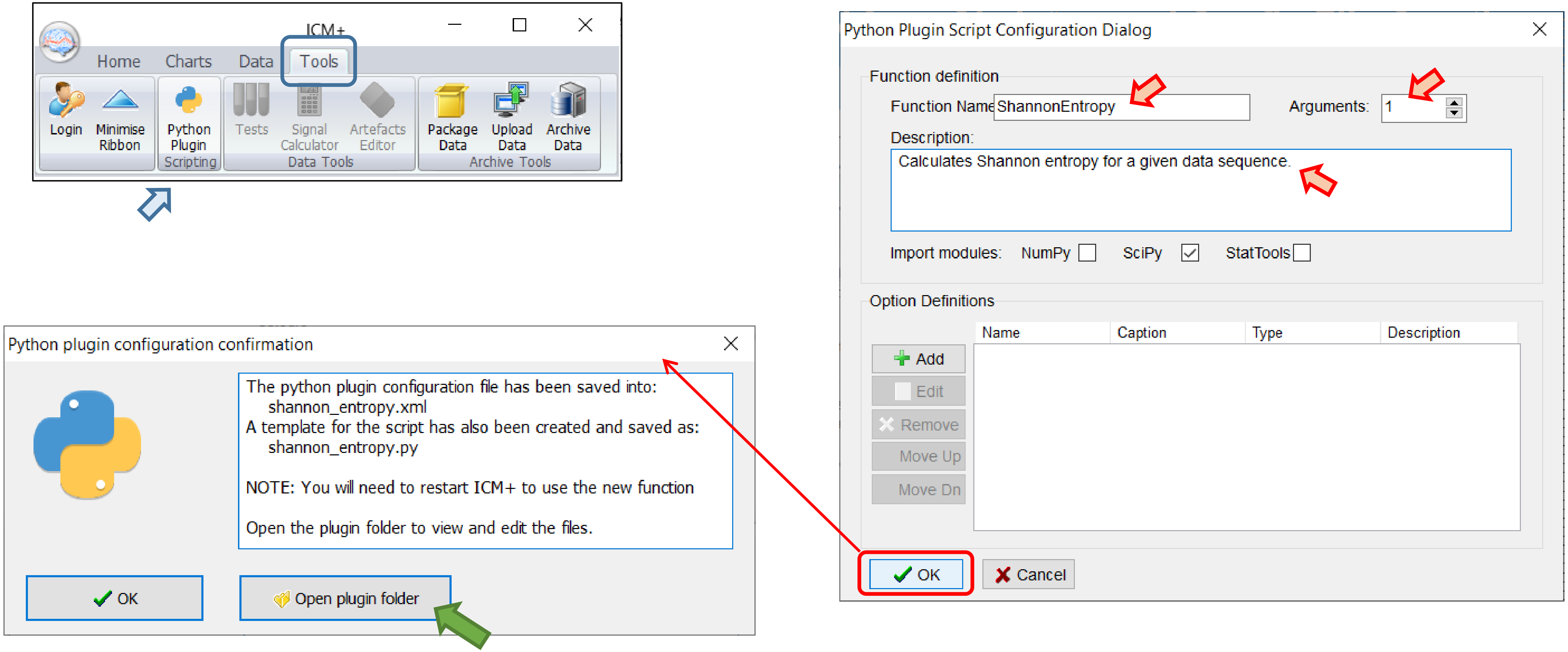
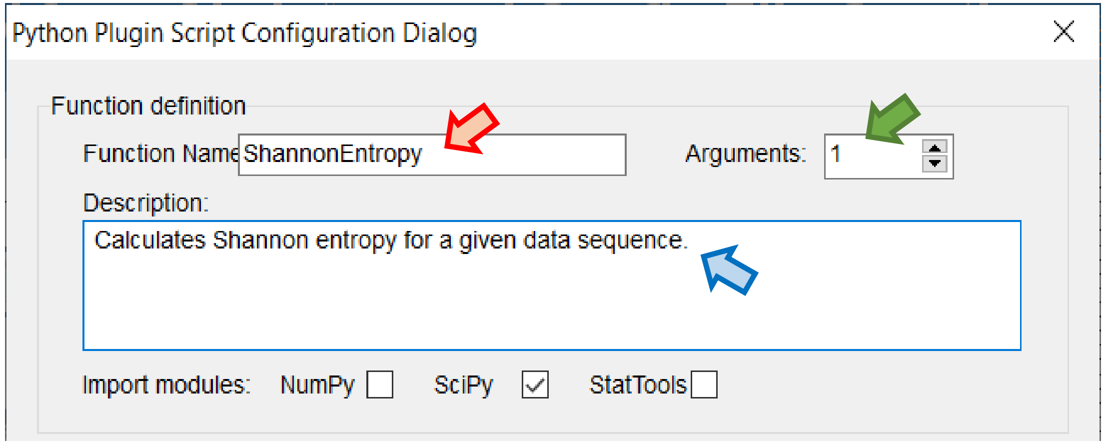


Generated Configuration File

The XML config file generated by ICM+

```xml
<?xml version = "1.0"?>

<PyToICMPlusConfig>
    <Function Name="ShannonEntropy" Type="Stats" SignalsCount="1">
        <GUID>{7A097741-6044-4828-8371-B4BC3E6A1BFE}</GUID>
        <Description>Calculates Shannon entropy for a given data sequence.</Description>
    </Function>
</PyToICMPlusConfig>
```



The generated Python script

```python
#import ...
import scipy as sp

class ShannonEntropy:

    # DO NOT MODIFY THIS METHOD. It is a part of the ICM+--Python interface.
    def set_parameter(self, param_name, param_value):
        setattr(self, param_name, param_value)

    # You can append your own code to the constructor, if needed.
    # You should not set here values of parameters declared in your XML
    # configuration file because ICM+ will do it for you.
    # You will have to add your own code, only if you need to initialise some
    # extra data structures which were not declared in the XML config file.
    def __init__(self):
        self.sampling_freq = None

    # You can append your own code to the destructor but most likely
    # you will not need it.
    def __del__(self):
        pass

    # 'calculate' is the main work-horse function.
    # It is called with a data buffer (one or more) of size corresponding to the Calculation Window
    # It must return one floating-point number
    # It take the following parameters:
    # sig1 - input variable/signal 1
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    # It can also use the data sampling frequency:
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    def calculate(self, sig1, ts_time, ts_date):
        # my_own_code_here
        result = 0.0
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    # It take th                 rs:
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One input signal

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One input signal

Add your own code to the *calculate* method

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        result = 0.0
        return result
```

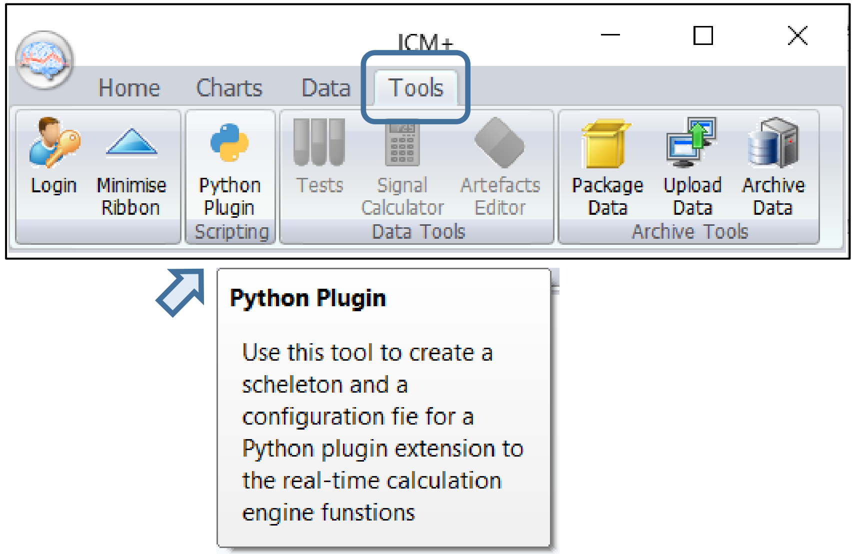
One input signal

Add your own code to the *calculate* method

```python
from scipy import stats

def calculate(self, sig1, ts_time, ts_date):
    result = stats.entropy(sig1)
    return result
```

Adding options to the user-defined Python function



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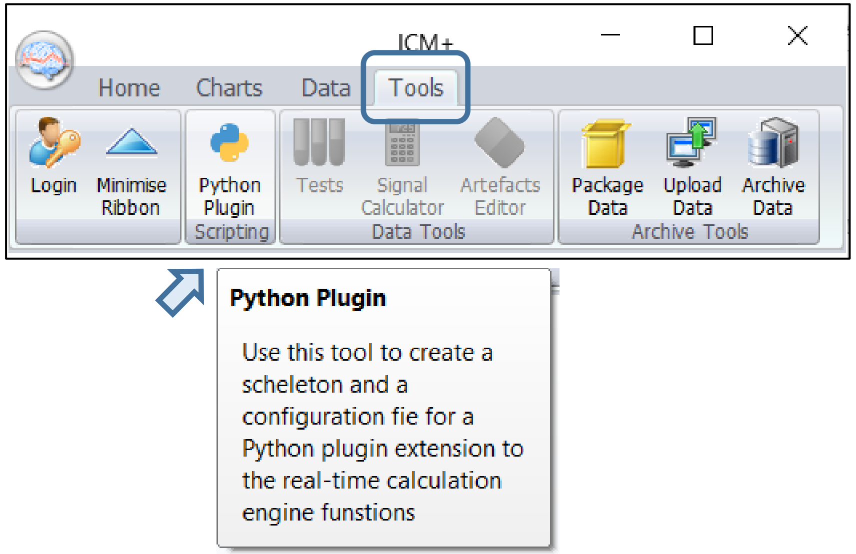

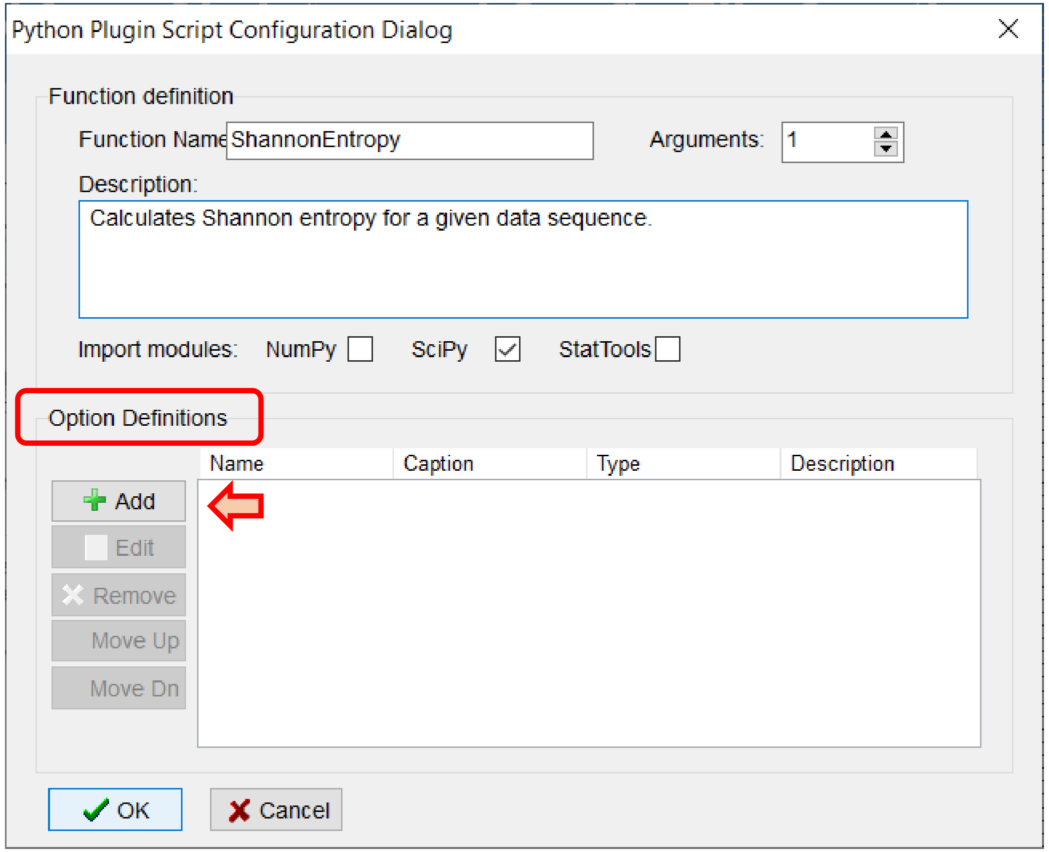

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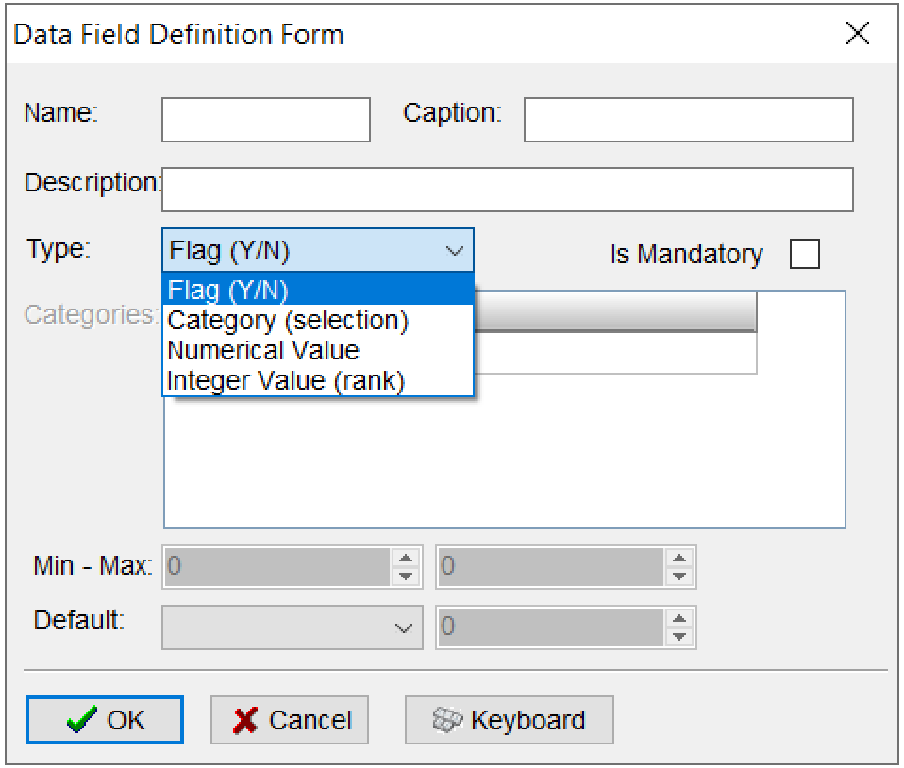
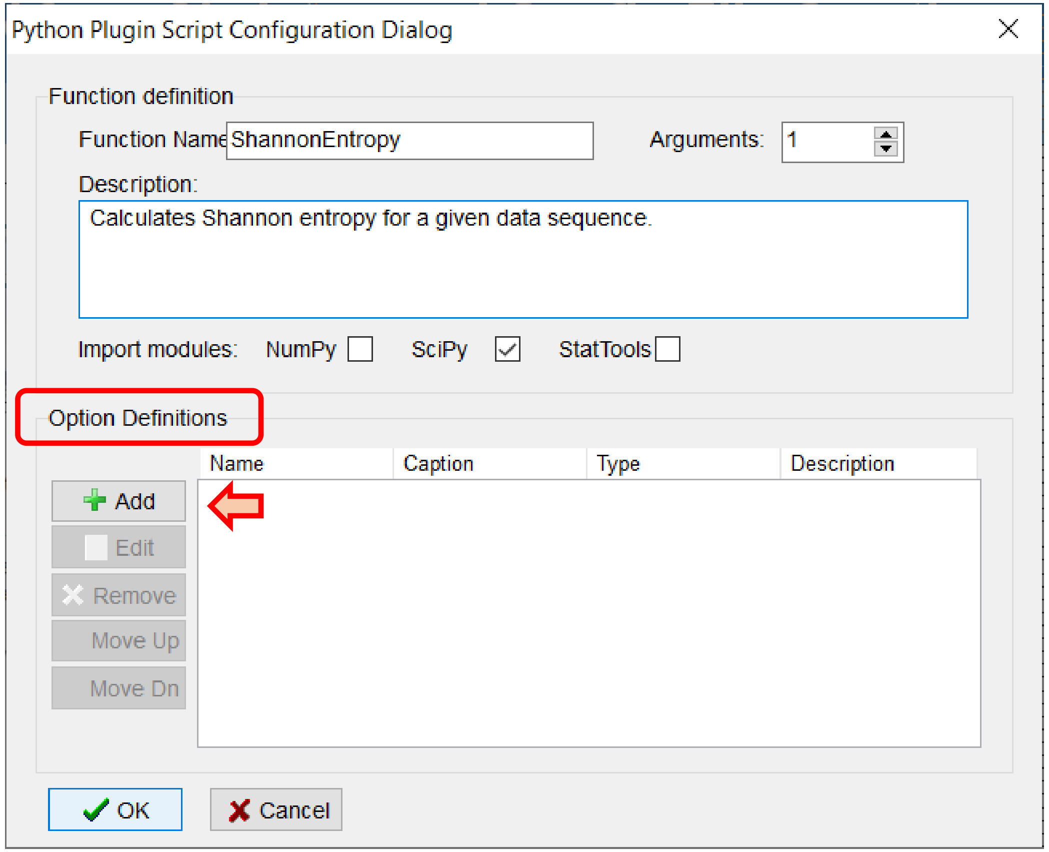
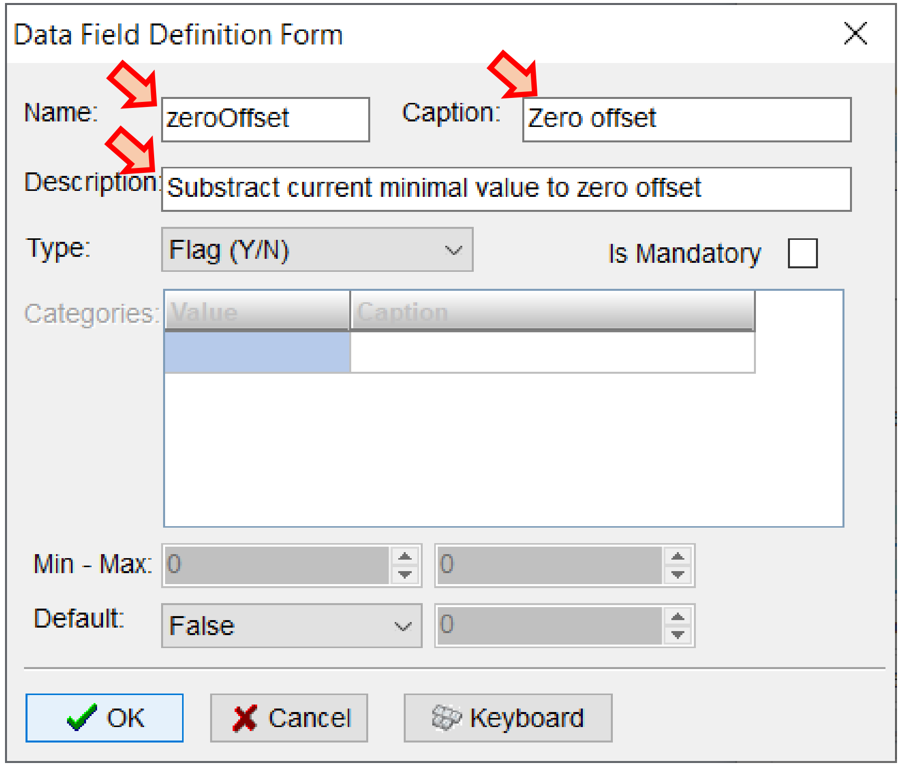




Adding an option of the type ’flag’



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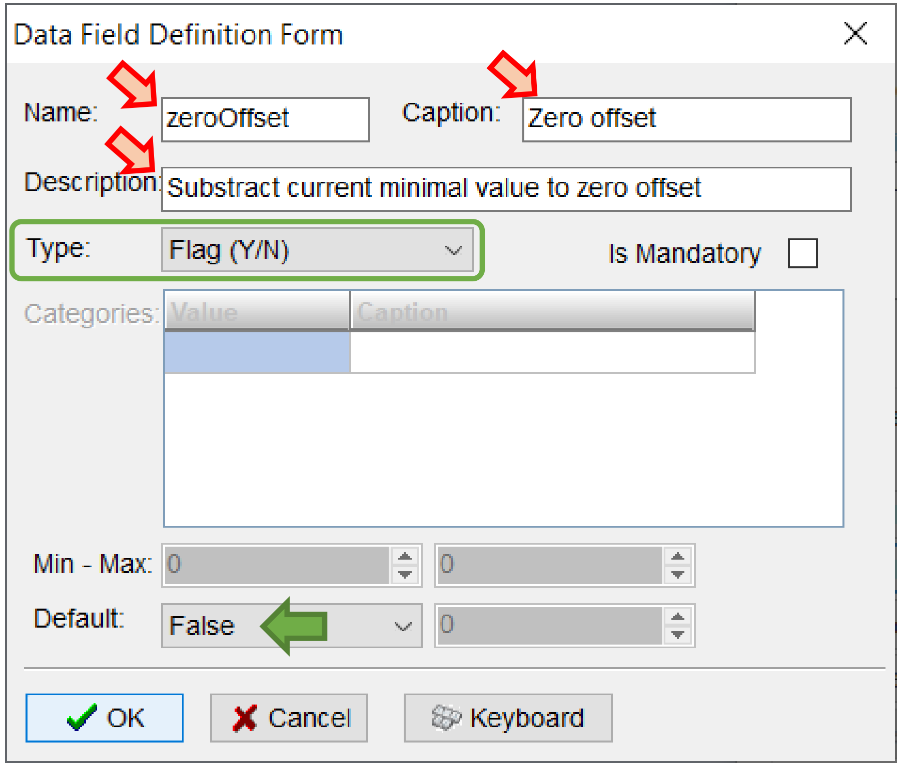
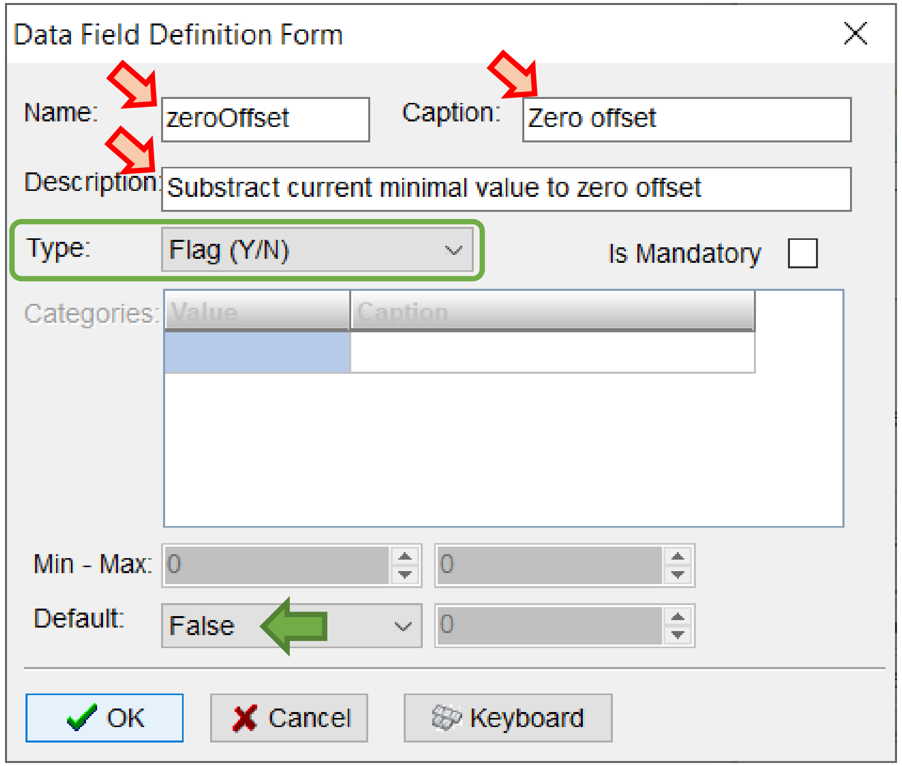
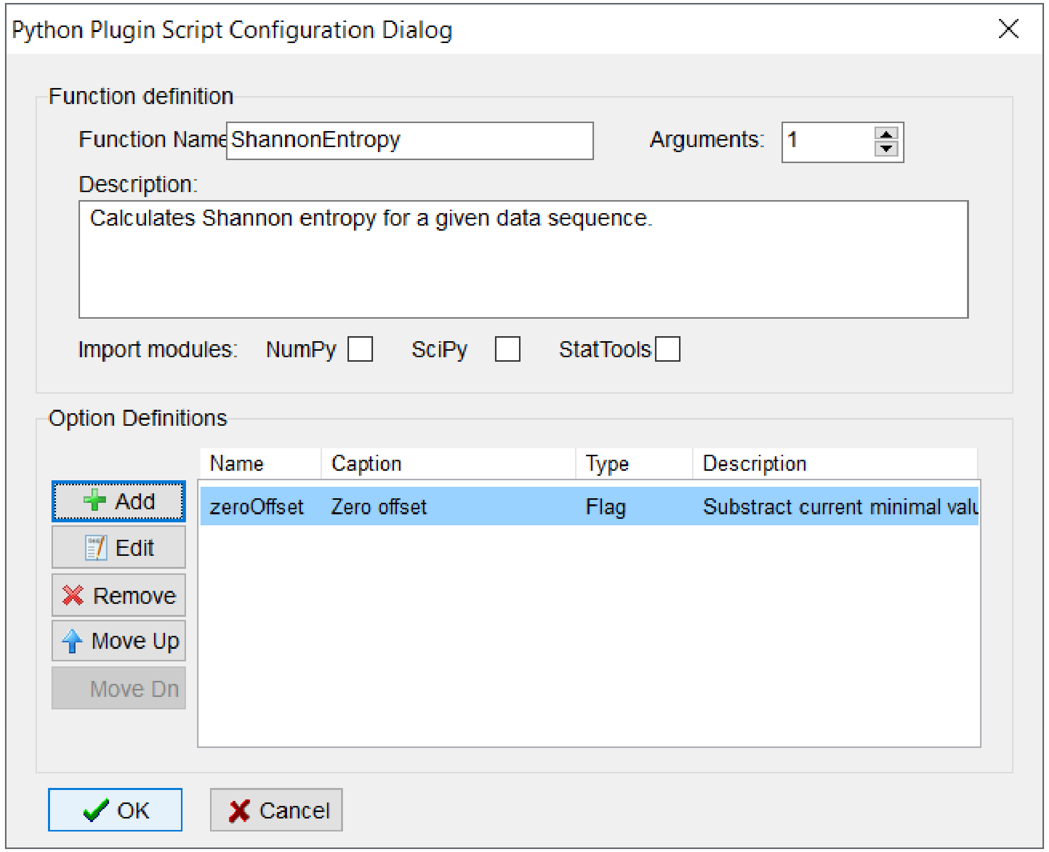
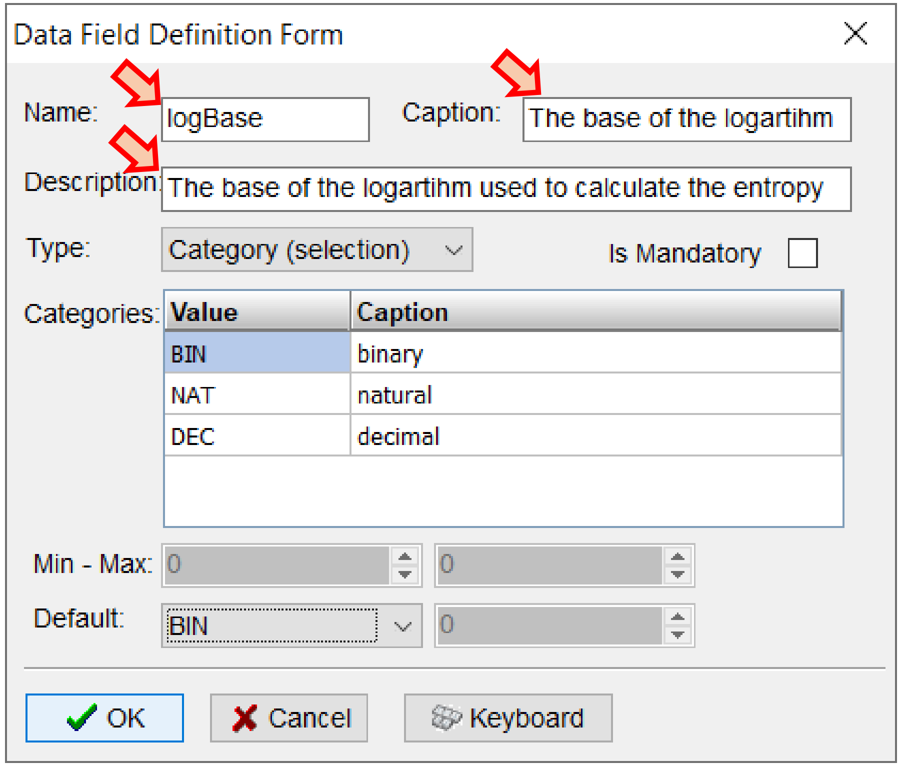


Adding an option of the type 'flag'





Adding an option of the type ’category’



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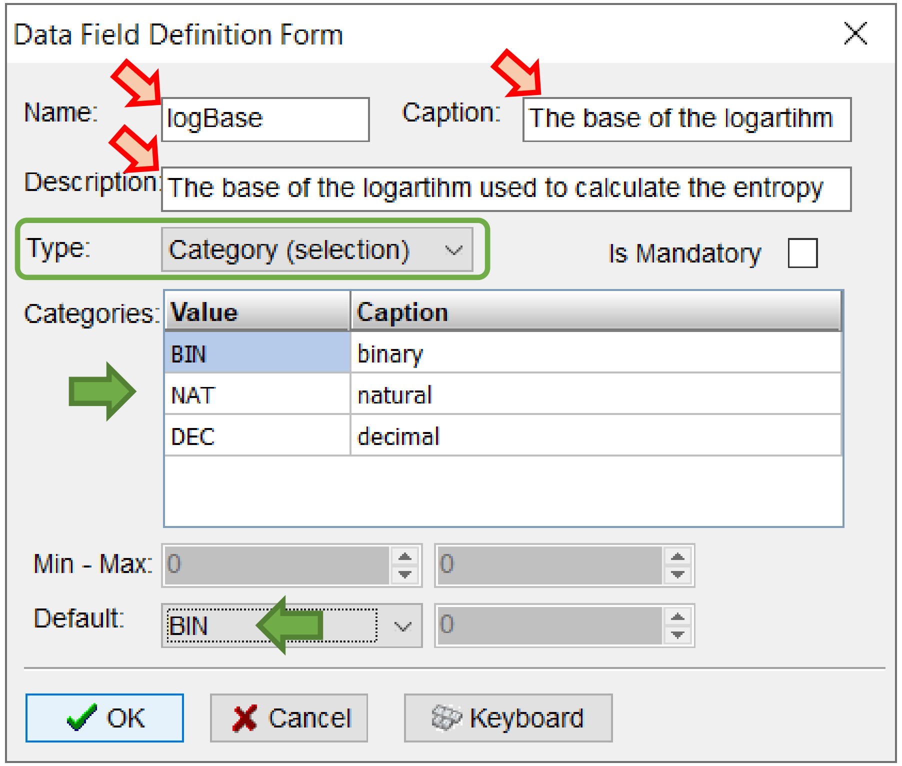

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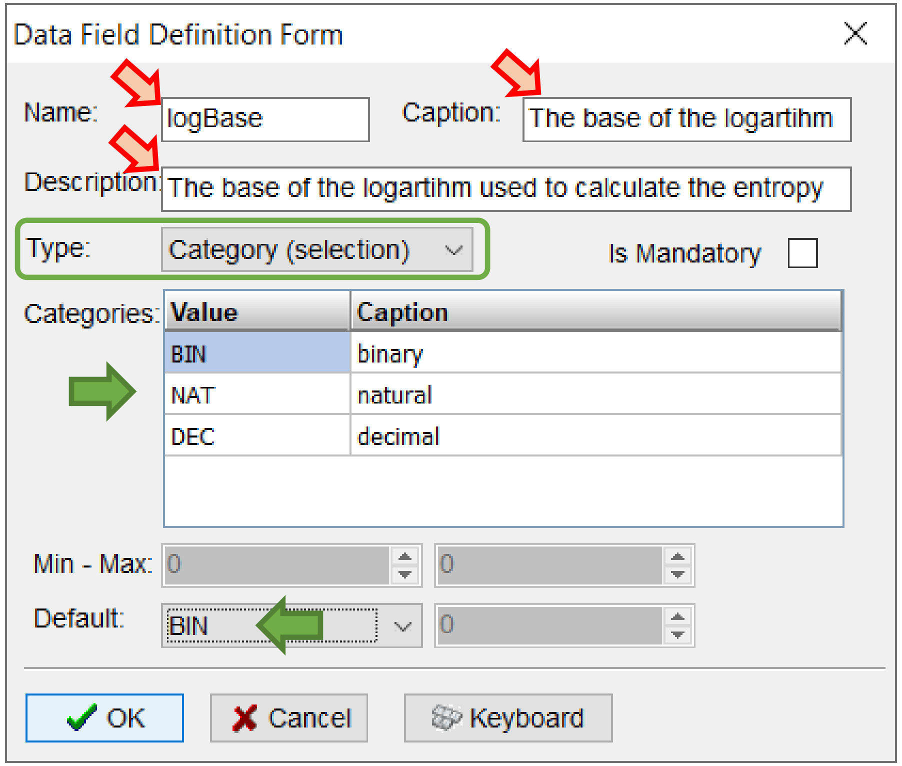

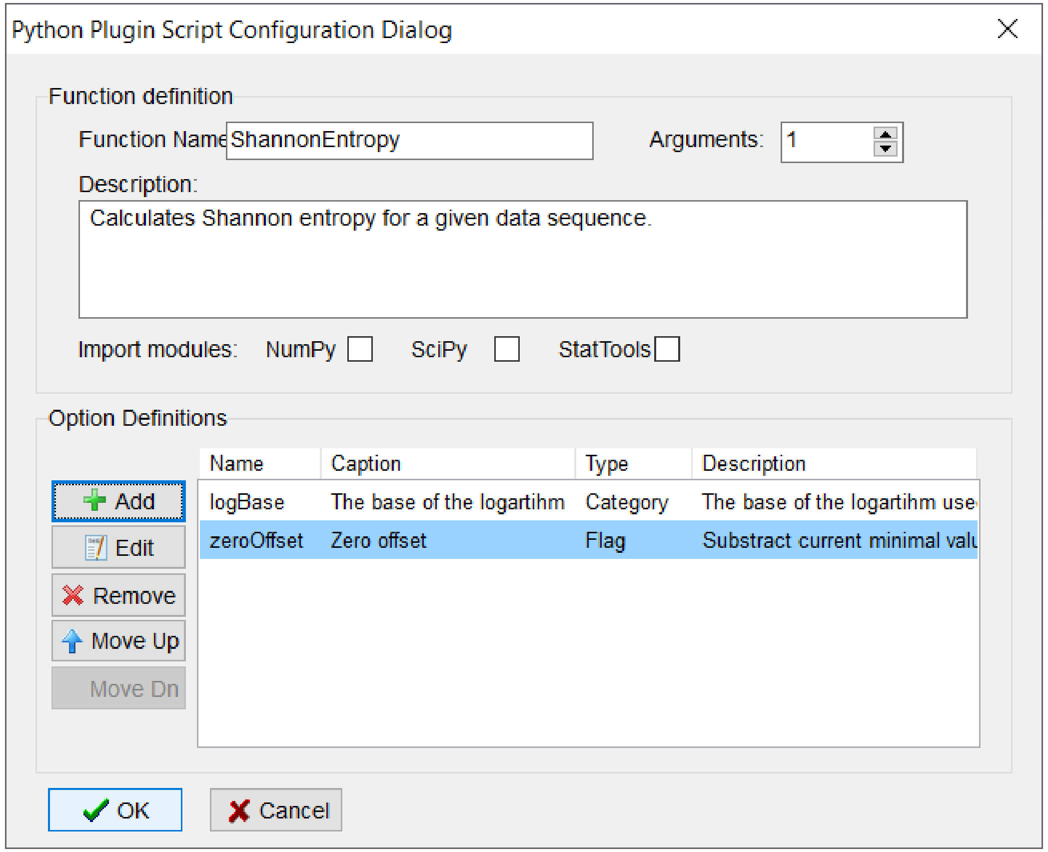

Generated Configuration File


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<?xml version = "1.0"?>

<PyToICMPlusConfig>
    <Function Name="ShannonEntropy" Type="Stats" SignalsCount="1">
        <GUID>{3DE497F8-5AF6-40D5-907E-02B2CCDF19C5}</GUID>
        <Description>Calculates Shannon entropy for a given data sequence.</Description>
        <Parameter ShortName="logBase" IsMandatory="False">
            <Caption>The base of the logartihm</Caption>
            <Description>The base of the logartihm used to calculate the entropy</Description>
            <Type Name="StringList">
                <Item Value="BIN" Caption="binary" IsDefault="True"/>
                <Item Value="NAT" Caption="natural"/>
                <Item Value="DEC" Caption="decimal"/>
            </Type>
        </Parameter>
        <Parameter ShortName="zeroOffset" IsMandatory="False">
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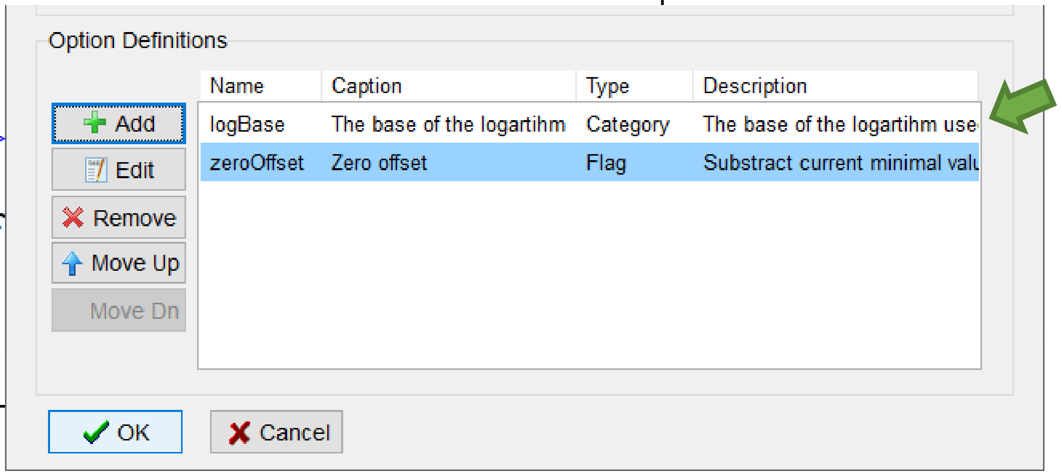

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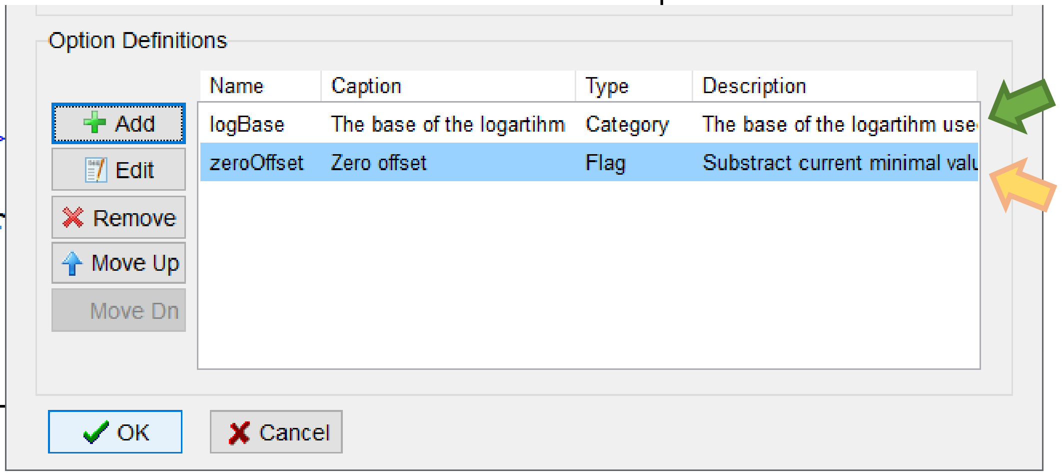

How to use the configured options in the Python script

```python
# 'calculate' is the main work-horse function.
# It is called with a data buffer (one or more) of size corresponding to the Calculation Window
# It must return one floating-point number
# It take the following parameters:
# sig1 - input variable/signal 1
# ts_time - part of the data time stamp - number of milliseconds since midnight
# ts_date - Part of the data time stamp - One plus number of days since 1/1/0001
# It can also use the data sampling frequency:
#    self.sampling_freq
# and the following variables already set at the initialisation time (via function options):
#    self.logBase - The base of the logartihm
#    self.zeroOffset - Substract current minimal value to zero offset

def calculate(self, sig1, ts_time, ts_date):

    if self.zeroOffset == True:
        sig1 = np.array(sig1) - min(sig1)

    if self.logBase == 'BIN':
        base = 2
    elif self.logBase == 'NAT':
        base = math.e
    elif self.logBase == 'DEC':
        base = 10

    result = stats.entropy(sig1, None, base)
    return result
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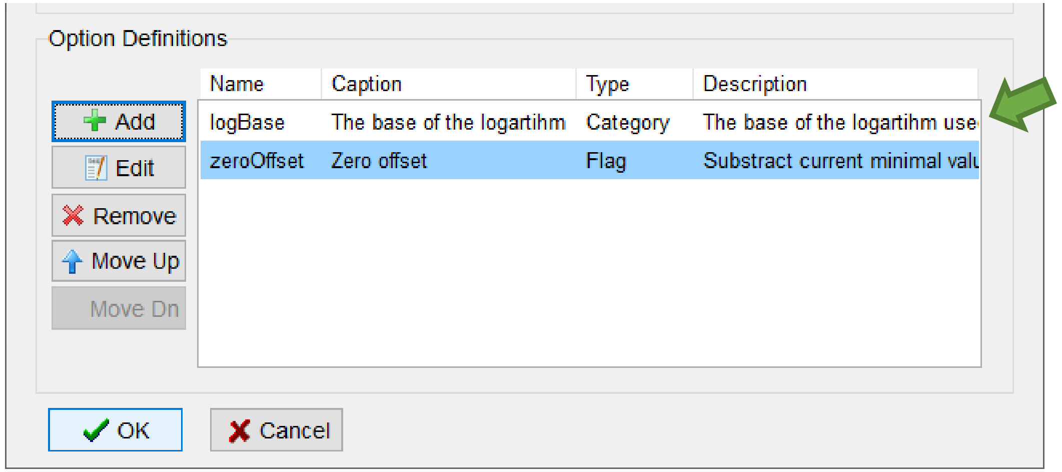

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```
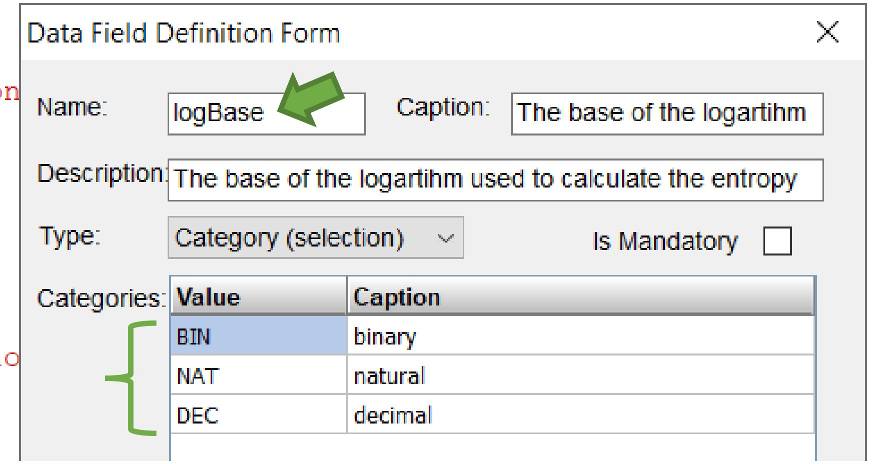
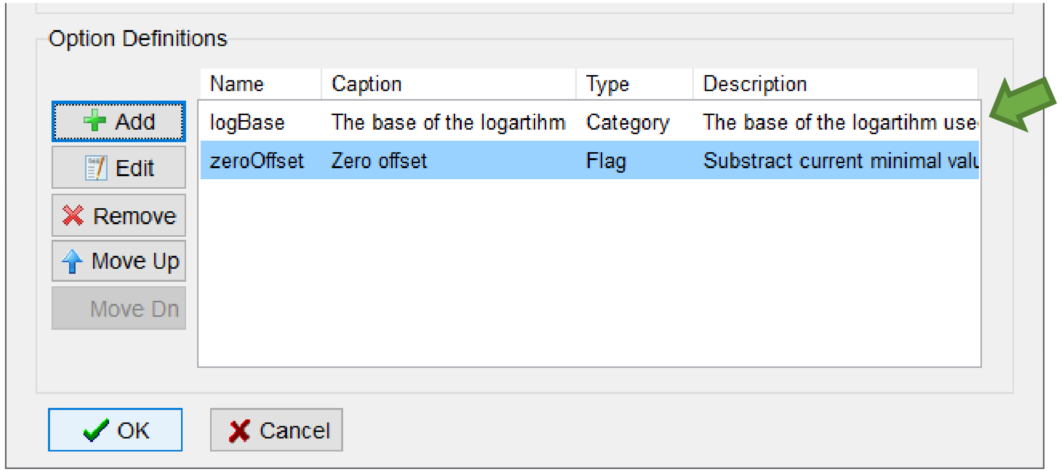
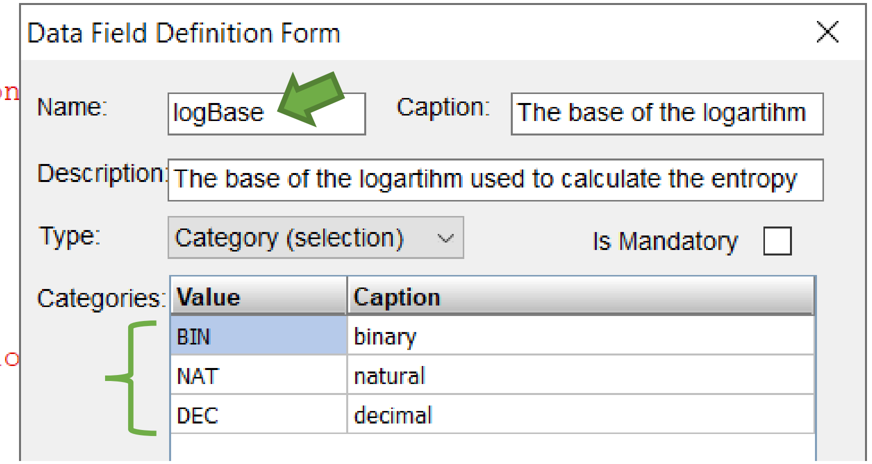
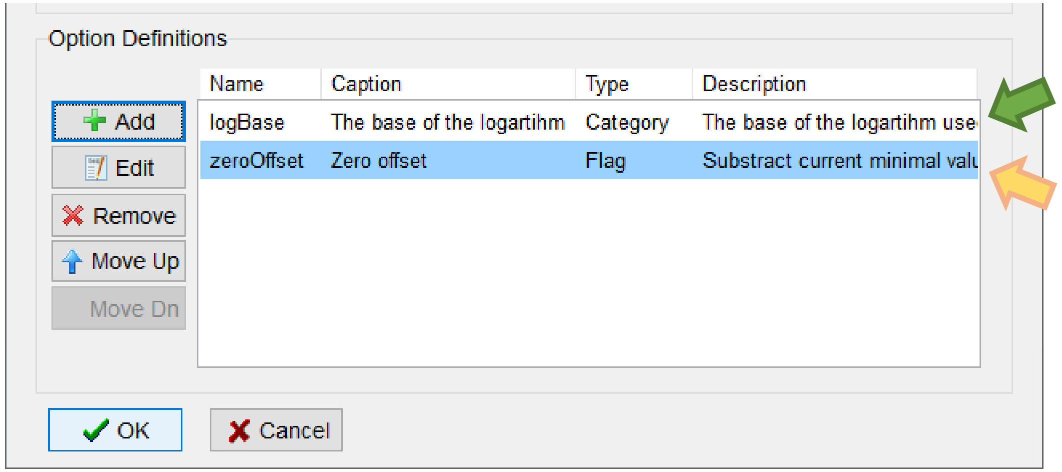





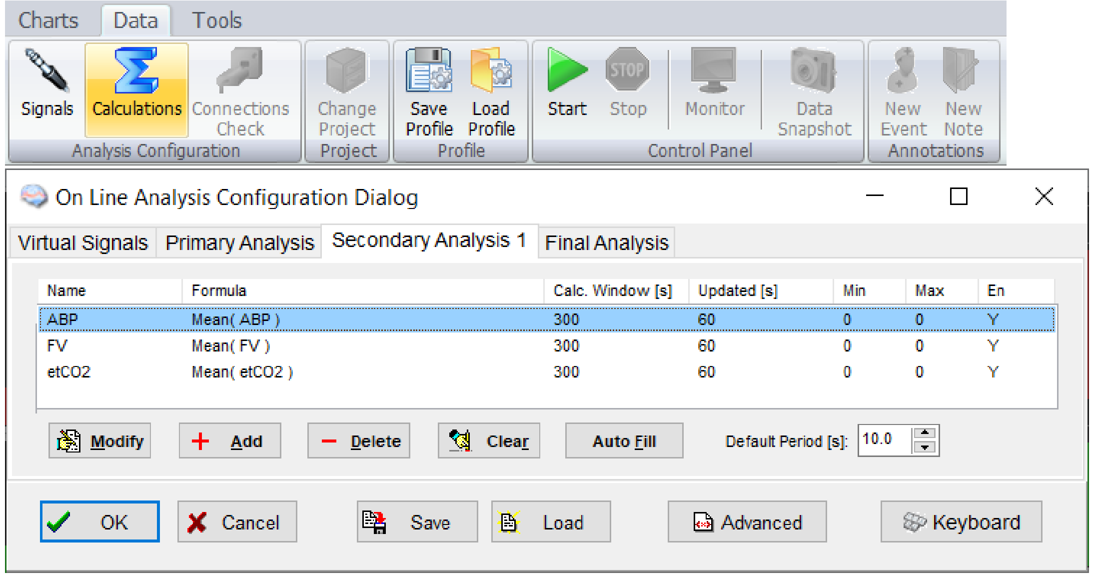
How to use the configured options in the Python script

```python
# 'calculate' is the main work-horse function.
# It is called with a data buffer (one or more) of size corresponding to the Calculation
# It must return one floating-point number
# It take the following parameters:
# sig1 - input variable/signal 1
# ts_time - part of the data time stamp - number of milliseconds since midnight
# ts_date - Part of the data time stamp - One plus number of days since 1/1/0001
# It can also use the data sampling frequency:
#    self.sampling_freq
# and the following variables already set at the initialisation time (via function optio
#    self.logBase - The base of the logartihm
#    self.zeroOffset - Substract current minimal value to zero offset

def calculate(self, sig1, ts_time, ts_date):

    if self.zeroOffset == True:
        sig1 = np.array(sig1) - min(sig1)

    if self.logBase == 'BIN':
        base = 2
    elif self.logBase == 'NAT':
        base = math.e
    elif self.logBase == 'DEC':
        base = 10

    result = stats.entropy(sig1, None, base)
    return result
```

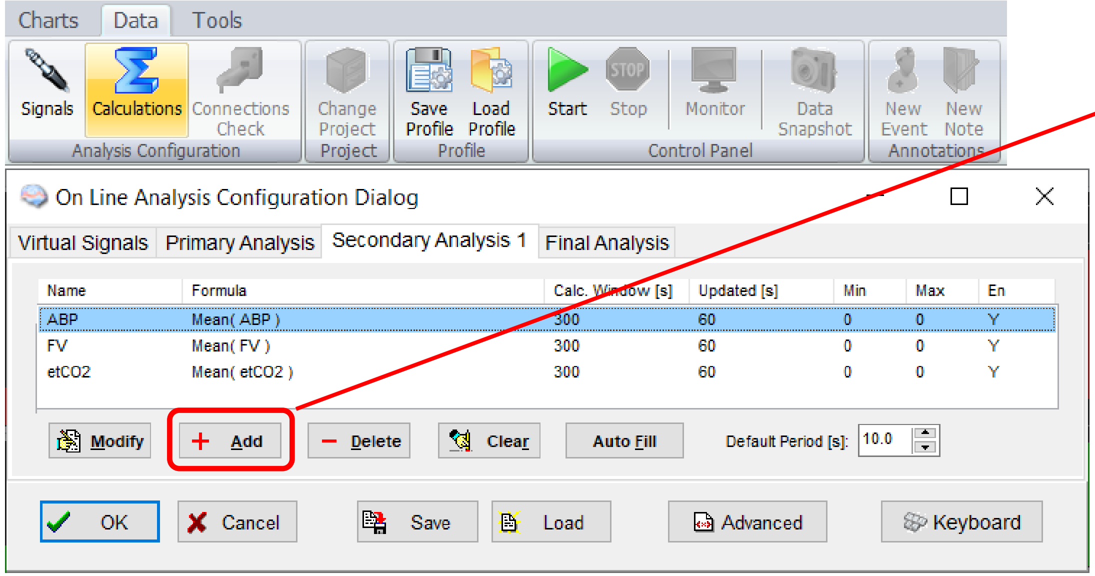


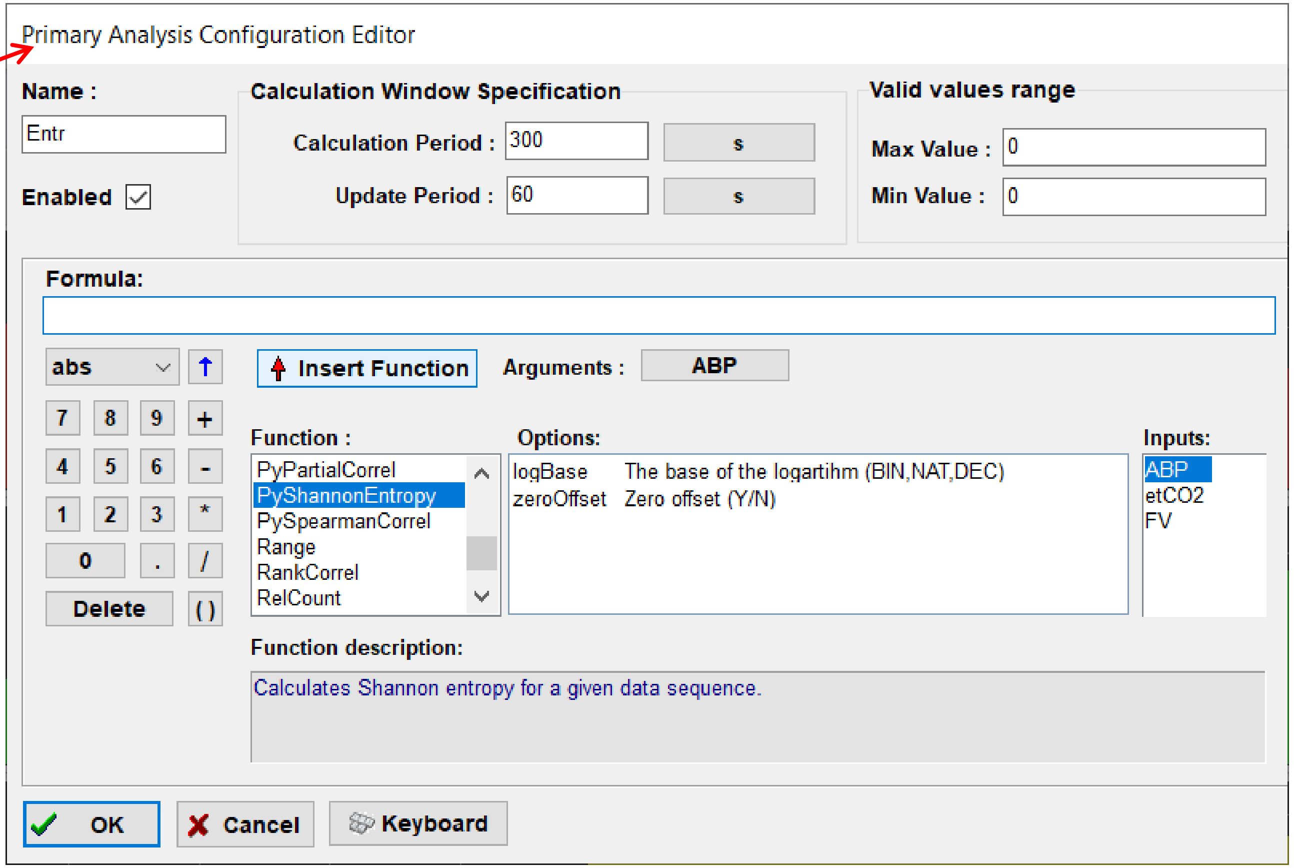


Using user-defined Python function in ICM+

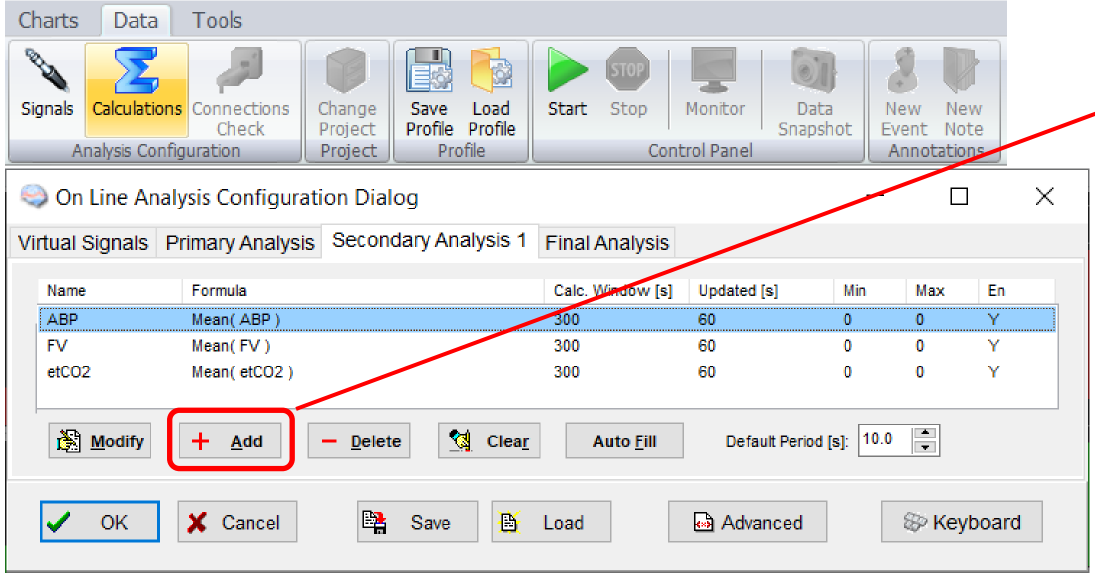


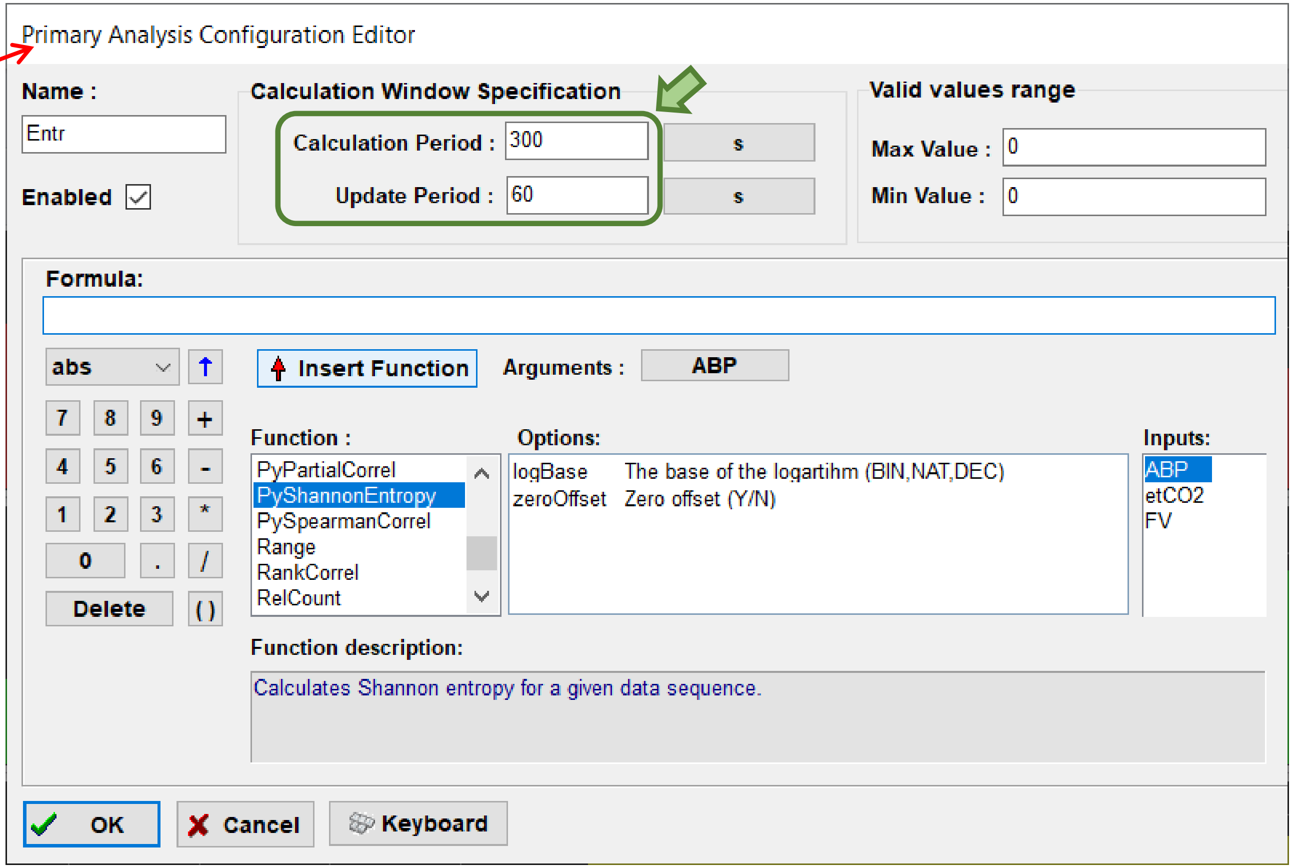
Using user-defined Python function in ICM+



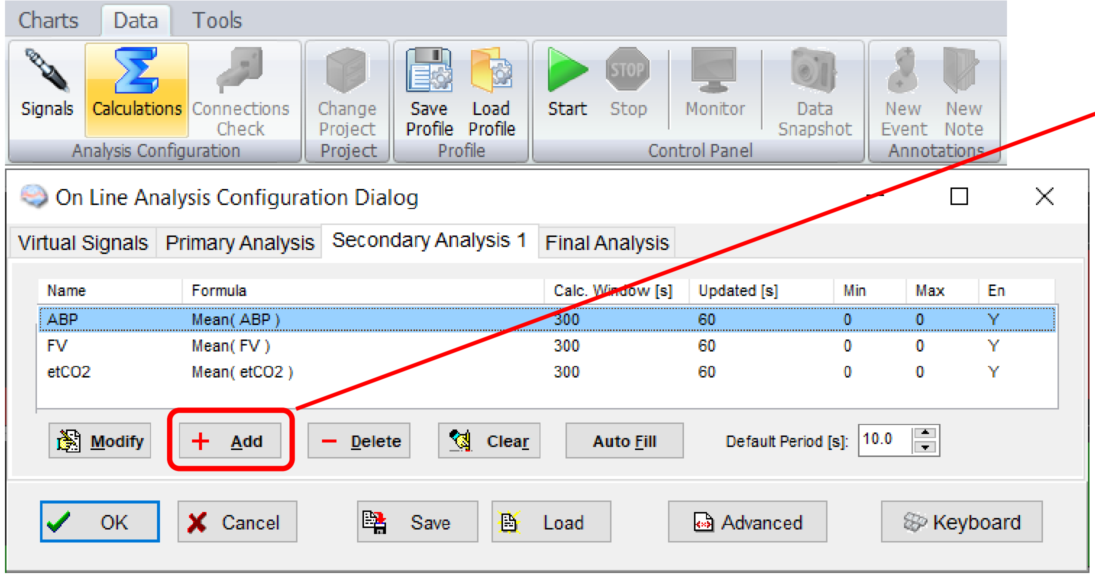


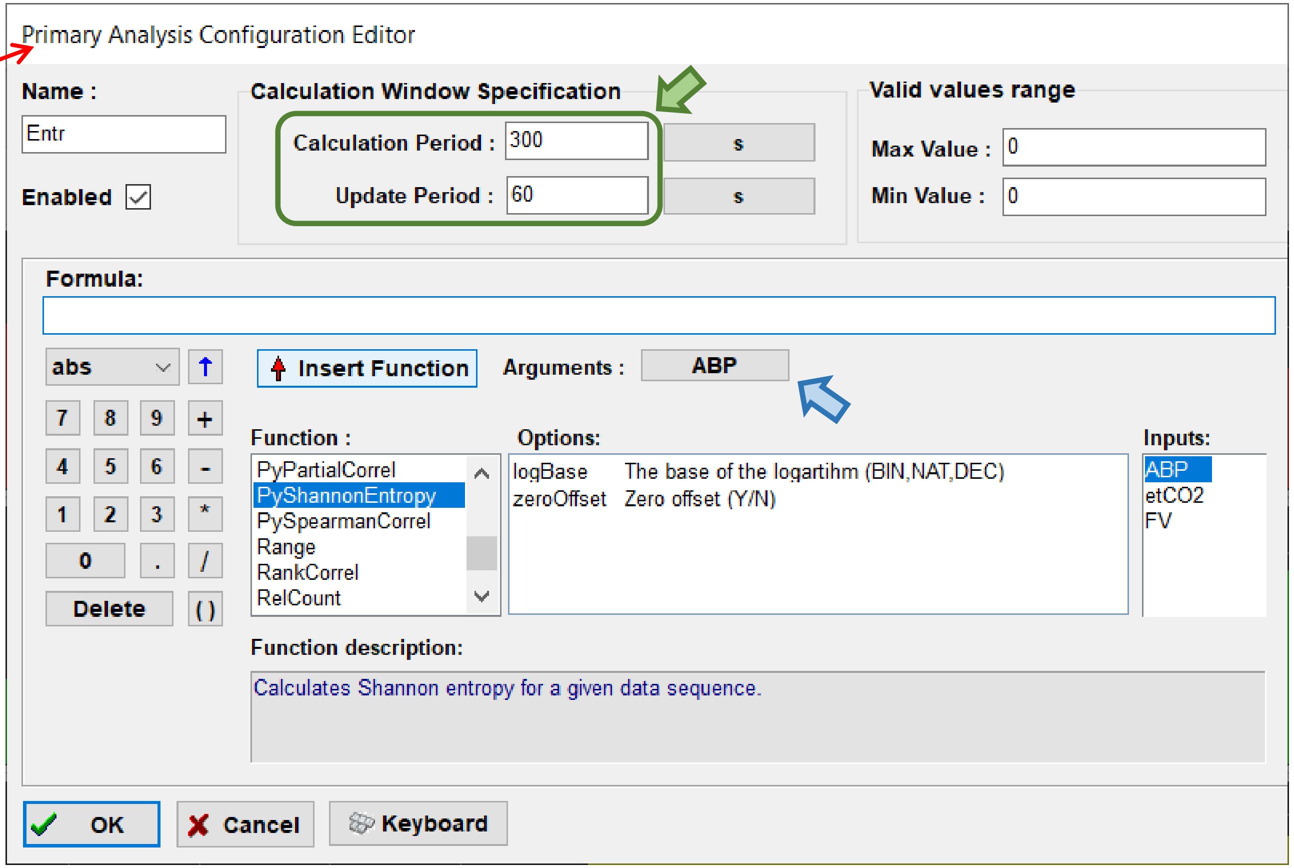
Using user-defined Python function in ICM+



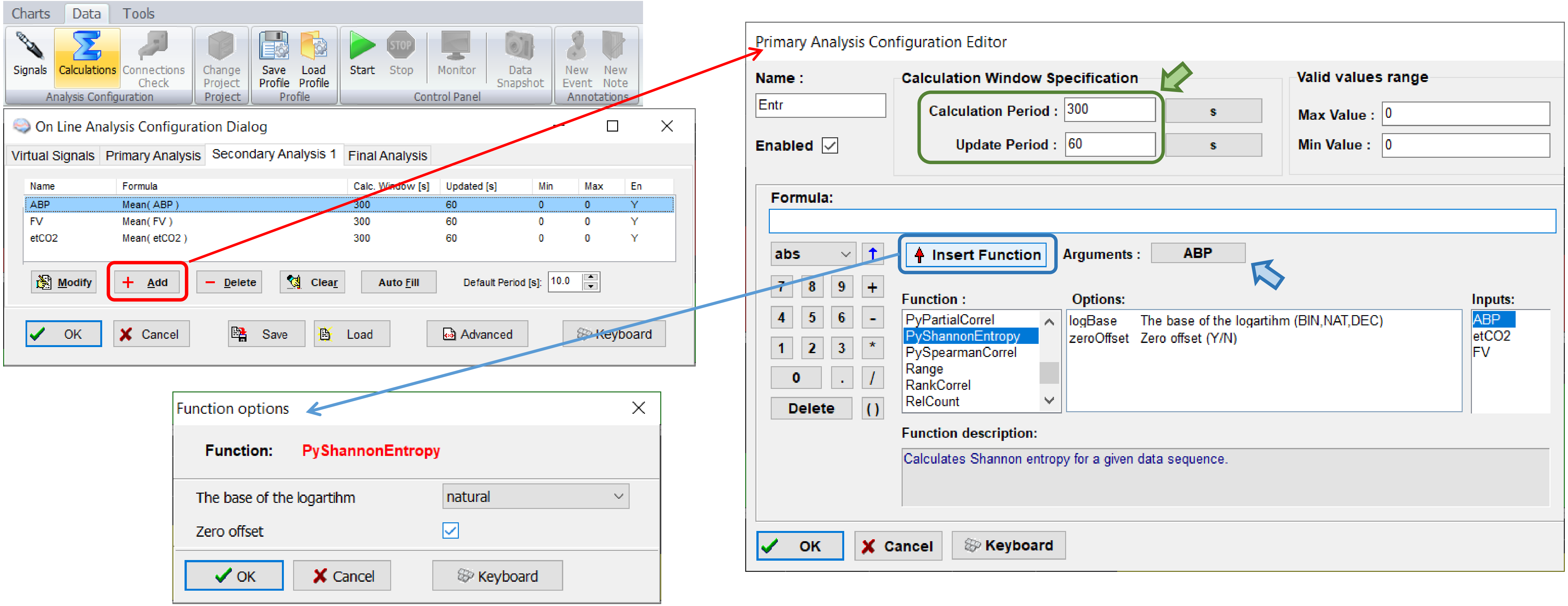


Using user-defined Python function in ICM+

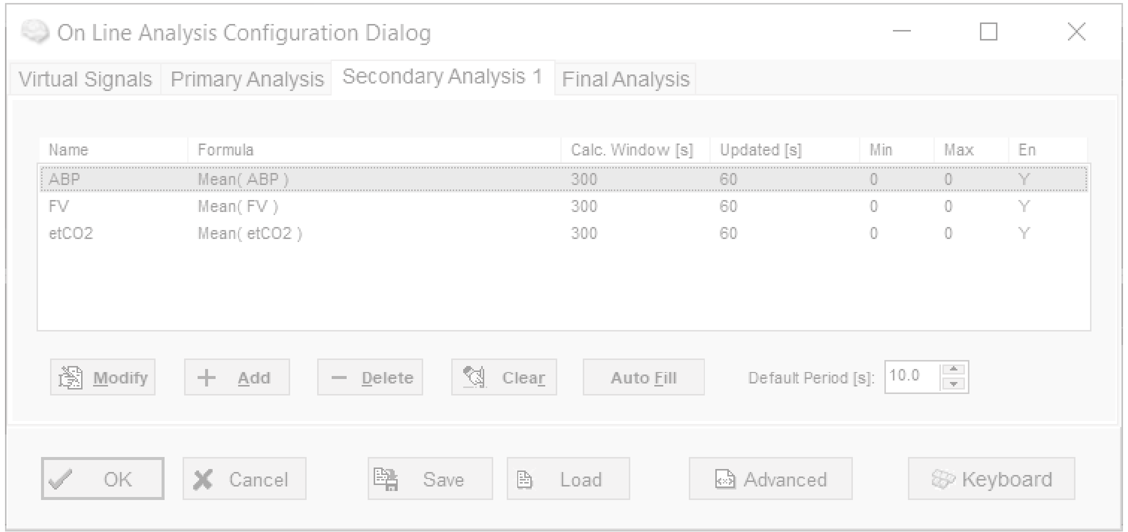


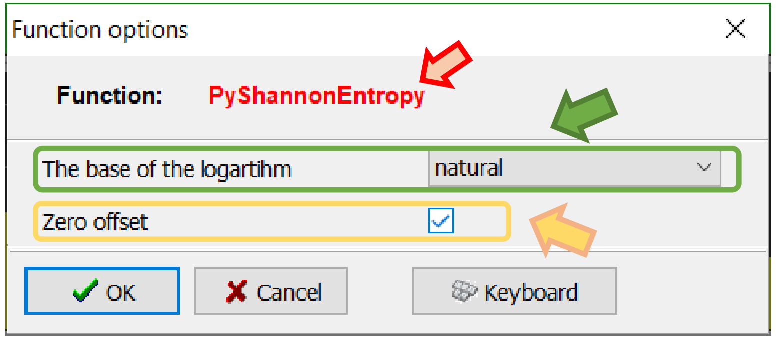


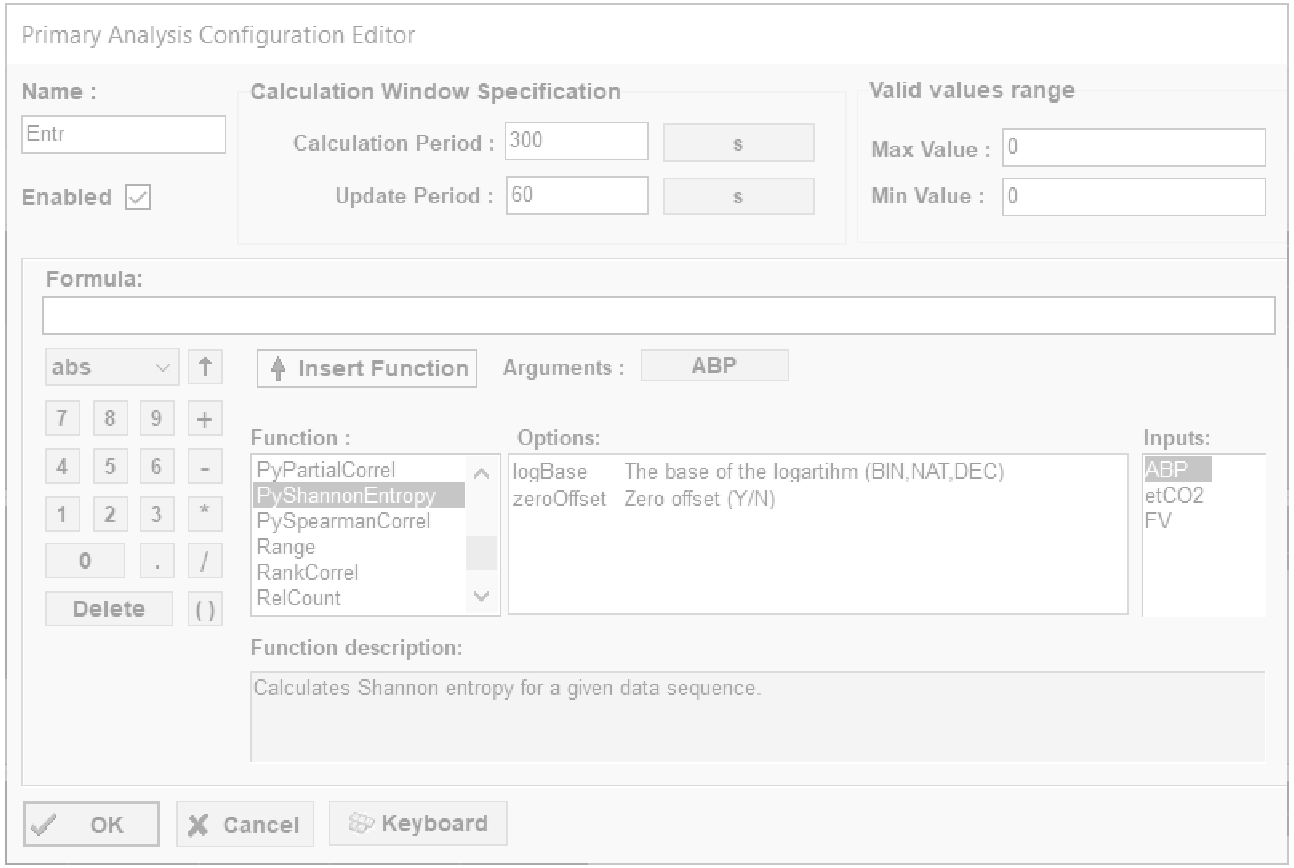
Using user-defined Python function in ICM+



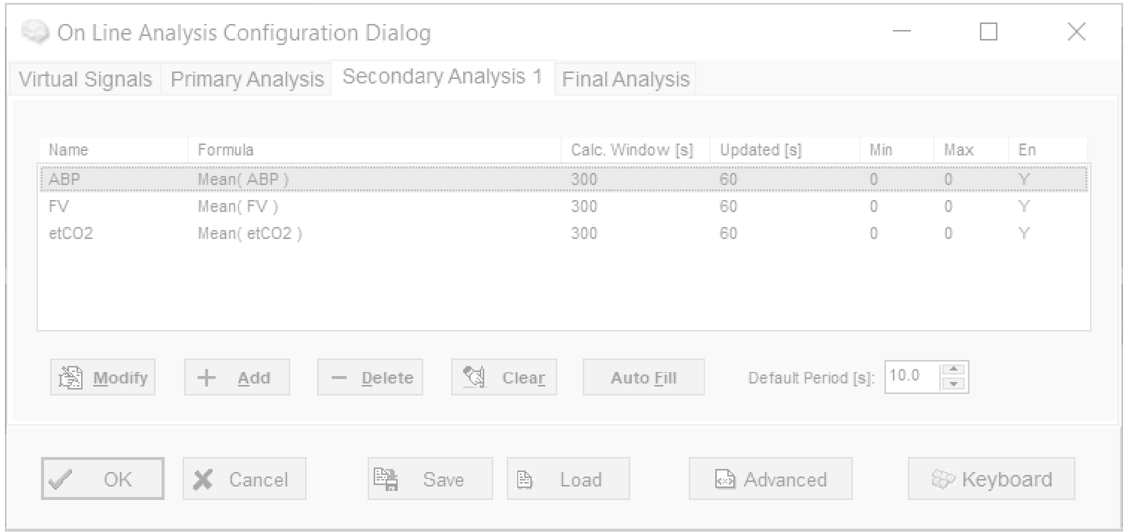
Using user-defined Python function in ICM+

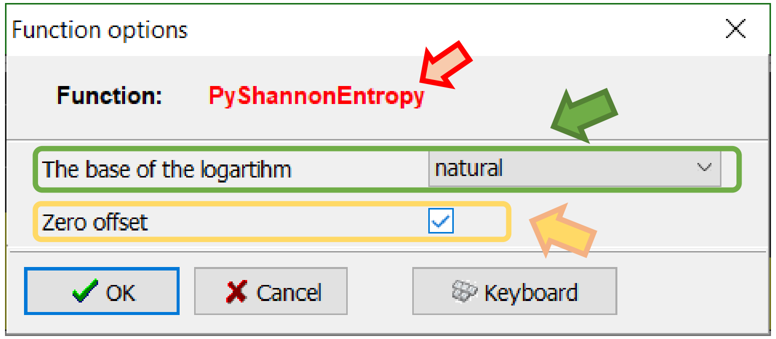


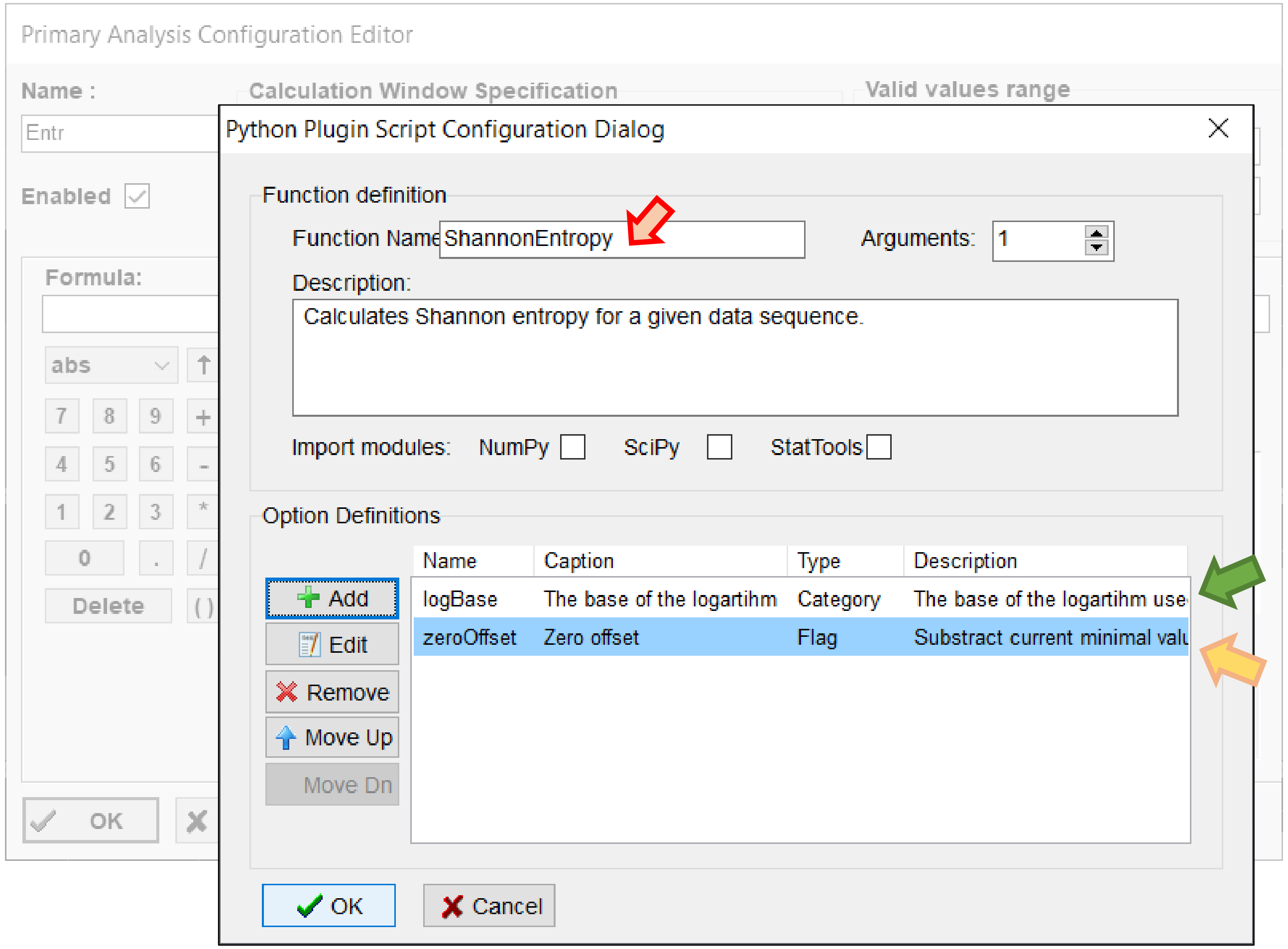




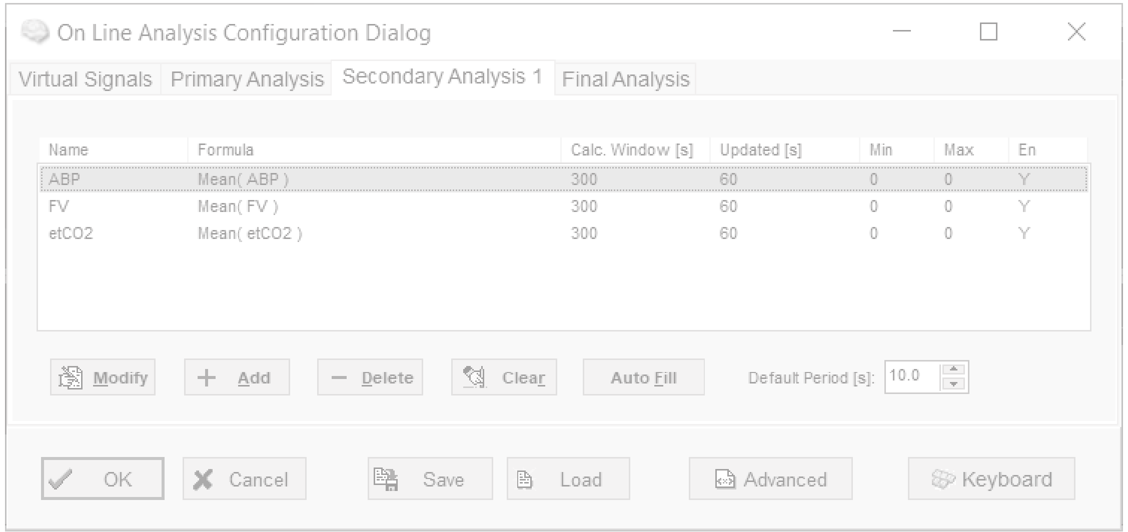
Using user-defined Python function in ICM+

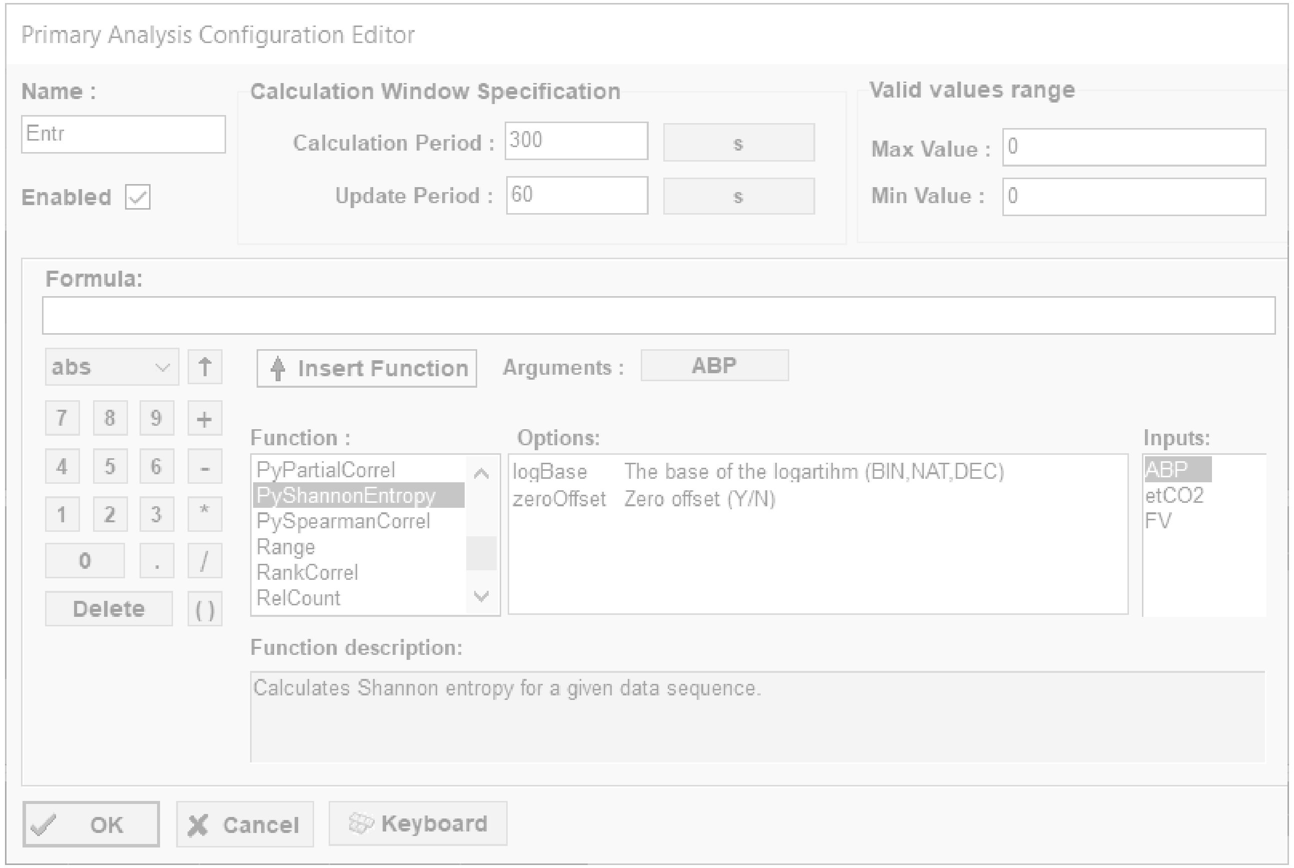


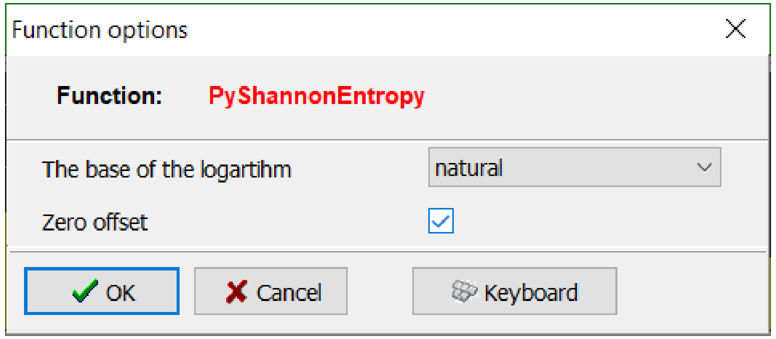




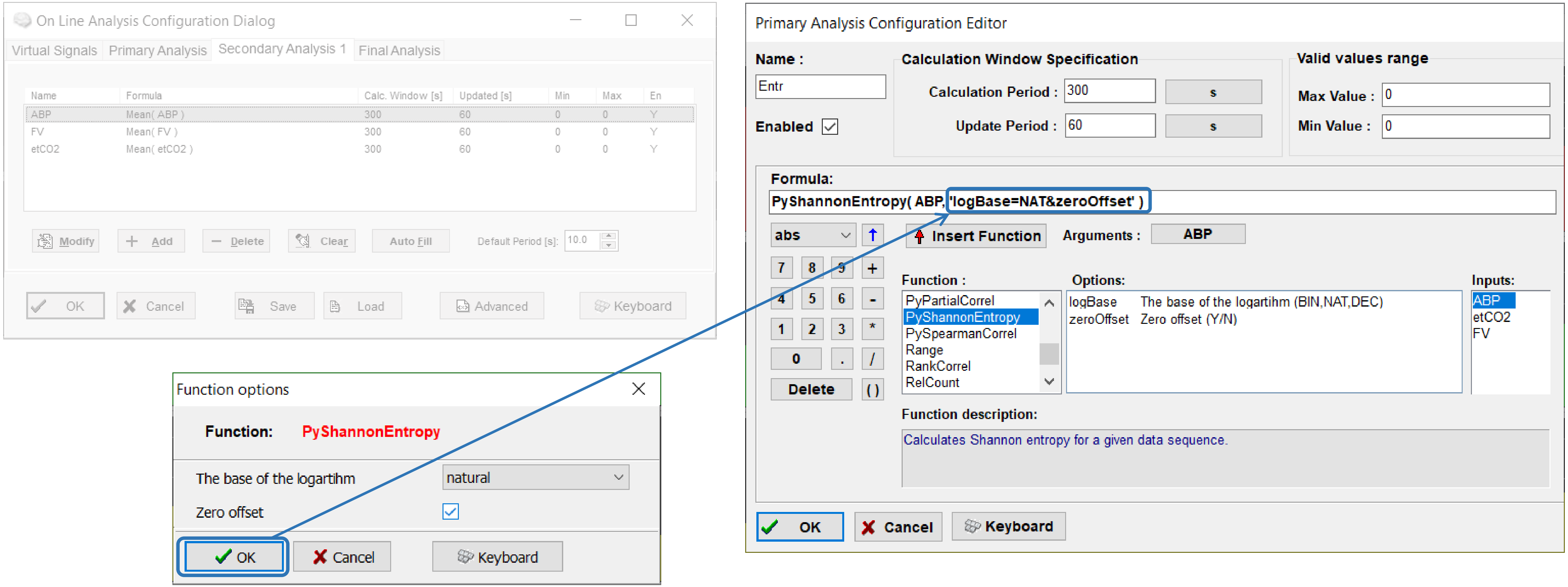
Using user-defined Python function in ICM+



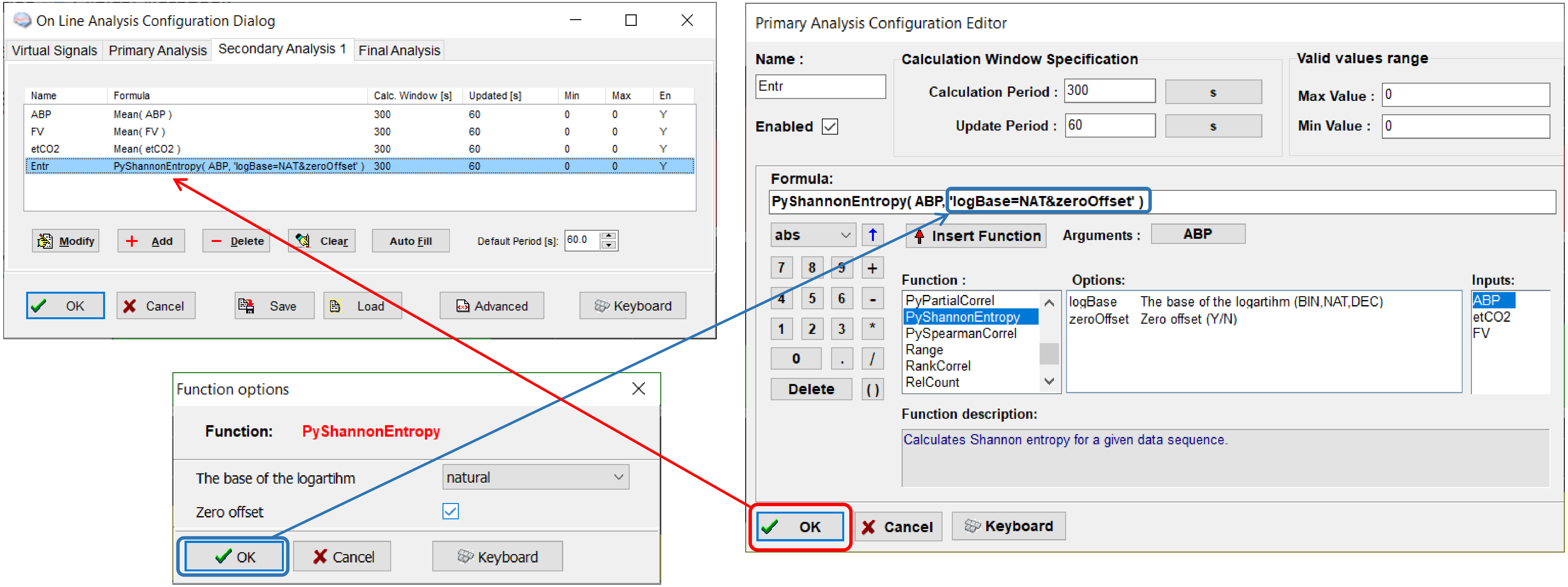




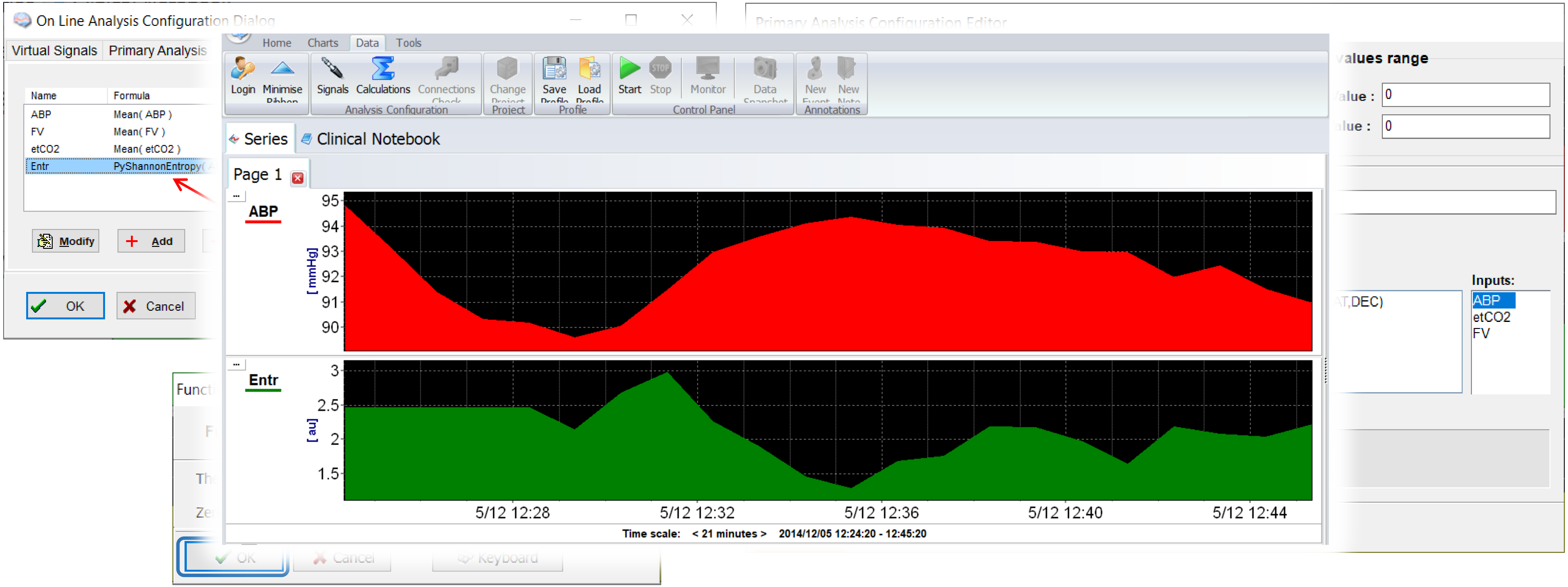
Using user-defined Python function in ICM+



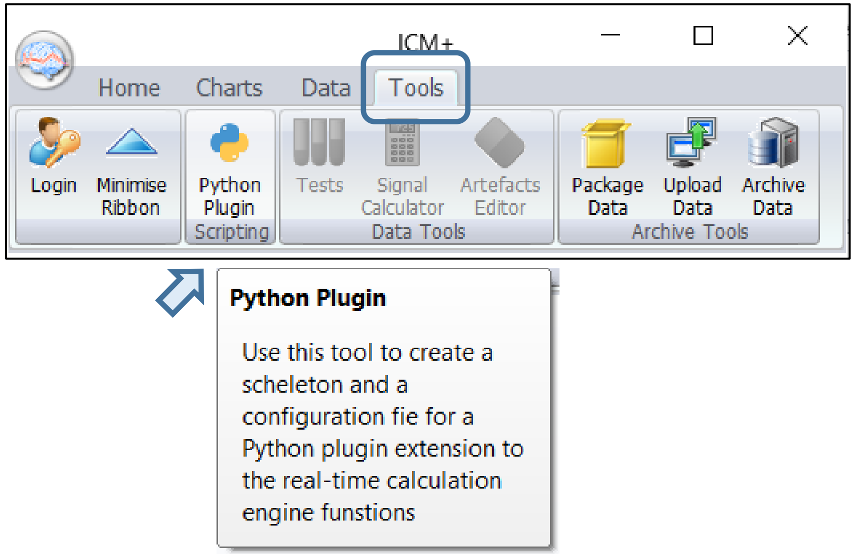
Using user-defined Python function in ICM+



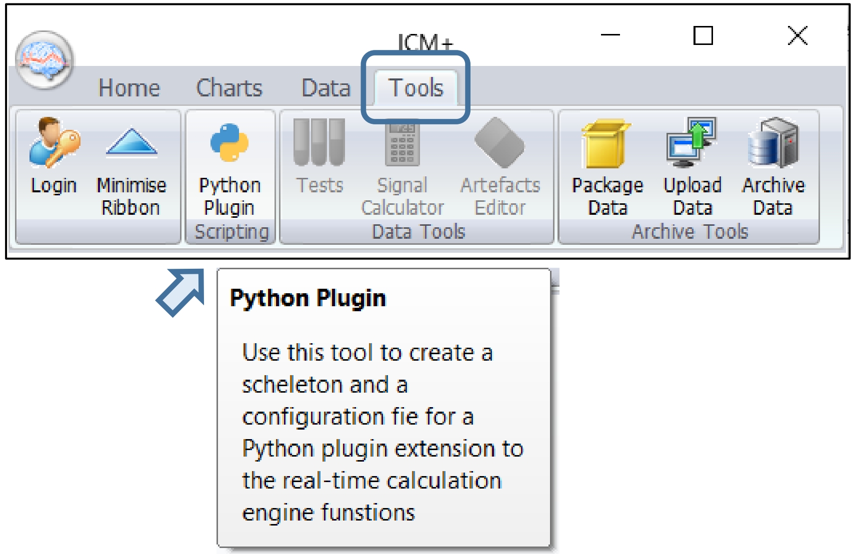
Using user-defined Python function in ICM+

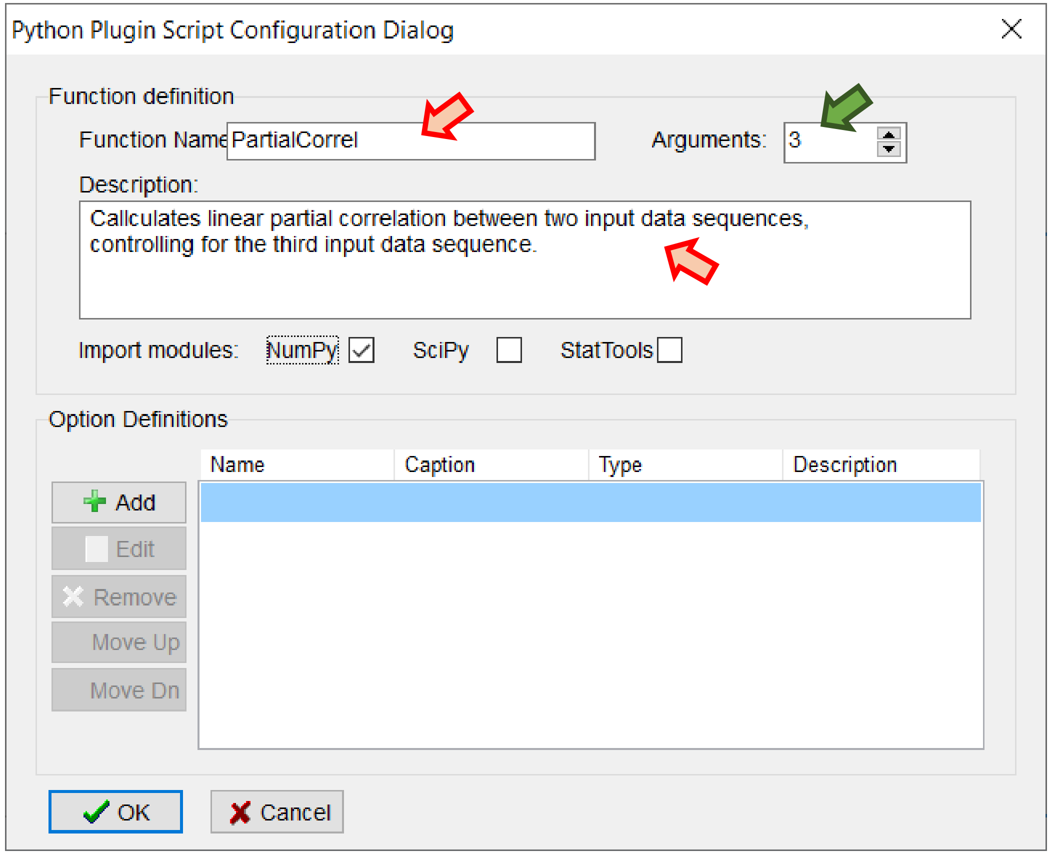


Partial correlation – example of a function with three inputs



Partial correlation – example of a function with three inputs





The generated Python script

```
import numpy as np


class PartialCorrel:

    # DO NOT MODIFY THIS METHOD. It is a part of the ICM+--Python interface.
    def set_parameter(self, param_name, param_value):
        setattr(self, param_name, param_value)

    # ...
    # ...

    # 'calculate' is the main work-horse function.
    # It is called with a data buffer (one or more) of size corresponding to the Calculation Window
    # It must return one floating-point number
    # It take the following parameters:
    # sig1 - input variable/signal 1
    # sig2 - input variable/signal 2
    # sig3 - input variable/signal 3
    # ts_time - part of the data time stamp - number of milliseconds since midnight
    # ts_date - Part of the data time stamp - One plus number of days since 1/1/0001
    # It can also use the data sampling frequency:
    #    self.sampling_freq
    def calculate(self, sig1,sig2,sig3, ts_time, ts_date):
        # my_own_code_here
        result = 0.0
        return result
```

The generated Python script

```python
import numpy as np


class PartialCorrel:

    # DO NOT MODIFY THIS METHOD. It is a part of the ICM+--Python interface.
    def set_parameter(self, param_name, param_value):
        setattr(self, param_name, param_value)

    # ...
    # ...

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    # ts_date - Part of the data time stamp - One plus number of days since 1/1/0001
    # It can also use the data  ampling frequency:
    #     self.sampling_freq
    def calculate(self, sig1,sig2,sig3, ts_time, ts_date):
        # my_own_code_here
        result = 0.0
        return result
```

Three input signals

The generated Python script

```
import numpy as np
from par_corr_module import partial_corr
```

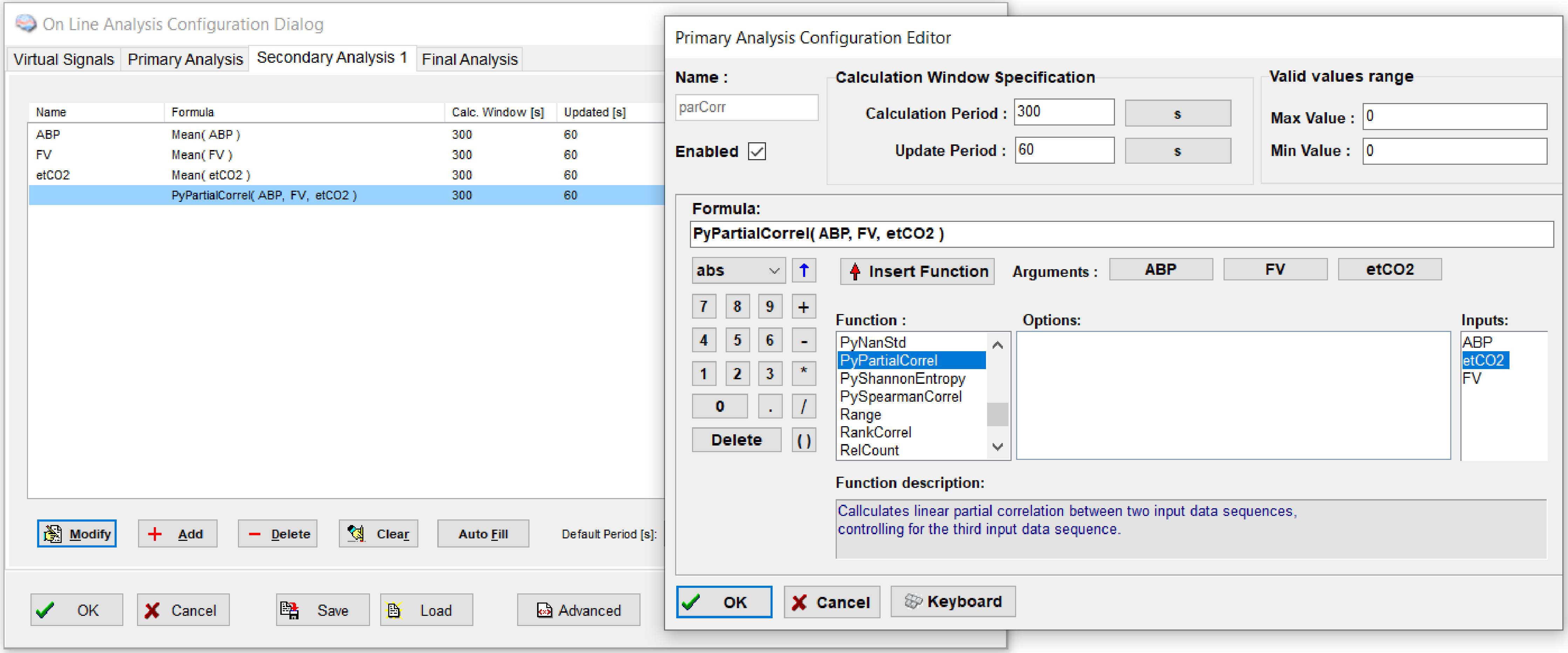
Importing function from another module

```
class PartialCorrel:

    # DO NOT MODIFY THIS METHOD. It is a part of the ICM+--Python interface.
    def set_parameter(self, param_name, param_value):
        setattr(self, param_name, param_value)

    # ...
    # ...

    # 'calculate' is the main work-horse function.
    # It is called with a data buffer (one or more) of size corresponding to the Calculation Window
    # It must return one floating-point number
    # It take the following parameters:
    # sig1 - input variable/signal 1
    # sig2 - input variable/signal 2
    # sig3 - input vari
    # ts_time - part of                  mp - number of milliseconds since midnight
    # ts_date - Part of                    stamp - One plus number of days since 1/1/0001
    # It can also use the data   ampling frequency:
    #    self.sampling_freq
    def calculate(self, sig1,sig2,sig3, ts_time, ts_date):

        A = np.array([sig1, sig2, sig3]).transpose()
        R_coefficients = partial_corr(A)
        return R_coefficients[0,1]
```

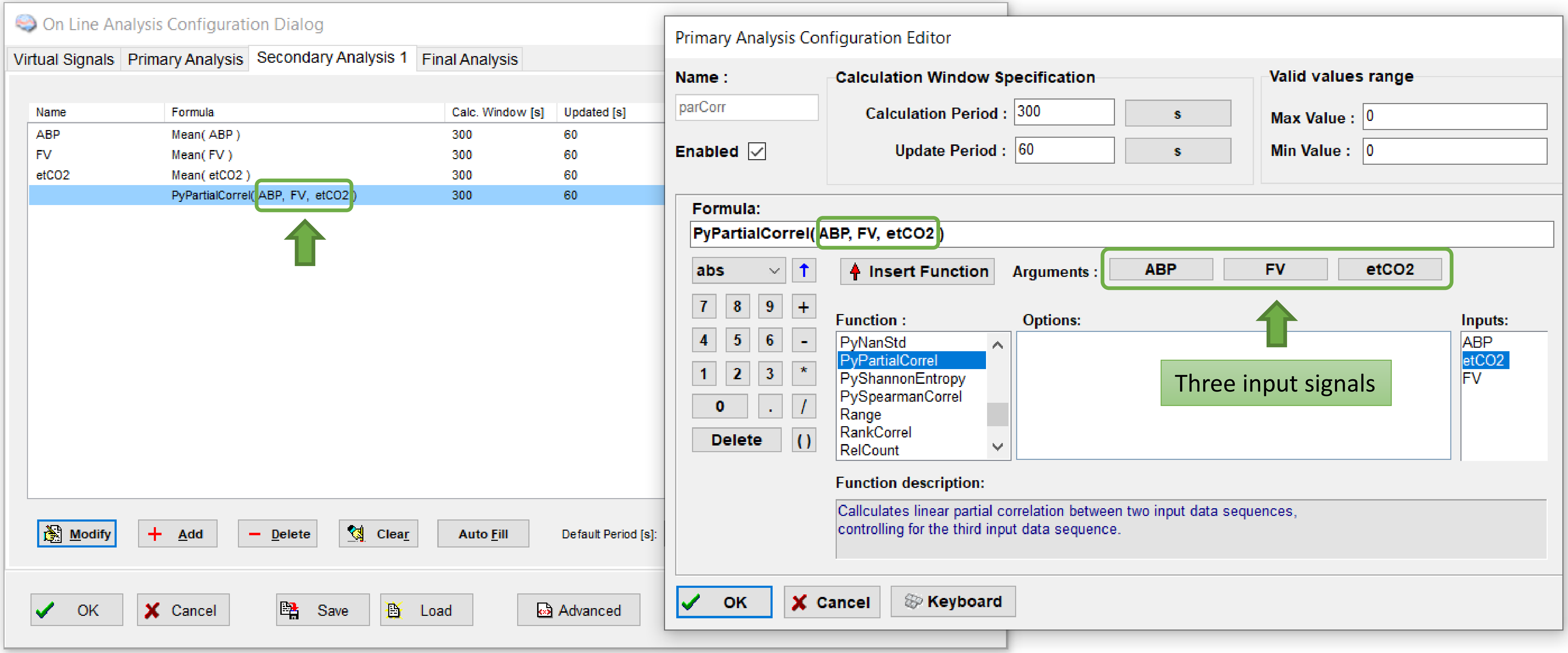
Three input signals

My own code added to the *calculate* method

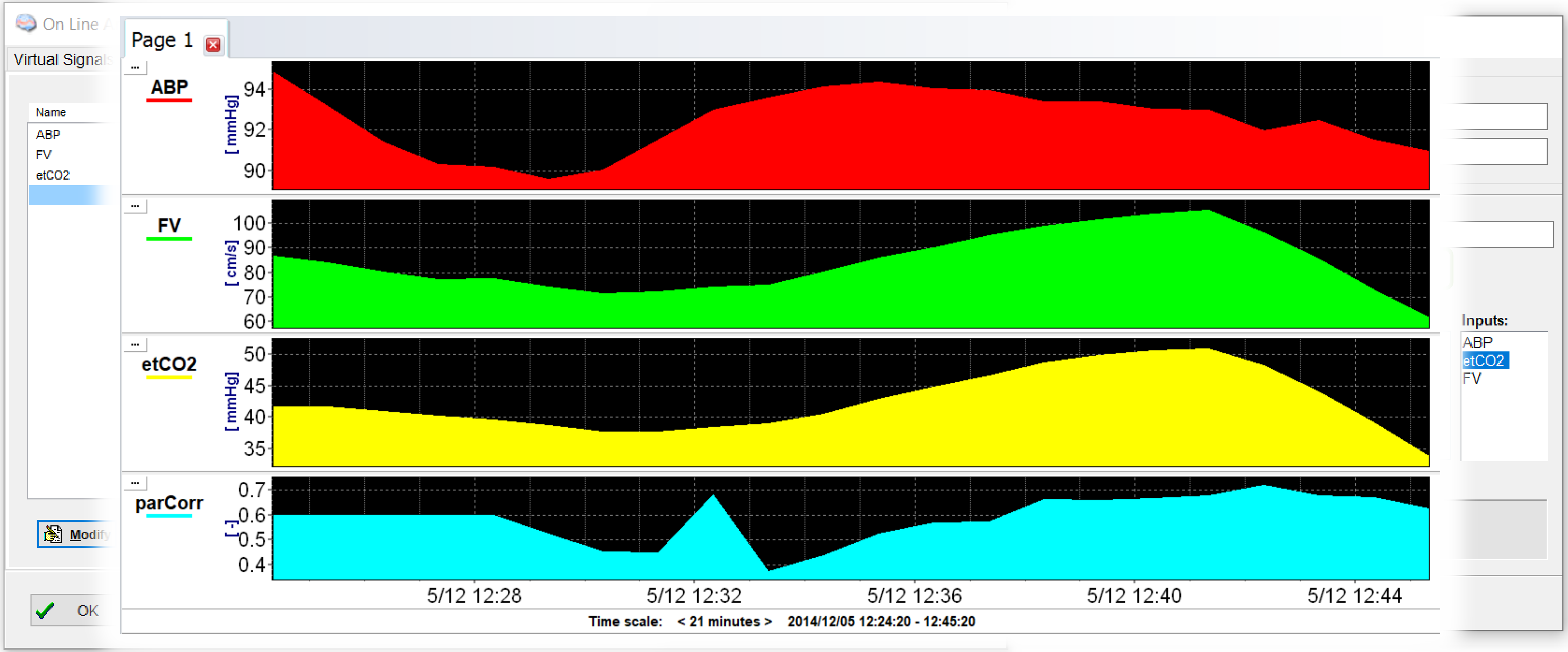
Using user-defined Python function in ICM+



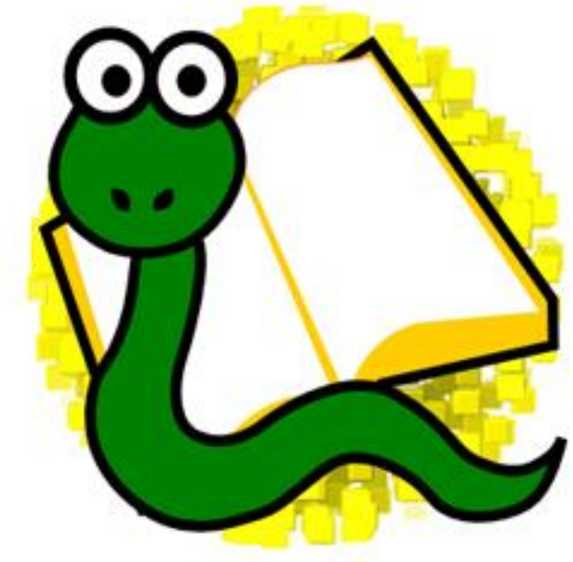
Using user-defined Python function in ICM+



Using user-defined Python function in ICM+

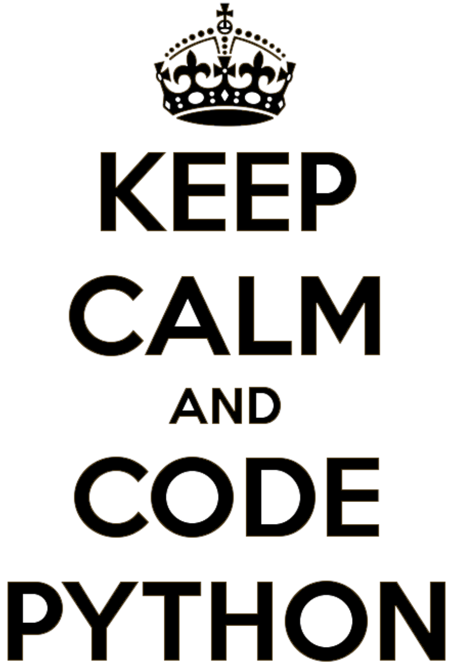


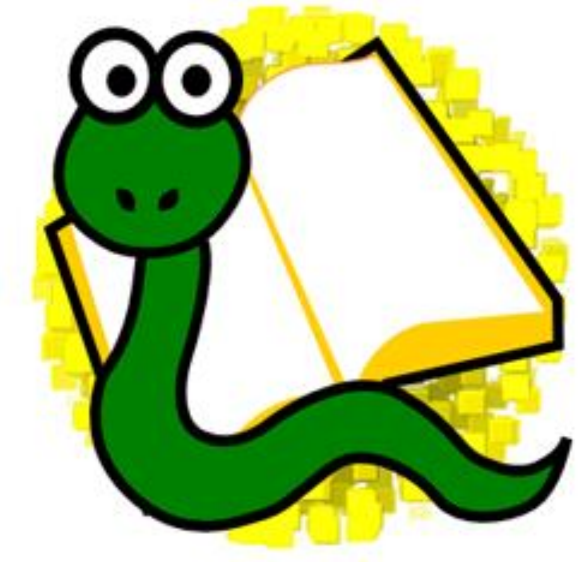
Happy pythoning!



Based on image by Jeffrey Elkner

Happy pythoning!





Based on image by Jeffrey Elkner

I invite you to see my poster (**#321**, Monday, 12:00–13:00)