Euromod Connector

Release 0.1.20a

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Jul 10, 2024

CONTENTS

The Euromod Connector for Python is built to facilitate and simplify the usage of the EUROMOD microsimulation model for research and analysis purposes.

EUROMOD is a tax-benefit microsimulation model for the European Union that enables researchers and policy analysts to calculate, in a comparable manner, the effects of taxes and benefits on household incomes and work incentives for the population of each country and for the EU as a whole. It is a static microsimulation model that applies user-defined tax and benefit policy rules to harmonised microdata on individuals and households, calculates the effects of these rules on household income.

CHAPTER

ONE

CONTENTS

1.1 Getting Started

The Euromod Conector is a Python library providing tools for running simulations and interacting with the tax-benefit microsimulation model EUROMOD.

1.1.1 Installation

The Euromod Connector can be installed from PyPi using *pip*:

```
$ pip install euromod
```

Requirements

The Euromod Connector requires two EUROMOD components: 1) the model (coded policy rules), and 2) the input microdata with the variables that respect the EUROMOD naming conventions. For more information, please, read the sections "Model" and "Input microdata" on the Download Euromod web page.

1.1.2 Load the model

Import the EUROMOD model:

```
from euromod import Model
```

Create an object of the `core.Model` class by passing the path to the EUROMOD project:

```
mod=Model(r"C:\EUROMOD_RELEASES_I6.0+")
mod
```

```
Model located in C:\EUROMOD_RELEASES_I6.0+
```

1.1.3 Countries and systems

The `Model.countries` attirbute is a container storing the `core.Country` objects which nest the country-specific tax-benefit policies and systems.

Displays the EUROMOD default countries:

```
mod.countries
```

```
0: AT
1: BE
2: BG
3: CY
4: CZ
5: DE
6: DK
7: EE
8: EL
9: ES
10: FI
11: FR
12: HR
13: HU
14: IE
15: IT
16: LT
17: LU
18: LV
19: MT
20: NL
21: PL
22: PT
23: RO
24: SE
25: SI
26: SK
27: SL
```

Displaying a specific country model, e.g. Simpleland, using the two-letters country code index:

```
mod.countries['SL']
```

```
------------------------------
Country
------------------------------
         datasets: sl_demo_v4
         local_extensions: 0 elements
         name: 'SL'
         policies: 12 elements
         systems: SL_1996
```

Get the `core.System` object from the country class, e.g. for the system 'SL_1996' of the country Simpleland 'SL':

```
mod.countries['SL'].systems['SL_1996']
```

```
------------------------------
System
------------------------------
        ID: 'F7E5CACE-CECC-4BB6-9841-A936D0975481'
        bestmatch_datasets: sl_demo_v4
        currencyOutput: 'euro'
        currencyParam: 'euro'
        datasets: sl_demo_v4
        headDefInc: 'ils_origy'
        name: 'SL_1996'
        order: '1'
        policies: 12 elements
        private: 'no'
        year: '1996'
```

Datasets

All the datasets that are available for a country-system model are collected in the attribute `datasets` as `core.Dataset` objects.

Displaying information about a dataset relative to a country, e.g. dataset 'sl_demo_v4' for the country Simpleland, by indexing the attribute `datasets`:

```
mod.countries['SL'].datasets[0]
```

```
------------------------------
Dataset
------------------------------
        ID: 'CBA7E428-F8E4-4CEB-8A5E-9ACE73987DD7'
        coicopVersion: ''
        comment: ''
        currency: 'euro'
        decimalSign: '.'
        name: 'sl_demo_v4'
        private: 'no'
        readXVariables: 'no'
        useCommonDefault: 'no'
```

Displaying information about a dataset relative to a system, e.g. dataset 'sl_demo_v4' for the system 'SL_1996', by indexing the attribute `datasets`:

```
mod.countries['SL'].systems['SL_1996'].datasets[0]
```

```
------------------------------
DatasetInSystem
------------------------------
        ID: 'F7E5CACE-CECC-4BB6-9841-A936D0975481CBA7E428-F8E4-4CEB-8A5E-9ACE73987DD7'
        bestMatch: 'yes'
        coicopVersion: ''
```

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```
        comment: ''
        currency: 'euro'
        dataID: 'CBA7E428-F8E4-4CEB-8A5E-9ACE73987DD7'
        decimalSign: '.'
        name: 'sl_demo_v4'
        private: 'no'
        readXVariables: 'no'
        sysID: 'F7E5CACE-CECC-4BB6-9841-A936D0975481'
        useCommonDefault: 'no'
```

Policies

All the policies that apply in a country-system model are collected in the attribute `policies` as `core.Policy` and `core.PolicyInSystem` objects, respectively for the country and system objects.

Displaying all the policies modeled in a country using the attribute `policies`:

```
mod.countries['SL'].policies
```

```
0: Uprate_sl            |    DEF: UPRATING FACTORS
1: ILsDef_sl            |    DEF: STANDARD INCOME CONCEPTS
2: ILDef_sl             |    DEF: SPECIFIC INCOME CONCEPTS
3: TUDef_sl             |    DEF: ASSESSMENT UNITS
4: yem_sl               |    DEF: Minimum Wage
5: neg_sl               |    DEF: recode negative self-employment income to zer ...
6: sic_sl               |    SIC: Social Insurance Contributions
7: bch_sl               |    BEN: Child Benefit
8: tin_sl               |    TAX: Income Tax
9: bsa_sl               |    BEN: Social Assistance
10: output_std_sl       |    DEF: STANDARD OUTPUT INDIVIDUAL LEVEL
11: output_std_hh_sl    |    DEF: STANDARD OUTPUT HOUSEHOLD LEVEL
```

Displaying all the policies modeled in a system using the attribute `policies`:

```
mod.countries['SL'].systems['SL_1996'].policies
```

```
0: Uprate_sl             | on        |    DEF: UPRATING FACTORS
1: ILsDef_sl             | on        |    DEF: STANDARD INCOME CONCEPTS
2: ILDef_sl              | on        |    DEF: SPECIFIC INCOME CONCEPTS
3: TUDef_sl              | on        |    DEF: ASSESSMENT UNITS
4: yem_sl                | on        |    DEF: Minimum Wage
5: neg_sl                | on        |    DEF: recode negative self-employment income to␣
↪zer ...
6: sic_sl                | on        |    SIC: Social Insurance Contributions
7: bch_sl                | on        |    BEN: Child Benefit
8: tin_sl                | on        |    TAX: Income Tax
9: bsa_sl                | on        |    BEN: Social Assistance
10: output_std_sl        | on        |    DEF: STANDARD OUTPUT INDIVIDUAL LEVEL
11: output_std_hh_sl     | off       |    DEF: STANDARD OUTPUT HOUSEHOLD LEVEL
```

Displaying the `core.Policy` 'sic_sl' in the country Simpleland 'SL':

```
mod.countries['SL'].policies[6]
```

```
------------------------------
Policy
------------------------------
        ID: '20901CF5-0A2A-4BA8-A18A-7092CD6A182D'
        comment: 'SIC: Social Insurance Contributions'
        extensions: 0 elements
        functions: SchedCalc, SchedCalc, SchedCalc
        name: 'sic_sl'
        order: '7'
        private: 'no'
        spineOrder: '7'
```

Displaying the `core.PolicyInSystem` 'sic_sl' for the system 'SL_1996' in country Simpleland 'SL':

```
mod.countries['SL'].systems['SL_1996'].policies[6]
```

```
------------------------------
PolicyInSystem
------------------------------
        ID: 'F7E5CACE-CECC-4BB6-9841-A936D097548120901CF5-0A2A-4BA8-A18A-7092CD6A182D'
        comment: 'SIC: Social Insurance Contributions'
        extensions: 0 elements
        functions: SchedCalc, SchedCalc, SchedCalc
        name: 'sic_sl'
        order: '7'
        polID: '20901CF5-0A2A-4BA8-A18A-7092CD6A182D'
        private: 'no'
        spineOrder: '7'
        switch: 'on'
        sysID: 'F7E5CACE-CECC-4BB6-9841-A936D0975481'
```

Functions

The attribute `functions` stores all the functions defined in a country-system model as `core.Function` objects and `core.FunctionInSystem` objects, respectively.

Displaying the `core.Function` object for the function 'SchedCalc' in the policy 'sic_sl' in country Simpleland 'SL':

```
mod.countries['SL'].policies[6].functions[1]
```

```
------------------------------
Function
------------------------------
        ID: '0093C4C1-5B69-492F-B88B-99E880201D08'
        comment: "employee's contribution"
        extensions: 0 elements
        name: 'SchedCalc'
        order: '2'
        parameters: base, band_rate, uplim, output_var, TAX_UNIT
```

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```
        polID: '20901CF5-0A2A-4BA8-A18A-7092CD6A182D'
        spineOrder: '7.2'
```

Displaying the `core.FunctionInSystem` object for the function 'SchedCalc' in the policy 'sic_sl' and system 'SL_1996' in country Simpleland 'SL':

```
mod.countries['SL'].systems['SL_1996'].policies[6].functions[1]
```

```
------------------------------
FunctionInSystem
------------------------------
        ID: 'F7E5CACE-CECC-4BB6-9841-A936D09754810093C4C1-5B69-492F-B88B-99E880201D08'
        comment: "employee's contribution"
        extensions: 0 elements
        funID: '0093C4C1-5B69-492F-B88B-99E880201D08'
        name: 'SchedCalc'
        order: '2'
        parameters: base, band_rate, uplim, output_var, TAX_UNIT
        polID: '20901CF5-0A2A-4BA8-A18A-7092CD6A182D'
        spineOrder: '7.2'
        switch: 'on'
        sysID: 'F7E5CACE-CECC-4BB6-9841-A936D0975481'
```

Parameters

The attribute `parameters` is a container collecting all the policy-functions parameters of a given country-system model, respectively as `core.Parameter` and `core.ParameterInSystem` objects.

Displaying the `core.Parameter` object for parameter 'uplim' from the function 'SchedCalc' in policy 'sic_sl' for country 'SL':

```
mod.countries['SL'].policies[6].functions[1].parameters[2]
```

```
------------------------------
Parameter
------------------------------
        ID: '7BE96A7F-610A-4B58-A9B0-36A387B785A7'
        comment: 'i.e. switched off'
        extensions: 0 elements
        funID: '0093C4C1-5B69-492F-B88B-99E880201D08'
        group: ''
        name: 'uplim'
        order: '3'
        spineOrder: '7.2.3'
```

Displaying the `core.ParameterInSystem` object for parameter 'uplim' from the function 'SchedCalc' in policy 'sic_sl' for system 'SL_1996' and country 'SL':

```
mod['SL']['SL_1996'].policies[6].functions[1].parameters[2]
```

```
------------------------------
ParameterInSystem
------------------------------
        ID: 'F7E5CACE-CECC-4BB6-9841-A936D09754817BE96A7F-610A-4B58-A9B0-36A387B785A7'
        comment: 'i.e. switched off'
        extensions: 0 elements
        funID: '0093C4C1-5B69-492F-B88B-99E880201D08'
        group: ''
        name: 'uplim'
        order: '3'
        parID: '7BE96A7F-610A-4B58-A9B0-36A387B785A7'
        spineOrder: '7.2.3'
        sysID: 'F7E5CACE-CECC-4BB6-9841-A936D0975481'
        value: '999999999.99#m'
```

1.1.4 Run simulation

The example below shows how to run a simulation on the EUROMOD's Simpleland country model, which is an example of a simple country model provided by default with EUROMOD.

Load the EUROMOD model:

```
from euromod import Model
mod = Model("C:\EUROMOD_RELEASES_I6.0+")
```

Get the best-match dataset for the system 'SL_1996' in the country Simpleland 'SL':

```
dataset_id = mod.countries['SL'].systems['SL_1996'].bestmatch_datasets[-1].name
dataset_id
```

```
'sl_demo_v4'
```

Load the Simpleland 'SL' dataset as a `pandas.DataFrame`:

```
import pandas as pd
data = pd.read_csv(r"C:\EUROMOD_RELEASES_I6.0+\Input\sl_demo_v4.txt",sep="\t")
```

Run the simulation of the 'SL' system 'SL_1996' using the dataset 'sl_demo_v4':

```
out=mod.countries['SL'].systems['SL_1996'].run(data,'sl_demo_v4')
```

```
Simulation for system SL_1996 with dataset sl_demo_v4 finished.
```

The simulation run returns a `core.Simulation` class that stores the results as `pandas.DataFrame` objects in the attribute `outputs`:

```
out.outputs[0]
```

```
      idhh  idperson  idmother  idfather  idpartner   dag  dgn  dec   dwt  \
0      1.0     101.0       0.0       0.0      102.0  65.0  1.0  0.0  10.0
1      1.0     102.0       0.0       0.0      101.0  60.0  0.0  0.0  10.0
2      1.0     103.0     102.0     101.0        0.0  30.0  1.0  0.0  10.0
```

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```
3       1.0     104.0     102.0     101.0        0.0  28.0  1.0  0.0  10.0
4       2.0     201.0       0.0       0.0      202.0  29.0  1.0  0.0  10.0
...     ...       ...       ...       ...        ...   ...  ...  ...   ...
1255  500.0   50003.0   50002.0   50001.0        0.0   5.0  0.0  2.0  10.0
1256  500.0   50004.0   50002.0   50001.0        0.0   3.0  1.0  0.0  10.0
1257  500.0   50005.0   50002.0   50001.0        0.0   1.0  0.0  0.0  10.0
1258  500.0   50006.0       0.0       0.0    50007.0  68.0  1.0  0.0  10.0
1259  500.0   50007.0       0.0       0.0    50006.0  62.0  0.0  0.0  10.0

      dms  ...  ils_taxsim   ils_tax  ils_sicee  ils_sicse  ils_sicer  \
0     2.0  ...     0.00000   0.00000    0.00000        0.0    0.00000
1     2.0  ...     0.00000   0.00000    0.00000        0.0    0.00000
2     1.0  ...     0.00000   0.00000    0.00000        0.0    0.00000
3     1.0  ...     0.00000   0.00000    7.87094        0.0   15.74188
4     2.0  ...    84.31707  84.31707   53.76765        0.0  107.53530
...   ...  ...         ...       ...        ...        ...        ...
1255  1.0  ...     0.00000   0.00000    0.00000        0.0    0.00000
1256  1.0  ...     0.00000   0.00000    0.00000        0.0    0.00000
1257  1.0  ...     0.00000   0.00000    0.00000        0.0    0.00000
1258  2.0  ...     0.00000   0.00000    0.00000        0.0    0.00000
1259  2.0  ...     0.00000   0.00000    0.00000        0.0    0.00000

      ils_sicot  ils_sicdy    ils_dispy  il_taxabley  il_bsa_base
0           0.0    0.00000   807.018500      0.00000    807.01850
1           0.0    0.00000     0.000000      0.00000      0.00000
2           0.0    0.00000     0.000000      0.00000      0.00000
3           0.0    7.87094   934.294772    149.54786    149.54786
4           0.0   53.76765  1337.268280   1421.58535   1337.26828
...         ...        ...          ...          ...          ...
1255        0.0    0.00000     0.000000      0.00000      0.00000
1256        0.0    0.00000     0.000000      0.00000      0.00000
1257        0.0    0.00000     0.000000      0.00000      0.00000
1258        0.0    0.00000   839.845300      0.00000    839.84530
1259        0.0    0.00000     0.000000      0.00000      0.00000

[1260 rows x 43 columns]
```

1.2 Simulation examples

1.2.1 Load model and data

Import the EUROMOD connector Model and the dataset 'PL_2020_b2.txt' for Poland.

```
from euromod import Model
mod=Model(r"C:\EUROMOD_RELEASES_I6.0+")
import pandas as pd
data=pd.read_csv(r"C:\EUROMOD_RELEASES_I6.0+\Input\PL_2020_b2.txt",sep="\t")
```

1.2.2 1. Run two systems with default parameters

Run the simulation for the Poland systems 'PL_2021' and 'PL_2022' using the dataset 'PL_2020_b2'.

Checking the best-match datasets for systems 'PL_2021' and 'PL_2022'.

```
print('System    Dataset')
for sys in {'PL_2021', 'PL_2022'}:
    dataset_name = mod['PL']['PL_2022'].bestmatch_datasets[-1].name
    print(sys, ' ', dataset_name)
```

```
System    Dataset
```

```
PL_2022   PL_2020_b2
PL_2021   PL_2020_b2
```

Running multiple simulations in a loop:

```
out=[]
for sysnam in ['PL_2021','PL_2022']:
    out.append(mod['PL'][sysnam].run(data,"PL_2020_b2"))
```

```
Simulation for system PL_2021 with dataset PL_2020_b2 finished.
```

```
Simulation for system PL_2022 with dataset PL_2020_b2 finished.
```

Access the simulation results indexing the `Simulation.outputs` object either with the index position or with the names of the datasets provided in the attribute `Simulation.outputs`:

```
out[1].outputs
```

```
0:             idhh     idperson     idmother     idfather  idpartner   idorighh  \
0          100.0      10001.0          0.0          0.0    10002.0      100.0
1          100.0      10002.0          0.0          0.0    10001.0      100.0
2          100.0      10003.0      10002.0      10001.0        0.0      100.0
3          100.0      10004.0      10002.0      10001.0        0.0      100.0
4          200.0      20001.0          0.0          0.0        0.0      200.0
...          ...          ...          ...          ...        ...        ...
38637  2047100.0  204710003.0  204710002.0  204710001.0        0.0  2047100.0
38638  2047100.0  204710004.0  204710002.0  204710001.0        0.0  2047100.0
38639  2047200.0  204720001.0          0.0          0.0        0.0  2047200.0
38640  2047300.0  204730001.0          0.0          0.0        0.0  2047300.0
38641  2047500.0  204750001.0          0.0          0.0        0.0  2047500.0

       idorigperson   dag  dgn  dec  ...      il_ben0    il_dpisilc  \
0           10001.0  38.0  1.0  0.0  ...  1050.000000  16367.636079
1           10002.0  38.0  0.0  0.0  ...     0.000000   6602.816820
2           10003.0  12.0  0.0  2.0  ...     0.000000      0.000000
3           10004.0   8.0  0.0  2.0  ...     0.000000      0.000000
4           20001.0  62.0  0.0  0.0  ...   223.073333   1771.645564
...             ...   ...  ...  ...  ...          ...           ...
38637   204710003.0  18.0  1.0  4.0  ...     0.000000      0.000000
38638   204710004.0   7.0  0.0  2.0  ...     0.000000      0.000000
```

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```
38639   204720001.0  51.0  0.0  0.0  ...     0.000000   3391.598079
38640   204730001.0  62.0  1.0  0.0  ...   975.291991   2180.895682
38641   204750001.0  69.0  0.0  0.0  ...   223.073333   3029.881169

        il_thlmx_s  il_thlmm_s   il_tinhlit   il_tinhljt  il_pa     il_bhomx  \
0      1804.242991         0.0  4035.086190  4035.086190    0.0   123.436998
1       787.534766         0.0   720.046355   720.046355    0.0     0.000000
2         0.000000         0.0     0.000000     0.000000    0.0     0.000000
3         0.000000         0.0     0.000000     0.000000    0.0     0.000000
4       164.491807         0.0     0.000000     0.000000    0.0   678.998548
...            ...         ...          ...          ...    ...          ...
38637     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38638     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38639   349.129643         0.0   135.506191   135.506191    0.0  1160.473138
38640   131.263597         0.0     0.000000     0.000000    0.0   395.047916
38641   183.583065         0.0    37.968866    37.968866    0.0   716.030976

           il_bsamt      il_bsatm
0      15333.066256  15333.066256
1       6602.816820   6602.816820
2          0.000000      0.000000
3          0.000000      0.000000
4       1551.658266   1551.658266
...             ...           ...
38637      0.000000      0.000000
38638      0.000000      0.000000
38639   3394.582426   3394.582426
38640   1476.410557   1476.410557
38641   2816.888295   2816.888295

[38642 rows x 453 columns]
```

```
out[1].outputs.keys()
```

```
dict_keys(['pl_2022_std.txt'])
```

```
out[1].outputs['pl_2022_std.txt']
```

```
            idhh     idperson     idmother     idfather  idpartner   idorighh  \
0          100.0      10001.0          0.0          0.0    10002.0      100.0
1          100.0      10002.0          0.0          0.0    10001.0      100.0
2          100.0      10003.0      10002.0      10001.0        0.0      100.0
3          100.0      10004.0      10002.0      10001.0        0.0      100.0
4          200.0      20001.0          0.0          0.0        0.0      200.0
...          ...          ...          ...          ...        ...        ...
38637  2047100.0  204710003.0  204710002.0  204710001.0        0.0  2047100.0
38638  2047100.0  204710004.0  204710002.0  204710001.0        0.0  2047100.0
38639  2047200.0  204720001.0          0.0          0.0        0.0  2047200.0
38640  2047300.0  204730001.0          0.0          0.0        0.0  2047300.0
38641  2047500.0  204750001.0          0.0          0.0        0.0  2047500.0
```

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```
       idorigperson   dag  dgn  dec  ...      il_ben0    il_dpisilc  \
0           10001.0  38.0  1.0  0.0  ...  1050.000000  16367.636079
1           10002.0  38.0  0.0  0.0  ...     0.000000   6602.816820
2           10003.0  12.0  0.0  2.0  ...     0.000000      0.000000
3           10004.0   8.0  0.0  2.0  ...     0.000000      0.000000
4           20001.0  62.0  0.0  0.0  ...   223.073333   1771.645564
...             ...   ...  ...  ...  ...          ...           ...
38637   204710003.0  18.0  1.0  4.0  ...     0.000000      0.000000
38638   204710004.0   7.0  0.0  2.0  ...     0.000000      0.000000
38639   204720001.0  51.0  0.0  0.0  ...     0.000000   3391.598079
38640   204730001.0  62.0  1.0  0.0  ...   975.291991   2180.895682
38641   204750001.0  69.0  0.0  0.0  ...   223.073333   3029.881169

        il_thlmx_s  il_thlmm_s   il_tinhlit   il_tinhljt  il_pa     il_bhomx  \
0      1804.242991         0.0  4035.086190  4035.086190    0.0   123.436998
1       787.534766         0.0   720.046355   720.046355    0.0     0.000000
2         0.000000         0.0     0.000000     0.000000    0.0     0.000000
3         0.000000         0.0     0.000000     0.000000    0.0     0.000000
4       164.491807         0.0     0.000000     0.000000    0.0   678.998548
...            ...         ...          ...          ...    ...          ...
38637     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38638     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38639   349.129643         0.0   135.506191   135.506191    0.0  1160.473138
38640   131.263597         0.0     0.000000     0.000000    0.0   395.047916
38641   183.583065         0.0    37.968866    37.968866    0.0   716.030976

           il_bsamt      il_bsatm
0      15333.066256  15333.066256
1       6602.816820   6602.816820
2          0.000000      0.000000
3          0.000000      0.000000
4       1551.658266   1551.658266
...             ...           ...
38637      0.000000      0.000000
38638      0.000000      0.000000
38639   3394.582426   3394.582426
38640   1476.410557   1476.410557
38641   2816.888295   2816.888295

[38642 rows x 453 columns]
```

`Simulation.configSettings` attribute shows the simulation configuration settings:

```
out[1].configSettings
```

```
{'PATH_EUROMODFILES': 'C:\\EUROMOD_RELEASES_I6.0+',
 'PATH_DATA': 'C:\\EUROMOD_RELEASES_I6.0+\\Input',
 'PATH_OUTPUT': '',
 'ID_DATASET': 'PL_2020_b2',
 'COUNTRY': 'PL',
 'ID_SYSTEM': 'PL_2022'}
```

Attribute `Simulation.configSettings` is a `struct` collecting the information about the system, dataset, addons,

extensions, and other configuration settings used in the simulation.

1.2.3 2. Run with changing constant

Run the simulation for the Poland system PL_2022 setting to 10000 the value of the constant '$f_h_cpi' with group number 2022.

```
out=mod['PL']['PL_2022'].run(data,"PL_2020_b2",constantsToOverwrite={("$f_h_cpi","2022"):
↪'10000'})
```

```
Simulation for system PL_2022 with dataset PL_2020_b2 finished.
```

The optional parameter `constantsToOverwrite` specifies which constants to overwrite in the policy spline. `constantsToOverwrite` must be a `dict`, where the keys are `tuples` of two `str` objects: the first string is the name of the constant and the second string is its group number (**Note:** Pass an empty string if the group number is `None`); the values are `str` with the new values of the constants. The default is None.

Attribute `Simulation.constantsToOverwrite` shows the modified constants used in the simulation:

```
out.constantsToOverwrite
```

```
{('$f_h_cpi', '2022'): '10000'}
```

1.2.4 3. Run with add-ons

Run the simulation for the Poland system PL_2022 including the Labour Market Adjustment add-on 'LMA'.

```
out =mod['PL']['PL_2022'].run(data,"PL_2020_b2",addons=[("LMA","LMA_PL")])
out
```

```
Simulation for system PL_2022 with dataset PL_2020_b2 finished.
```

```
output:              0:            idhh     idperson     idmother     idfather ␣
↪idpartner   idorighh  \
0          100.0      10001.0          0.0          0.0    10002.0      100.0
1          100.0      10002.0          0.0          0.0    10001.0      100.0
2          100.0      10003.0      10002.0      10001.0        0.0      100.0
3          100.0      10004.0      10002.0      10001.0        0.0      100.0
4          200.0      20001.0          0.0          0.0        0.0      200.0
...          ...          ...          ...          ...        ...        ...
38637  2047100.0  204710003.0  204710002.0  204710001.0        0.0  2047100.0
38638  2047100.0  204710004.0  204710002.0  204710001.0        0.0  2047100.0
38639  2047200.0  204720001.0          0.0          0.0        0.0  2047200.0
38640  2047300.0  204730001.0          0.0          0.0        0.0  2047300.0
38641  2047500.0  204750001.0          0.0          0.0        0.0  2047500.0

       idorigperson   dag  dgn  dec  ...      il_ben0    il_dpisilc  \
0           10001.0  38.0  1.0  0.0  ...  1050.000000  16367.636079
1           10002.0  38.0  0.0  0.0  ...     0.000000   6602.816820
2           10003.0  12.0  0.0  2.0  ...     0.000000      0.000000
3           10004.0   8.0  0.0  2.0  ...     0.000000      0.000000
```

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```
4           20001.0  62.0  0.0  0.0  ...   223.073333   1771.645564
...             ...   ...  ...  ...  ...          ...          ...
38637   204710003.0  18.0  1.0  4.0  ...     0.000000     0.000000
38638   204710004.0   7.0  0.0  2.0  ...     0.000000     0.000000
38639   204720001.0  51.0  0.0  0.0  ...     0.000000  3391.598079
38640   204730001.0  62.0  1.0  0.0  ...   975.291991  2180.895682
38641   204750001.0  69.0  0.0  0.0  ...   223.073333  3029.881169

        il_thlmx_s  il_thlmm_s   il_tinhlit   il_tinhljt  il_pa     il_bhomx  \
0      1804.242991         0.0  4035.086190  4035.086190    0.0   123.436998
1       787.534766         0.0   720.046355   720.046355    0.0     0.000000
2         0.000000         0.0     0.000000     0.000000    0.0     0.000000
3         0.000000         0.0     0.000000     0.000000    0.0     0.000000
4       164.491807         0.0     0.000000     0.000000    0.0   678.998548
...            ...         ...          ...          ...    ...          ...
38637     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38638     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38639   349.129643         0.0   135.506191   135.506191    0.0  1160.473138
38640   131.263597         0.0     0.000000     0.000000    0.0   395.047916
38641   183.583065         0.0    37.968866    37.968866    0.0   716.030976

           il_bsamt      il_bsatm
0      15333.066256  15333.066256
1       6602.816820   6602.816820
2          0.000000      0.000000
3          0.000000      0.000000
4       1551.658266   1551.658266
...             ...           ...
38637      0.000000      0.000000
38638      0.000000      0.000000
38639   3394.582426   3394.582426
38640   1476.410557   1476.410557
38641   2816.888295   2816.888295

[38642 rows x 453 columns]
```

```
out.configSettings
```

```
{'PATH_EUROMODFILES': 'C:\\EUROMOD_RELEASES_I6.0+',
 'PATH_DATA': 'C:\\EUROMOD_RELEASES_I6.0+\\Input',
 'PATH_OUTPUT': '',
 'ID_DATASET': 'PL_2020_b2',
 'COUNTRY': 'PL',
 'ID_SYSTEM': 'PL_2022',
 'ADDON0': 'LMA|LMA_PL'}
```

The optional parameter `addons` is a `list` of EUROMOD Addons to be integrated in the spine . Each item of the `list` is a `tuple` with two `str` objects. The first `str` is the name of the Addon and the second `str` is the name of the system in the Addon to be integrated (typically, it is the name of the Addon _ two-letter country code, e.g. LMA_AT). Available Addons are: LMA, MTR, NRR, TCA. The default is [].

1.2.5 4. Run with extensions

Run the simulation for the Poland system PL_2022 switching on the Benefit Take-up Adjustment extension 'BTA'.

```
out =mod['PL']['PL_2022'].run(data,"PL_2020_b2",switches=[("BTA",True)])
out
```

```
Simulation for system PL_2022 with dataset PL_2020_b2 finished.
```

```
output:               0:             idhh     idperson     idmother     idfather ␣
↪idpartner   idorighh  \
0           100.0      10001.0          0.0          0.0    10002.0      100.0
1           100.0      10002.0          0.0          0.0    10001.0      100.0
2           100.0      10003.0      10002.0      10001.0        0.0      100.0
3           100.0      10004.0      10002.0      10001.0        0.0      100.0
4           200.0      20001.0          0.0          0.0        0.0      200.0
...           ...          ...          ...          ...        ...        ...
38637  2047100.0  204710003.0  204710002.0  204710001.0        0.0  2047100.0
38638  2047100.0  204710004.0  204710002.0  204710001.0        0.0  2047100.0
38639  2047200.0  204720001.0          0.0          0.0        0.0  2047200.0
38640  2047300.0  204730001.0          0.0          0.0        0.0  2047300.0
38641  2047500.0  204750001.0          0.0          0.0        0.0  2047500.0

       idorigperson   dag  dgn  dec  ...      il_ben0    il_dpisilc  \
0           10001.0  38.0  1.0  0.0  ...  1050.000000  16367.636079
1           10002.0  38.0  0.0  0.0  ...     0.000000   6602.816820
2           10003.0  12.0  0.0  2.0  ...     0.000000      0.000000
3           10004.0   8.0  0.0  2.0  ...     0.000000      0.000000
4           20001.0  62.0  0.0  0.0  ...   223.073333   1771.645564
...             ...   ...  ...  ...  ...          ...           ...
38637   204710003.0  18.0  1.0  4.0  ...     0.000000      0.000000
38638   204710004.0   7.0  0.0  2.0  ...     0.000000      0.000000
38639   204720001.0  51.0  0.0  0.0  ...     0.000000   3391.598079
38640   204730001.0  62.0  1.0  0.0  ...   975.291991   2180.895682
38641   204750001.0  69.0  0.0  0.0  ...   223.073333   3029.881169

        il_thlmx_s  il_thlmm_s   il_tinhlit   il_tinhljt  il_pa     il_bhomx  \
0      1804.242991         0.0  4035.086190  4035.086190    0.0   123.436998
1       787.534766         0.0   720.046355   720.046355    0.0     0.000000
2         0.000000         0.0     0.000000     0.000000    0.0     0.000000
3         0.000000         0.0     0.000000     0.000000    0.0     0.000000
4       164.491807         0.0     0.000000     0.000000    0.0   678.998548
...            ...         ...          ...          ...    ...          ...
38637     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38638     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38639   349.129643         0.0   135.506191   135.506191    0.0  1160.473138
38640   131.263597         0.0     0.000000     0.000000    0.0   395.047916
38641   183.583065         0.0    37.968866    37.968866    0.0   716.030976

           il_bsamt      il_bsatm
0      15333.066256  15333.066256
1       6602.816820   6602.816820
2          0.000000      0.000000
```

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```
3          0.000000      0.000000
4       1551.658266   1551.658266
...             ...           ...
38637      0.000000      0.000000
38638      0.000000      0.000000
38639   3394.582426   3394.582426
38640   1476.410557   1476.410557
38641   2816.888295   2816.888295

[38642 rows x 453 columns]
```

```
out.configSettings
```

```
{'PATH_EUROMODFILES': 'C:\\EUROMOD_RELEASES_I6.0+',
 'PATH_DATA': 'C:\\EUROMOD_RELEASES_I6.0+\\Input',
 'PATH_OUTPUT': '',
 'ID_DATASET': 'PL_2020_b2',
 'COUNTRY': 'PL',
 'ID_SYSTEM': 'PL_2022',
 'EXTENSION_SWITCH0': 'BTA=on'}
```

The optional parameter `switches` must define a `list` of the EUROMOD extensions to be switched on or off in the simulation. Each item in the `list` is a `tuple` with two objects. The first object is a `str` short name of the Extension. The second object is a `boolean`. Available Extensions are: BTA, TCA, FYA, UAA, EPS, PBE, MWA, HHoT_un, WEB, HHoT_ext, HHoT_ncp. The default is [].

1.3 User Guide

1.3.1 What is the Euromod Conector?

Euromod Conector is a Python library providing tools for running simulations and interacting with the tax-benefit microsimulation model EUROMOD. The fundamental object of the Euromod Connector is the `core.Model` class that nests the EUROMOD country-system models under the attribute `countries`. Each country object is a `core.Country` class that collects in the `systems` attribute the country specific `core.System` classes with the EUROMOD tax-benefit systems. The country and system objects contain other various derived objects, such as datasets, policies, parameters, functions, extensions, and add-ons. The simulation output is returned from the `run` method as a `core.Simulation` class.

Some indexing conventions apply:

- The objects of the attributes `countries`, `systems`, and `simulations` can be accessed using a single integer or a label. For the country object the label is a two-letter country name, for the system object it is the system's name, for the simulation object it is the name of the simulation output dataset (Examples: `core.Model.countries['PL']`, `core.Model.countries['PL'].systems['PL_2020']`, `core.Model.countries[3]`, `core.Model.countries[3].systems[10]`).
- The `core.Country` objects can be accessed directly from the model object, i.e. omitting the attribute `countries` (Examples: `core.Model['PL']`, `core.Model[3]` are equivalent to `core.Model.countries[3]`).
- The `core.System` objects can be accessed directly from the country object, i.e. omitting the attribute

`systems` (Examples: `core.Model['PL'][0]`, `core.Model[3]['PL_2005']` are equivalent to `core.Model.['PL'].systems['PL_2005']`).

Note: Modifying the objects in the Euromod Connector does not affect the EUROMOD original model, that is the `core.Model` module everytime loads the original EUROMOD xml model files.

1.3.2 Installation

The Euromod Connector can be installed from PyPi using *pip*:

```
$ pip install euromod
```

Requirements

The Euromod Connector requires two EUROMOD components: 1) the model (coded policy rules) , and 2) the input microdata with the variables that respect the EUROMOD naming conventions. For more information, please, read the sections "Model" and "Input microdata" on the Download Euromod web page.

Python version support

Minimum Python version 3.8 required

Windows version support

Windows 64-bit

Dependencies

The Euromod Connector requires the following dependencies:

Package	Minimum supported version
pandas	2.0.3
pythonnet	3.0.2

Managing Errors

1) ModuleNotFoundError or AttributeError:

If the `import` of the Euromod Connector libreries fails displaying one of the messages below:

```
ModuleNotFoundError: No module named 'System'
```

```
AttributeError: module 'clr' has no attribute 'AddReference'
```

uninstall the Python *clr* package and re-install the *pythonnet* package:

```
$ pip uninstall clr
$ pip install pythonnet
```

This error is caused by a conflict between the Python *clr* package and the *clr* library of the *pythonnet* package.

2) RuntimeError:

If you encounter a `RuntimeError` as below, either 1) restart the kernel, or 2) open a new console window, or 3) deselect the option **User Module Reloader (UMR)** in the `Tools-> Preferences -> Python Interpreter` (or `Tools -> Console -> Advanced setting`, depending on the Python editor version) then press `Apply` and `Ok` and restart the consol windows.

Note: Re-enabling the UMR option has no effect on the console windows that are already open.

This error is produced when Python reloads the libraries of the *pythonnet* package.

```
RuntimeError: Failed to initialize Python.Runtime.dll

Failed to initialize pythonnet: System.InvalidOperationException: This property must be␣
↪set before runtime is initialized
   at Python.Runtime.Runtime.set_PythonDLL(String value)
   at Python.Runtime.Loader.Initialize(IntPtr data, Int32 size)
   at Python.Runtime.Runtime.set_PythonDLL(String value)
   at Python.Runtime.Loader.Initialize(IntPtr data, Int32 size)
```

1.3.3 Model

Import the EUROMOD model:

```
from euromod import Model
```

Create an object of the `core.Model` class by passing the path to the EUROMOD project:

```
mod = Model(r"C:\EUROMOD_RELEASES_I6.0+")
```

The model object `mod` has two attributes: the EUROMOD `model_path` defined by the user, and `countries` which instantiates the `core.Country` classes for the EUROMOD default countries.

1.3.4 Country

Use `Model.countries` to display the default EUROMOD country objects:

```
mod.countries
```

```
0: AT
1: BE
2: BG
3: CY
4: CZ
5: DE
6: DK
```

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```
7: EE
8: EL
9: ES
10: FI
11: FR
12: HR
13: HU
14: IE
15: IT
16: LT
17: LU
18: LV
19: MT
20: NL
21: PL
22: PT
23: RO
24: SE
25: SI
26: SK
27: SL
```

Getting the `core.Country` object for Belgium 'BE' (**Note:** The following commands are equivalent):

```
mod.countries['BE']
mod.countries[1]
mod[1]
mod['BE']
```

```
------------------------------
Country
------------------------------
        datasets: 28 elements
        local_extensions: Belmod_endo, Belmod_exo
        name: 'BE'
        policies: 42 elements
        systems: 20 elements
```

The attributes of the `core.Country` class store the EUROMOD country-specific objects, such as the available datasets and systems, and the modelled policies and extensions. These objects contain other sub-classes with more specific information about the model.

Datasets

Attribute `datasets` is a collection of `core.Dataset` objects with all the available datasets for a given country (e.g. Belgium 'BE'):

```
mod["BE"].datasets
```

```
0: BE_2006_a3
1: BE_2007_a3
```

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```
2: BE_2008_a1
3: training_data
4: BE_2010_a2
5: BE_2012_a5
6: BE_2009_hhot
7: BE_2010_hhot
8: BE_2011_hhot
9: BE_2012_hhot
10: BE_2013_hhot
11: BE_2014_hhot
12: BE_2015_hhot
13: BE_2016_hhot
14: BE_2015_a1
15: BE_2016_a1
16: BE_2017_hhot
17: BE_2018_hhot
18: BE_2019_hhot
19: BE_2017_a4
20: BE_2018_a3
21: BE_2020_hhot
22: BE_2019_c3
23: BE_2021_hhot
24: BE_2020_c2
25: BE_2022_hhot
26: BE_2023_hhot
27: BE_2021_c6
```

Display the general information about a specific dataset by indexing the `datasets` attribute of a country (e.g. Belgium 'BE'):

```
mod["BE"].datasets[-1]
```

```
------------------------------
Dataset
------------------------------
         ID: '2171a46a-7480-41e3-9ee0-7caa85a306c8'
         coicopVersion: ''
         comment: ''
         currency: 'euro'
         decimalSign: '.'
         name: 'BE_2021_c6'
         private: 'no'
         readXVariables: 'no'
         useCommonDefault: 'no'
         yearCollection: '2021'
         yearInc: '2020'
```

Extensions

Display the extensions modelled for a given country (e.g. Belgium 'BE') using the attribute `local_extensions`:

```
mod.countries[1].local_extensions
```

```
0: BELMOD - Endogenous
1: BELMOD - Exogenous
```

The attribute returns a collection of `core.Extension` objects that can be indexed to get the element-specific information:

```
mod['BE'].local_extensions[0].name
```

```
'BELMOD - Endogenous'
```

Policies

Use the attribute `policies` to display all the policies for a given country (e.g. Belgium 'BE'):

```
mod["BE"].policies
```

```
0: SetDefault_be          |                                                    |  ␣
↪DEF: Default VALUES
1: uprate_be              |                                                    |  ␣
↪DEF: UPRATING FACTORS
2: ConstDef_be            |  (with switch set for Belmod_endo, Belmod_exo)     |  ␣
↪DEF: Constants
3: ILsDef_be              |                                                    |  ␣
↪DEF: STANDARD INCOME CONCEPTS
4: ILsUDBDef_be           |  (with switch set for Belmod_endo, Belmod_exo)     |  ␣
↪DEF: UDB INCOME CONCEPTS
5: ILDef_be               |                                                    |  ␣
↪DEF: NON-STANDARD INCOME CONCEPTS
6: random_be              |                                                    |  ␣
↪Def: Random number generator
7: TransLMA_be            |                                                    |  ␣
↪DEF: Modelling labour market transitions (DO NOT S ...
8: TUDef_be               |                                                    |  ␣
↪DEF: ASSESSMENT UNITS (OFF for MOTYFF)
9: InitVars_be            |                                                    |  ␣
↪DEF: Initialization of variables
10: yem_be                |  (with switch set for MWA)                         |  ␣
↪DEF: minimum wage  (off in motyff)
11: neg_be                |  (with switch set for Belmod_endo, Belmod_exo)     |  ␣
↪DEF: recode negative income to zero
12: yemcomp_be            |  (with switch set for Belmod_endo, Belmod_exo)     |  ␣
↪BEN: Wage compensation scheme Covid-19
13: ysecomp_be            |  (with switch set for Belmod_endo, Belmod_exo)     |  ␣
↪BEN: Wage compensation scheme Covid-19 (self-emplo ...
14: tscee_be              |                                                    |  ␣
↪SIC: employee (OFF for MOTYFF)
```

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```
15: tscpe_be             |                                                          |  ␣
↪SIC: pensioners contributions to health and disabi ...
16: tscer_be             |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪SIC: employer (OFF for MOTYFF)
17: tscse_be             |                                                          |  ␣
↪SIC: self-employed
18: tintace_be           |                                                          |  ␣
↪ADMIN TAX: PIT - deduction professional expenses ( ...
19: tinwh_be             |                                                          |  ␣
↪TAX: withholding Income Tax | (not implemented bef ...
20: bmact_be             |  (with switch set for PBE)                               |  ␣
↪BEN: Maternity leave
21: bpact_be             |  (with switch set for PBE)                               |  ␣
↪BEN: Paternity leave benefit
22: bfapl_be             |  (with switch set for PBE)                               |  ␣
↪BEN: Parental leave
23: bun_be               |                                                          |  ␣
↪BEN: Unemployment benefit (PART SIMULATED)
24: byr_be               |                                                          |  ␣
↪BEN: Early Retirement Benefit
25: tprhm_be             |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪TAX: Advance levy on immovable property
26: tintb_be             |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪TAX: PIT - Tax deductions & marital quotient
27: tinna_be             |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪TAX: PIT - Federal Taxes
28: tinrg_be             |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪TAX: PIT - Regional Taxes
29: tinfe_be             |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪TAX: PIT - Fiscal Expenditures
30: tinmu_be             |                                                          |  ␣
↪TAX: PIT - Local Taxes
31: tinkt_be             |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪TAX: Capital Income Tax
32: tsceesp_be           |                                                          |  ␣
↪SIC: special social insurance contribution
33: bchba_be             |                                                          |  ␣
↪BEN: birth allowance
34: bsa_be               |                                                          |  ␣
↪Income support (switch: OFF for MOTYFF, ON for oth ...
35: bch_be               |                                                          |  ␣
↪BEN: child benefit
36: bsaoa_be             |  (with switch set for Belmod_endo, Belmod_exo)           |
↪"BEN: income support for the elderly (TO BE SWITCH ...
37: bed_be               |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪BEN: Study allowances (Flemish and French communit ...
38: bwkrg_be             |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪BEN: Flemish jobbonus
39: tci_be               |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪SIC: Care Insurance Contribution (zorgverzekering) ...
40: output_std_be        |  (with switch set for Belmod_endo, Belmod_exo)           |  ␣
↪DEF: STANDARD OUTPUT INDIVIDUAL LEVEL
```

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```
41: output_std_hh_be     |                                                    |   ␣
↪DEF: STANDARD OUTPUT HOUSEHOLD LEVEL
```

Get a `core.Policy` specific information by indexing the `policies` attribute (e.g. the employment income policy 'yem_be'):

```
mod["BE"].policies[10]
```

```
------------------------------
Policy
------------------------------
        ID: '923fae10-f0b6-4666-aa2f-ae37bde1d4dc'
        comment: 'DEF: minimum wage  (off in motyff)'
        extensions: ExtensionSwitch Minimum Wage Adjustments: on
        functions: DefConst, Elig, ArithOp, BenCalc, BenCalc, ArithOp, BenCalc, Elig,␣
↪ArithOp
        name: 'yem_be'
        order: '11'
        private: 'no'
        spineOrder: '11'
```

The attributes in the `core.Policy` class contain the information about the policy name, ID, a related comment, as well as objects describing policy functions and extensions.

Extensions

The attribute `extensions` contains `base.ExtensionSwitch` objects with policy-extension relevant information for a given country (e.g. policy 'yem_be' for Belgium 'BE'):

```
mod["BE"].policies[10].extensions
```

```
0: Minimum Wage Adjustments
```

```
mod["BE"].policies[10].extensions[0]
```

```
------------------------------
ExtensionSwitch
------------------------------
        baseOff: 'false'
        extensionID: '557c232a-9ce6-4808-b52f-ca5e02fe8cf4'
        polID: '923fae10-f0b6-4666-aa2f-ae37bde1d4dc'
```

Functions

The attribute `functions` stores all the functions related to the specific policy in a country (e.g. policy 'yem_be' for Belgium 'BE'):

```
mod["BE"].policies[10].functions
```

```
0: DefConst    |
1: Elig        |
2: ArithOp     |    monthly wage (corrected for the amounts of months  ...
3: BenCalc     |
4: BenCalc     |
5: ArithOp     |    Adding holiday money to the statutory max
6: BenCalc     |
7: Elig        |
8: ArithOp     |
```

Getting the information about a specific function from the `core.Function` object (e.g. function 'ArithOp' in policy 'yem_be' for Belgium 'BE'):

```
mod["BE"].policies[10].functions[2]
```

```
------------------------------
Function
------------------------------
         ID: 'bb7caeaf-e808-468e-9e1c-de029378ccd2'
         comment: 'monthly wage (corrected for the amounts of months you worked)'
         extensions: 0 elements
         name: 'ArithOp'
         order: '3'
         parameters: Who_Must_Be_Elig, Formula, Output_Var, TAX_UNIT
         polID: '923fae10-f0b6-4666-aa2f-ae37bde1d4dc'
         private: 'no'
         spineOrder: '11.3'
```

Beyond the usual attributes containing the name, identifier and a comment for the function object, the attribute `polID` provides the reference policy identifier from the `core.Policy` object, `parameters` collects the `core.Parameter` objects, and `extensions` attribute includes further modelling information of extensions.

Parameters

Display all the policy-function related parameters or the specific information about a parameter for a given country (e.g. function 'ArithOp' in policy 'yem_be' for Belgium 'BE'):

```
mod["BE"].policies[10].functions[2].parameters
```

```
0: Who_Must_Be_Elig
1: Formula
2: Output_Var
3: TAX_UNIT
```

Get the specific parameter (e.g. parameter 'Formula' in function 'ArithOp' in policy 'yem_be' for Belgium 'BE'):

```
mod["BE"].policies[10].functions[2].parameters[1]
```

```
------------------------------
Parameter
------------------------------
         ID: '2edfb096-4f7b-48cf-add9-9aed5b3eeab8'
         comment: ''
         extensions: 0 elements
         funID: 'bb7caeaf-e808-468e-9e1c-de029378ccd2'
         group: ''
         name: 'Formula'
         order: '2'
         spineOrder: '11.3.2'
```

1.3.5 System

The Euromod Connector stores the EUROMOD tax-benefit systems as `core.System` objects in the attribute `systems` of the `core.Country` class.

Display all the available country systems in a country (e.g. Belgium 'BE'):

```
mod['BE'].systems
```

```
0: BE_2005
1: BE_2006
2: BE_2007
3: BE_2008
4: BE_2009
5: BE_2010
6: BE_2011
7: BE_2012
8: BE_2013
9: BE_2014
10: BE_2015
11: BE_2016
12: BE_2017
13: BE_2018
14: BE_2019
15: BE_2020
16: BE_2021
17: BE_2022
18: BE_2023
19: BE_2023_const
```

Get a specific system object (**Note:** The following commands, returning the system BE_2022 for Belgium, are equivalent):

```
mod[1][17]
mod[1].systems[17]
mod.countries[1].systems[17]
mod.countries['BE'].systems['BE_2022']
```

```
------------------------------
System
------------------------------
         ID: '413c98e1-0fb9-4ff6-8adf-90438cf051b0'
         bestmatch_datasets: BE_2021_c6
         comment: ''
         currencyOutput: 'euro'
         currencyParam: 'euro'
         datasets: training_data, BE_2020_c2, BE_2022_hhot, BE_2021_c6
         headDefInc: 'ils_origrepy'
         name: 'BE_2022'
         order: '26'
         policies: 42 elements
         private: 'no'
         year: '2022'
```

The `core.System` attributes contain the specific system information such as the identifier, the best-match dataset(s),a comment, the currencies of the model parameters and of the simulation output, all the system-specific datasets of type `core.DatasetInSystem` class, the system's name, order, access and the reference year. The `policies` attribute collects the information about the system policies in `core.PolicyInSystem` classes.

Datasets

Attribute `datasets` stores the `core.DatasetInSystem` objects with all the available datasets for a system (e.g. system 'BE_2022' for Belgium):

```
mod["BE"][17].datasets
```

```
0: training_data     |
1: BE_2020_c2        |
2: BE_2022_hhot      |
3: BE_2021_c6        | best match
```

Getting the information about a specific system-dataset by indexing the `datasets` attribute:

```
mod["BE"][17].datasets[3]
```

```
------------------------------
DatasetInSystem
------------------------------
         ID: '413c98e1-0fb9-4ff6-8adf-90438cf051b02171a46a-7480-41e3-9ee0-7caa85a306c8'
         bestMatch: 'yes'
         coicopVersion: ''
         comment: ''
         currency: 'euro'
         dataID: '2171a46a-7480-41e3-9ee0-7caa85a306c8'
         decimalSign: '.'
         name: 'BE_2021_c6'
         private: 'no'
         readXVariables: 'no'
         sysID: '413c98e1-0fb9-4ff6-8adf-90438cf051b0'
         useCommonDefault: 'no'
```

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```
        yearCollection: '2021'
        yearInc: '2020'
```

Policies

The attribute `policies` contains all the system-specific `core.PolicyInSystem` objects describing the policies. Get a specific policy object referring to a country-system model (e.g. the personal income tax policy 'tinmu_be' in system 'BE_2022' for Belgium) by indexing the `policies` attribute:

```
mod["BE"]['BE_2022'].policies[30]
```

```
------------------------------
PolicyInSystem
------------------------------
        ID: '413c98e1-0fb9-4ff6-8adf-90438cf051b07464c9b2-1b1f-416b-acc7-1bd15c72bf56'
        comment: 'TAX: PIT - Local Taxes'
        extensions: 0 elements
        functions: DefConst, BenCalc, ArithOp
        name: 'tinmu_be'
        order: '31'
        polID: '7464c9b2-1b1f-416b-acc7-1bd15c72bf56'
        private: 'no'
        spineOrder: '31'
        switch: 'on'
        sysID: '413c98e1-0fb9-4ff6-8adf-90438cf051b0'
```

With respect to a country class, the policy objects in the system classes store additional information about the identifiers `sysID` and `polID` from, respectively, the `core.System` class and the `core.Policy` class, the policy switch and the order number. The attributes `extensions` and `functions` is a collection of `core.FunctionInSystem` classes.

Extensions

Display the extensions modelled for a given system-policy (e.g. for policy 'ConstDef_be' in system 'BE_2022' for Belgium 'BE') using the attribute `extensions`:

```
mod["BE"]['BE_2022'].policies[2].extensions
```

```
0: BELMOD - Endogenous
1: BELMOD - Exogenous
```

The attribute returns a collection of `base.ExtensionSwitch` objects that can be indexed to get the element-specific information:

```
mod["BE"]['BE_2022'].policies[2].extensions[0]
```

```
------------------------------
ExtensionSwitch
------------------------------
        baseOff: 'true'
```

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```
        extensionID: 'af3a504d-4552-47be-b612-a3ff814509b1'
        polID: '4e2539bd-490c-48ce-a4d8-fdd8f4f5fb1e'
```

Functions

Compared to the country class, the attribute `functions` in the system class, containing `core.FunctionInSystem` objects, additionally shows which functions are used in the simulations of a given system-policy (e.g. policy 'tinmu_be' in system 'BE_2022' for Belgium):

```
mod["BE"]["BE_2022"].policies[30].functions
```

```
0: DefConst     | on (with switch set for Belmod_endo, Belmod_exo)       |
1: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)       |    Local␣
↪taxes, average per region
2: ArithOp      | on                                                     |    Total PIT␣
↪(Cumulative)
```

Get a specific policy-function object indexing the `functions` attribute (e.g. function 'ArithOp' from policy 'tinmu_be' in system 'BE_2022'):

```
mod["BE"]["BE_2022"].policies[30].functions[2]
```

```
------------------------------
FunctionInSystem
------------------------------
        ID: '413c98e1-0fb9-4ff6-8adf-90438cf051b065bf7c6b-8178-4a20-a31d-71059ea5fce7'
        comment: 'Total PIT (Cumulative)'
        extensions: 0 elements
        funID: '65bf7c6b-8178-4a20-a31d-71059ea5fce7'
        name: 'ArithOp'
        order: '3'
        parameters: Formula, Output_Add_Var, TAX_UNIT
        polID: '7464c9b2-1b1f-416b-acc7-1bd15c72bf56'
        private: 'no'
        spineOrder: '31.3'
        switch: 'on'
        sysID: '413c98e1-0fb9-4ff6-8adf-90438cf051b0'
```

The returned object is a `core.FunctionInSystem` class with some default attributes, such as the name, identifier, extensions, and comment, a series of attributes for the reference identifiers (`funID` from the `core.Function` class, `polID` from the `core.Policy` class, and `sysID` from the `core.System` class), the policy-function switch, and the order number. The attribute `parameters` stores additional modelling information of the system-specific parameters.

Parameters

The `core.ParameterInSystem` class, which is stored in the `parameters` attribute, provides modelling information on a specific system-policy-function-parameter element.

Display all the policy-function-specific parameters for a given system (e.g. system 'BE_2022' for the Belgium personal income tax policy 'tinmu_be' in function 'ArithOp') using the attribute `parameters`:

```
mod["BE"]["BE_2022"].policies[30].functions[2].parameters
```

```
0: Formula            | tinmu_s               |    + local taxes
1: Output_Add_Var     | tin_s                 |    = total PIT
2: TAX_UNIT           | tu_individual_be      |
```

Display a specific parameter object by indexing the `parameters` attribute (e.g. the parameter 'Formula' in the function 'ArithOp' from policy 'tinmu_be' in system 'BE_2022'):

```
mod["BE"]["BE_2022"].policies[30].functions[2].parameters[0]
```

```
------------------------------
ParameterInSystem
------------------------------
        ID: '413c98e1-0fb9-4ff6-8adf-90438cf051b0c5d59ade-a653-4fe4-82ea-101324142f95'
        comment: '+ local taxes'
        extensions: 0 elements
        funID: '65bf7c6b-8178-4a20-a31d-71059ea5fce7'
        group: ''
        name: 'Formula'
        order: '1'
        parID: 'c5d59ade-a653-4fe4-82ea-101324142f95'
        spineOrder: '31.3.1'
        sysID: '413c98e1-0fb9-4ff6-8adf-90438cf051b0'
        value: 'tinmu_s'
```

The `core.ParameterInSystem` object contains, additionally to the country object parameter, the order number, the related identifiers from the `core.System` and the `core.Parameter` objects, respectively `sysID` and `parID`, and the parameter `value`.

1.3.6 Find objects

The method `find` allows searching for a string pattern in a class attribute of the Euromod Connector. It requires two input parameters: the name of the class attribute (the class name can also be specified using the dot notation), and a string pattern.

Find all the policies containing string 'UPRATING' in the attribute `comment` in country Simpleland 'SL', setting parameter `case_insentive` to `False` (Note that the default is `True`):

```
mod['SL'].policies.find('comment','UPRATING',case_insentive=False)
```

```
0: Uprate_sl    |    DEF: UPRATING FACTORS
```

Find all the functions of a `core.Policy` class of a system, containing string 'on' in the `switch` attribute (e.g. policy 'Uprate_sl' in system 'SL_1996' for country Simpleland 'SL'):

```
mod['SL']['SL_1996'].policies[0].functions.find('switch','on')
```

```
0: Uprate     | on
```

Getting all the policy objects containing 'tax' in the `name` attribute for Poland:

```
mod['PL'].policies.find('name','tax')
```

```
0: tax_hl_fr_pl       |    TAX:Farmer health contribution
1: tax_kt_pl          |    TAX:Lump-sum Capital Income Tax
2: tax_hl_mx_ee_pl    |    TAX:Maximum Health Insurance - employees
3: tax_hl_mx_se_pl    |    TAX:Maximum Health Insurance - self-employed
4: tax_hl_mx_pl       |    TAX:Maximum Health Insurance
5: tax_it_tb_pl       |    TAX:Income Tax Base
6: tax_it_it_pl       |    TAX:Income Tax: Individual Taxation
7: tax_it_lin_pl      |    TAX:Income Tax: Individual Taxation: linear tax
8: tax_it_jt_pl       |    TAX:Income Tax: Joint Taxation
9: tax_it_pl          |    TAX:Income Tax: optimisation
10: tax_hl_pl         |    TAX:Health Insurance
11: tax_ag_pl         |    TAX:Agricultural tax
```

Getting the systems objects containing '2022' in the `name` attribute for Poland:

```
mod['PL'].systems.find('name','2022')
```

```
0: PL_2022
1: PL_2022_const
```

Getting the policy-functions objects containing 'wage' in the `comment` attribute for Poland:

```
mod['PL'].policies[0].functions.find('comment','wage')
```

```
0: DefConst    |    constants for wage compensation scheme
```

Getting the policy functions containing string "BenCalc" in the attribute `name` setting the optional input parameter `return_children=True` (Note that the default is `False`):

```
mod["BE"]["BE_2023"].policies.find("functions.name","BenCalc",return_children =True)
```

```
0: BenCalc       | on                                                    |    random␣
↪allocation (based on ESTAT data) - transiti ...
1: BenCalc       | on                                                    |    random␣
↪allocation (based on ESTAT data) - transiti ...
2: BenCalc       | on                                                    |    random␣
↪allocation (based on ESTAT data) - transiti ...
3: BenCalc       | on                                                    |    define␣
↪yemmy_a
4: BenCalc       | on                                                    |    MC_EE ␣
↪step 2: random allocation (based on ESTAT s ...
5: BenCalc       | on                                                    |    MC_EE␣
↪step 3a: random allocation of months in MC ( ...
6: BenCalc       | on                                                    |    MC_EE␣
```

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```
↪step 4: share of hours worked in MC (based o ...
7: BenCalc       | on                                                    |    MC SE␣
↪step 2: random allocation (based on ESTAT st ...
8: BenCalc       | on                                                    |    MC_SE␣
↪step 3a: random allocation of months in MC ( ...
9: BenCalc       | on                                                    |    MC_SE␣
↪step 4: share of hours worked in MC (based o ...
10: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)      |    ␣
↪calculation of pension amount for determining depe ...
11: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)      |    ␣
↪determine number of dependent persons in tax unit  ...
12: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)      |    ␣
↪determine whether a person is dependent or not
13: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)      |    Shift␣
↪year of start mortgage
14: BenCalc      | on                                                    |
15: BenCalc      | on                                                    |
16: BenCalc      | on                                                    |
17: BenCalc      | on                                                    |    ␣
↪Correction for part-time workers
18: BenCalc      | on                                                    |    ␣
↪Conversion to monthly average
19: BenCalc      | on                                                    |
20: BenCalc      | on                                                    |
21: BenCalc      | on                                                    |    ␣
↪Correction for duration in months and conversion t ...
22: BenCalc      | on                                                    |    ␣
↪Correction for duration in months and conversion t ...
23: BenCalc      | on                                                    |    sum of␣
↪two components
24: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)      |    Compute␣
↪statutory gross monthly income
25: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)      |    social␣
↪insurance contributions on disability benef ...
26: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)      |    social␣
↪insurance contributions disability benefits ...
27: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)      |    ␣
↪calculate full-time equivalent income for calculat ...
28: BenCalc      | on (with switch set for Belmod_endo, Belmod_exo)      |    ␣
↪reduction of social insurance contributions (workb ...
29: BenCalc      | off (with switch set for Belmod_endo, Belmod_exo)     |    ␣
↪reduction of social insurance contributions (workb ...
30: BenCalc      | off (with switch set for Belmod_endo, Belmod_exo)     |    ␣
↪reduction of social insurance contributions (workb ...
31: BenCalc      | off (with switch set for Belmod_endo, Belmod_exo)     |    ␣
↪reduction of social insurance contributions (workb ...
32: BenCalc      | on                                                    |    common␣
↪social insurance contributions for pensions ...
33: BenCalc      | on                                                    |    " "
↪"Solidarity Contribution"" for pension benefici ...
34: BenCalc      | on                                                    |    " "
↪"Solidarity Contribution"" for pension benefici ...
```

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```
35: BenCalc      | on                                                    |    SIC␣
↪reduction employer: general
36: BenCalc      | on                                                    |    SIC␣
↪employer reduction: adjustment coefficient 1 ( ...
37: BenCalc      | on                                                    |    SIC␣
↪employer reduction: adjustment coefficient 2 ( ...
38: BenCalc      | off (with switch set for Belmod_endo, Belmod_exo)     |    tax␣
↪credits
39: BenCalc      | off (with switch set for Belmod_endo, Belmod_exo)     |    tax␣
↪credits: continued
40: BenCalc      | off (with switch set for Belmod_endo, Belmod_exo)     |    tax␣
↪credits: continued
41: BenCalc      | off (with switch set for Belmod_endo, Belmod_exo)     |    Special␣
↪SIC contribution: singles and one-earner f ...
42: BenCalc      | off (with switch set for Belmod_endo, Belmod_exo)     |    Special␣
↪SIC contribution: two-earner fiscal couple ...
43: BenCalc      | on                                                    |  ␣
↪eligibility: employed mothers
44: BenCalc      | on                                                    |  ␣
↪eligibility: unemployed mothers
45: BenCalc      | on                                                    |  ␣
↪eligibility: self-employed mothers
46: BenCalc      | on                                                    |  ␣
↪duration: age of eligible child in days
47: BenCalc      | on                                                    |  ␣
↪duration: days per child for employed/unemployed m ...
48: BenCalc      | on                                                    |    this␣
↪fuction allocates duration to head of TU (=mo ...
49: BenCalc      | on                                                    |  ␣
↪adjustment for a 6 working days week
50: BenCalc      | on                                                    |  ␣
↪duration: days per child for self-employed
51: BenCalc      | on                                                    |    this␣
↪fuction allocates duration to head of TU (=mo ...
52: BenCalc      | on                                                    |    amount:␣
↪Gross Daily Wage for employed
53: BenCalc      | on                                                    |    Total␣
↪amount for EMPLOYED
54: BenCalc      | on                                                    |    Total␣
↪amount for UNEMPLOYED
55: BenCalc      | on                                                    |    Total␣
↪amount for SELF-EMPLOYED
56: BenCalc      | on                                                    |    Total␣
↪amount
57: BenCalc      | on                                                    |
58: BenCalc      | on                                                    |  ␣
↪eligibility:
59: BenCalc      | on                                                    |
60: BenCalc      | on                                                    |  ␣
↪duration: age of eligible child =0
61: BenCalc      | on                                                    |  ␣
↪duration: months per child
```

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```
62: BenCalc      | on                                                    |    this␣
↪fuction allocates duration to head of TU (=mo ...
63: BenCalc      | on                                                    |    Amount:␣
↪full time leave of 4 months (Default optio ...
64: BenCalc      | off                                                   |    Amount:␣
↪half time leave of 8 months
65: BenCalc      | off                                                   |    Amount:␣
↪fifthtime leave of 20 months
66: BenCalc      | off                                                   |    Amount:␣
↪tenthtime leave of 40 months
67: BenCalc      | on                                                    |
68: BenCalc      | on                                                    |    ␣
↪Transform number of months unemployed
69: BenCalc      | on                                                    |    ␣
↪Determine household type
70: BenCalc      | on (with switch set for HHoT_un)                      |    ␣
↪Eligibility: qualifying period
71: BenCalc      | on                                                    |
72: BenCalc      | on                                                    |    Benefit␣
↪amount: calculation of previous wage
73: BenCalc      | on                                                    |    ␣
↪Previous wage: minimum and maximum wage taken into ...
74: BenCalc      | on                                                    |
75: BenCalc      | on                                                    |
76: BenCalc      | on                                                    |
77: BenCalc      | on                                                    |
78: BenCalc      | on                                                    |
79: BenCalc      | n/a                                                   |    tax␣
↪credits for dependent children
80: BenCalc      | n/a                                                   |    early␣
↪retirement benefit: part paid by unemploymen ...
81: BenCalc      | n/a                                                   |    early␣
↪retirement benefit: part paid by employer (i ...
82: BenCalc      | on                                                    |    ␣
↪Flanders - base amount
83: BenCalc      | on                                                    |    ␣
↪Flanders - reduction for children
84: BenCalc      | on                                                    |    ␣
↪Brussels - base amount
85: BenCalc      | on                                                    |    ␣
↪Brussels - Reduction for children
86: BenCalc      | on                                                    |    ␣
↪Wallonia - base amount
87: BenCalc      | n/a                                                   |
88: BenCalc      | n/a                                                   |    ␣
↪Housing: Maximum amount of the mortgage that is ta ...
89: BenCalc      | n/a                                                   |
↪"Housing: For certain mortgages, the amount taken  ...
90: BenCalc      | n/a                                                   |
91: BenCalc      | off                                                   |    MOTYFF:␣
↪deduction for child care expenditures
92: BenCalc      | off                                                   |    MOTYFF:␣
```

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```
↪deduction for child care expenditures
93: BenCalc      | off                                                    |    MOTYFF:␣
↪deduction for child care expenditures
94: BenCalc      | off                                                    |    MOTYFF:␣
↪deduction for child care expenditures
95: BenCalc      | n/a                                                    |    base␣
↪tax allowance in 2001 different for married a ...
96: BenCalc      | n/a                                                    |    Base␣
↪allowance: suppl. low inc.
97: BenCalc      | on                                                     |    Base␣
↪allowance: supplements for dependent
98: BenCalc      | on                                                     |    Base␣
↪allowance: supplements for lone parent of dep ...
99: BenCalc      | on                                                     |    BA␣
↪supplements for children
100: BenCalc     | on                                                     |    Tax␣
↪allow.: <3y
101: BenCalc     | on                                                     |    Compute␣
↪non-used base allowance of spouse
102: BenCalc     | on                                                     |    Tax␣
↪reduction (1) replacement incomes - 2nd limita ...
103: BenCalc     | on                                                     |    Tax␣
↪reduction (2) Unempl. benenfits - 2nd limitati ...
104: BenCalc     | n/a                                                    |    Tax␣
↪reduction - take back
105: BenCalc     | n/a                                                    |    zero␣
↪taxes for replacement incomes
106: BenCalc     | n/a                                                    |    Extra␣
↪reduction for pension recipients
107: BenCalc     | n/a                                                    |    Extra␣
↪reduction for sick ben recipients
108: BenCalc     | n/a                                                    |    Extra␣
↪reduction for byr recipients
109: BenCalc     | on                                                     |
110: BenCalc     | n/a                                                    |
111: BenCalc     | on                                                     |    ␣
↪Regional surcharge (Brussels & Wallonia)
112: BenCalc     | on                                                     |    ␣
↪Housing: Tax reduction at the marginal tax rate
113: BenCalc     | on                                                     |    ␣
↪Housing: Maximum amount of the mortgage that is ta ...
114: BenCalc     | on                                                     |    ␣
↪Housing: The amount taken into account for capital ...
115: BenCalc     | on                                                     |    ␣
↪Housing: Regional Housing Bonus (Wallonia) NEW - f ...
116: BenCalc     | on                                                     |    ␣
↪Housing: Regional Housing Bonus (Wallonia) NEW - v ...
117: BenCalc     | on                                                     |    ␣
↪Housing: Regional Housing Bonus (Wallonia) NEW - v ...
118: BenCalc     | n/a                                                    |    ␣
↪Regional tax credit
119: BenCalc     | n/a                                                    |    ␣
```

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```
↪Regional tax credit: alternative
120: BenCalc     | on                                                    |   ␣
↪Refundable tax credit: Low activity income (since  ...
121: BenCalc     | n/a                                                   |   ␣
↪Refundable tax credit: Low activity income (2007)
122: BenCalc     | on                                                    |    From␣
↪2016: chèque habitat (Wallonia) is refundable ...
123: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)      |    Local␣
↪taxes, average per region
124: BenCalc     | on                                                    |    "to␣
↪determine possible multiplets (twin, triplets, ...
125: BenCalc     | on                                                    |   ␣
↪calculate birth allowance
126: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)      |    define␣
↪potential category for income support
127: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)      |   ␣
↪definition of category 3
128: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)      |   ␣
↪Calculate of own means with taking account of gene ...
129: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)      |   ␣
↪Calculation of  own means without taking account o ...
130: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)      |   ␣
↪Calculate the amount of means that need to be tran ...
131: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)      |   ␣
↪Calculate the amount of means that need to be tran ...
132: BenCalc     | on (with switch set for BTA)                          |    Take-up␣
↪correction of Income Support
133: BenCalc     | n/a                                                   |    1.1.␣
↪base amount
134: BenCalc     | n/a                                                   |   ␣
↪Calculate social supplement
135: BenCalc     | n/a                                                   |   ␣
↪Calculate social supplement
136: BenCalc     | n/a                                                   |   ␣
↪Calculate social supplement
137: BenCalc     | n/a                                                   |   ␣
↪Calculate social supplement
138: BenCalc     | n/a                                                   |   ␣
↪Calculate supplement
139: BenCalc     | n/a                                                   |    1.5.␣
↪back to school premium
140: BenCalc     | n/a                                                   |
141: BenCalc     | n/a                                                   |   ␣
↪Calculate age supplements
142: BenCalc     | n/a                                                   |   ␣
↪Calculate age supplements
143: BenCalc     | n/a                                                   |    2.1.␣
↪base amount
144: BenCalc     | n/a                                                   |    2.2.␣
↪back to school premium
145: BenCalc     | n/a                                                   |   ␣
↪Calculate general supplement
```

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```
146: BenCalc     | n/a                                                    |   ␣
↪calculate benefit
147: BenCalc     | n/a                                                    |   ␣
↪Calculate benefit
148: BenCalc     | n/a                                                    |    3.1.␣
↪Base amount
149: BenCalc     | n/a                                                    |    3.2.␣
↪back to school premium
150: BenCalc     | n/a                                                    |    3.3.␣
↪Age supplement
151: BenCalc     | n/a                                                    |   ␣
↪Calculate benefit
152: BenCalc     | n/a                                                    |   ␣
↪Calculate benefit
153: BenCalc     | n/a                                                    |    income␣
↪test for guaranteed child benefit in 2001
154: BenCalc     | n/a                                                    |   ␣
↪Additional 'indexsprong of 2017', i.e. the non-upr ...
155: BenCalc     | on                                                     |    1.1.␣
↪base amount
156: BenCalc     | on                                                     |   ␣
↪Calculate social supplement
157: BenCalc     | on                                                     |   ␣
↪Calculate social supplement
158: BenCalc     | on                                                     |   ␣
↪Calculate social supplement
159: BenCalc     | on                                                     |   ␣
↪Calculate social supplement
160: BenCalc     | on                                                     |   ␣
↪Calculate age supplements
161: BenCalc     | on                                                     |   ␣
↪Calculate age supplements
162: BenCalc     | on                                                     |    1.5.1␣
↪Universal Participation Supplement (former b ...
163: BenCalc     | on                                                     |    1.5.2 ␣
↪Kleutertoeslag: allowance for 3 and 4 year  ...
164: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)       |    1.5.3␣
↪Childcare supplement (only in childcare that ...
165: BenCalc     | on                                                     |     2.1␣
↪Base amounts
166: BenCalc     | on                                                     |   ␣
↪Calculate social supplement
167: BenCalc     | on                                                     |   ␣
↪Calculate social supplement
168: BenCalc     | on                                                     |    2.3.1␣
↪Universal Participation Supplement (former b ...
169: BenCalc     | on                                                     |    2.3.2␣
↪Kleutertoeslag: allowance for 3 and 4 year o ...
170: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)       |    3.3.3␣
↪Childcare supplement (only in childcare that ...
171: BenCalc     | on                                                     |    1.1.␣
↪base amount
```

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```
172: BenCalc     | on                                                          |   ␣
↪Calculate social supplement
173: BenCalc     | on                                                          |   ␣
↪Calculate social supplement
174: BenCalc     | on                                                          |   ␣
↪Calculate social supplement
175: BenCalc     | on                                                          |   ␣
↪Calculate social supplement
176: BenCalc     | on                                                          |   ␣
↪Calculate age supplements
177: BenCalc     | on                                                          |   ␣
↪Calculate age supplements
178: BenCalc     | on                                                          |
179: BenCalc     | on                                                          |
180: BenCalc     | n/a                                                         |   ␣
↪Calculate benefit
181: BenCalc     | n/a                                                         |    2.1.␣
↪Base amount
182: BenCalc     | n/a                                                         |    2.2.␣
↪back to school premium
183: BenCalc     | n/a                                                         |    3.3.␣
↪Age supplement
184: BenCalc     | n/a                                                         |   ␣
↪Calculate benefit
185: BenCalc     | n/a                                                         |   ␣
↪Calculate benefit
186: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)            |    base␣
↪amount
187: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)            |   ␣
↪Calculate social supplement
188: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)            |   ␣
↪Calculate social supplement
189: BenCalc     | on                                                          |   ␣
↪Calculate age supplements
190: BenCalc     | on                                                          |    1.1.␣
↪base amount
191: BenCalc     | on                                                          |   ␣
↪Calculate social supplement
192: BenCalc     | on                                                          |   ␣
↪Calculate social supplement
193: BenCalc     | on                                                          |   ␣
↪Calculate social supplement
194: BenCalc     | on                                                          |   ␣
↪Calculate social supplement
195: BenCalc     | on                                                          |   ␣
↪Calculate age supplements
196: BenCalc     | on                                                          |   ␣
↪Calculate age supplements
197: BenCalc     | n/a                                                         |
198: BenCalc     | n/a                                                         |
199: BenCalc     | on                                                          |
200: BenCalc     | n/a                                                         |   ␣
```

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```
↪Calculate benefit
201: BenCalc     | n/a                                                    |    2.1.␣
↪Base amount
202: BenCalc     | n/a                                                    |    2.2.␣
↪back to school premium
203: BenCalc     | n/a                                                    |    3.3.␣
↪Age supplement
204: BenCalc     | n/a                                                    |   ␣
↪Calculate benefit
205: BenCalc     | n/a                                                    |   ␣
↪Calculate benefit
206: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)       |    1. ␣
↪base amount
207: BenCalc     | on                                                     |
208: BenCalc     | on                                                     |
209: BenCalc     | on                                                     |
210: BenCalc     | on                                                     |
211: BenCalc     | on (with switch set for Belmod_endo, Belmod_exo)       |    1. ␣
↪base amount
212: BenCalc     | on                                                     |
213: BenCalc     | on                                                     |
214: BenCalc     | on                                                     |
215: BenCalc     | on                                                     |
216: BenCalc     | on                                                     |    Compare␣
↪old and new system
217: BenCalc     | on                                                     |    Married␣
↪student
218: BenCalc     | on                                                     |   ␣
↪Independent student
219: BenCalc     | on                                                     |
220: BenCalc     | on                                                     |
221: BenCalc     | on                                                     |
222: BenCalc     | on                                                     |    for␣
↪disabled child
223: BenCalc     | on                                                     |    for␣
↪child in post secondary education
224: BenCalc     | on                                                     |    own␣
↪points for  independent/single student
225: BenCalc     | on                                                     |
226: BenCalc     | on                                                     |
227: BenCalc     | on                                                     |    Maximum␣
↪allowed income to receive study allowances ...
228: BenCalc     | on                                                     |    Minimum␣
↪threshold from which the study allowances  ...
229: BenCalc     | on                                                     |    Maximum␣
↪allowed income to receive study allowances ...
230: BenCalc     | on                                                     |    Minimum␣
↪threshold from which the study allowances  ...
231: BenCalc     | on                                                     |
232: BenCalc     | on                                                     |
233: BenCalc     | on                                                     |
234: BenCalc     | on                                                     |
```

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```
235: BenCalc     | on                                                                |
236: BenCalc     | on                                                                |
237: BenCalc     | on                                                                |
238: BenCalc     | on                                                                |
239: BenCalc     | on                                                                |
240: BenCalc     | on                                                                |    French␣
↪community: Maximum allowed income to receiv ...
241: BenCalc     | on                                                                |    Maximum␣
↪allowed income to receive study allowances ...
242: BenCalc     | on                                                                |    Maximum␣
↪allowed income to receive special allowanc ...
243: BenCalc     | on                                                                |    Income␣
↪from which study allowances start to decrea ...
244: BenCalc     | on                                                                |    ␣
↪Computation of study allowances: no distinction be ...
245: BenCalc     | on                                                                |    ␣
↪Allocate i_bed_fr_be to household head for student ...
246: BenCalc     | on                                                                |    ␣
↪Allocate i_bed_fl_be to household head for student ...
247: BenCalc     | on                                                                |
248: BenCalc     | on                                                                |    ␣
↪Allocate random benefit to household head for stud ...
249: BenCalc     | on (with switch set for BTA)                                      |    Non␣
↪take-up correction
250: BenCalc     | on                                                                |    ␣
↪Calculate the amount received
251: BenCalc     | on                                                                |    Set the␣
↪Flemish job bonus to 0 for individuals wit ...
252: BenCalc     | on                                                                |
253: BenCalc     | on                                                                |    normal␣
↪cases
```

1.3.7 Run simulation

Use the `run` method to simulate the EUROMOD tax-benefit systems by passing two required input arguments, a `pandas.DataFrame` dataset and a name of the dataset. For a complete list of parameters please refere to the [API Reference User Guide][].

Note: The uprating factors are applied based on the dataset name.

The example below shows how to run a simulation with default optional input parameters for Poland 'PL', tax-benefit system 'PL_2022', using the best match dataset as input data.

Geting the name of the best-match dataset for system 'PL_2022':

```
dataset_id = mod['PL']['PL_2022'].bestmatch_datasets[0].name
dataset_id
```

```
'PL_2020_b2'
```

Load the data as a `pandas.DataFrame` object:

```
import pandas as pd
import os
dataset_path = os.path.join("C:\EUROMOD_RELEASES_I6.0+\Input",dataset_id+".txt")
data = pd.read_csv(dataset_path,sep="\t")
```

Run the simulation providing two input parameters, a `pandas.DataFrame` dataset and a name of the dataset:

```
out=mod.countries['PL'].systems['PL_2022'].run(data,'PL_2020_b2')
```

```
Simulation for system PL_2022 with dataset PL_2020_b2 finished.
```

The simulation run returns a `core.Simulation` class that stores the results as `pandas.DataFrame` objects in the attribute `outputs`:

```
out.outputs[0]
```

```
            idhh     idperson     idmother     idfather  idpartner   idorighh  \
0          100.0      10001.0          0.0          0.0    10002.0      100.0
1          100.0      10002.0          0.0          0.0    10001.0      100.0
2          100.0      10003.0      10002.0      10001.0        0.0      100.0
3          100.0      10004.0      10002.0      10001.0        0.0      100.0
4          200.0      20001.0          0.0          0.0        0.0      200.0
...          ...          ...          ...          ...        ...        ...
38637  2047100.0  204710003.0  204710002.0  204710001.0        0.0  2047100.0
38638  2047100.0  204710004.0  204710002.0  204710001.0        0.0  2047100.0
38639  2047200.0  204720001.0          0.0          0.0        0.0  2047200.0
38640  2047300.0  204730001.0          0.0          0.0        0.0  2047300.0
38641  2047500.0  204750001.0          0.0          0.0        0.0  2047500.0

       idorigperson   dag  dgn  dec  ...      il_ben0    il_dpisilc  \
0           10001.0  38.0  1.0  0.0  ...  1050.000000  16367.636079
1           10002.0  38.0  0.0  0.0  ...     0.000000   6602.816820
2           10003.0  12.0  0.0  2.0  ...     0.000000      0.000000
3           10004.0   8.0  0.0  2.0  ...     0.000000      0.000000
4           20001.0  62.0  0.0  0.0  ...   223.073333   1771.645564
...             ...   ...  ...  ...  ...          ...           ...
38637   204710003.0  18.0  1.0  4.0  ...     0.000000      0.000000
38638   204710004.0   7.0  0.0  2.0  ...     0.000000      0.000000
38639   204720001.0  51.0  0.0  0.0  ...     0.000000   3391.598079
38640   204730001.0  62.0  1.0  0.0  ...   975.291991   2180.895682
38641   204750001.0  69.0  0.0  0.0  ...   223.073333   3029.881169

        il_thlmx_s  il_thlmm_s   il_tinhlit   il_tinhljt  il_pa     il_bhomx  \
0      1804.242991         0.0  4035.086190  4035.086190    0.0   123.436998
1       787.534766         0.0   720.046355   720.046355    0.0     0.000000
2         0.000000         0.0     0.000000     0.000000    0.0     0.000000
3         0.000000         0.0     0.000000     0.000000    0.0     0.000000
4       164.491807         0.0     0.000000     0.000000    0.0   678.998548
...            ...         ...          ...          ...    ...          ...
38637     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38638     0.000000         0.0     0.000000     0.000000    0.0     0.000000
38639   349.129643         0.0   135.506191   135.506191    0.0  1160.473138
38640   131.263597         0.0     0.000000     0.000000    0.0   395.047916
```

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```
38641   183.583065         0.0    37.968866    37.968866    0.0   716.030976

           il_bsamt      il_bsatm
0      15333.066256  15333.066256
1       6602.816820   6602.816820
2          0.000000      0.000000
3          0.000000      0.000000
4       1551.658266   1551.658266
...             ...           ...
38637      0.000000      0.000000
38638      0.000000      0.000000
38639   3394.582426   3394.582426
38640   1476.410557   1476.410557
38641   2816.888295   2816.888295

[38642 rows x 453 columns]
```

1.4 API Reference

This reference documentation details the public objects of the Euromod Connector package. For a complete documentation please refer to the Euromod Connector User Guide. For futher readings on the tax-benefit microsimulation model EUROMOD please visit the official web-site.[1]

1.4.1 euromod

Subpackages

euromod.test

[1] Created with Euromod web-site

Submodules

euromod.test.main

Table 1: Function

simpleland()	Run simulation with default parameters for Simpleland.

Functions

euromod.test.main.**simpleland**()

Run simulation with default parameters for Simpleland.

Example

```
>>> from euromod import test
>>> test.simpleland()
```

Submodules

euromod.core

Table 2: Classes

Country	Country-specific EUROMOD tax-benefit model.
Dataset	Datasets available in a country model.
DatasetInSystem	Datasets available in a system model.
Extension	EUROMOD built-in extensions.
Function	Functions implemented in a country policy.
FunctionInSystem	Functions implemented in a policy for a specific system.
Model	Base class of the Euromod Connector instantiating the microsimulation model
Parameter	Parameters set up in a function.
ParameterInSystem	Parameters set up in a function for a specific system.
Policy	Policy rules modeled in a country.
PolicyInSystem	Policy rules modeled in a system.
ReferencePolicy	Object storing the reference policies.
Simulation	Object storing the simulation results.
System	A EUROMOD specific tax-benefit system.

Classes

class euromod.core.**Country**(*country: str*, *model: str*)

Bases: `base.Euromod_Element`

Country-specific EUROMOD tax-benefit model.

This class instantiates the EUROMOD tax benefit model for a given country. A class instance is automatically generated and stored in the attribute `countries` of the base class *Model*.

This class contains subclasses of type *System*, *Policy*, *Dataset* and *Extension*.

Example

```
>>> from euromod import Model
>>> mod=Model(r"C:\EUROMOD_RELEASES_I6.0+")
>>> mod.countries[0]
```

Overview

Table 3: Attributes

datasets	A `list` with *Dataset* objects.
local_extensions	A `list` with *Extension* objects.
model	Returns the base *Model* object.
name	Two-letters country code.
policies	A `list` with *Policy* objects.
systems	A `list` with *System* objects.

Table 4: Methods

load_data(ID_DATASET, PATH_DATA)	Load data as a `pandas.DataFrame` object.

Attributes

datasets: list[*Dataset*] | None = None

A list with *Dataset* objects.

local_extensions: list[*Extension*] | None = None

A list with *Extension* objects.

model: *Model*

Returns the base *Model* object.

Type
“

name: str

Two-letters country code.

policies: list[*Policy*] | None = None

A list with *Policy* objects.

systems: list[*System*] | None = None

A list with *System* objects.

Methods

load_data(*ID_DATASET*, *PATH_DATA=None*)

Load data as a pandas.DataFrame object.

Parameters

- **ID_DATASET** (str) – Name of the dataset excluding extension (Note: must be a *txt* file).
- **PATH_DATA** (str, optional) – Path to the dataset. Default is the PATH_TO_EUROMOD_PROJECT/Input folder.

Returns
Dataset is returned as a pandas.DataFrame object.

Return type
pandas.DataFrame

class euromod.core.**Dataset**(**args*)

Bases: base.Euromod_Element

Datasets available in a country model.

Overview

Table 5: Attributes

ID	Dataset identifier number.
coicopVersion	COICOP version.
comment	Comment about the dataset.
currency	Currency of the monetary values in the dataset.
decimalSign	Decimal sign
name	Name of the dataset.
private	Access type.
readXVariables	Read variables.
useCommonDefault	Use default.
yearCollection	Year of the dataset collection.
yearInc	Reference year for the income variables.

Attributes

ID: str

Dataset identifier number.

coicopVersion: str = ''

COICOP version.

comment: str = ''

Comment about the dataset.

currency: str = ''

Currency of the monetary values in the dataset.

decimalSign: str = ''

Decimal sign

name: str

Name of the dataset.

private: str = 'no'

Access type.

readXVariables: str = 'no'

Read variables.

useCommonDefault: str = 'no'

Use default.

yearCollection: str

Year of the dataset collection.

yearInc: str

Reference year for the income variables.

class euromod.core.**DatasetInSystem**

Bases: base.SystemElement

Datasets available in a system model.

Overview

Table 6: Attributes

ID	Dataset identifier number.
bestMatch	If yes, the current dataset is a best match for the specific system.
coicopVersion	COICOP version.
comment	Comment about the dataset.
currency	Currency of the monetary values in the dataset.
dataID	Identifier number of the reference dataset at the country level.
decimalSign	Decimal sign
name	Name of the dataset.
private	Access type.
readXVariables	Read variables.
sysID	Identifier number of the reference system.
useCommonDefault	Use default.
yearCollection	Year of the dataset collection.
yearInc	Reference year for the income variables.

Attributes

ID: str

Dataset identifier number.

bestMatch: str

If yes, the current dataset is a best match for the specific system.

coicopVersion: str

COICOP version.

comment: str

Comment about the dataset.

currency: str

Currency of the monetary values in the dataset.

dataID: str

Identifier number of the reference dataset at the country level.

decimalSign: str

Decimal sign

name: str

Name of the dataset.

private: str

Access type.

readXVariables: str

Read variables.

sysID: str

Identifier number of the reference system.

useCommonDefault: str

Use default.

yearCollection: str

Year of the dataset collection.

yearInc: str

Reference year for the income variables.

class euromod.core.**Extension**

Bases: base.Euromod_Element

EUROMOD built-in extensions.

Overview

Table 7: Attributes

name	Full name of the extension.
shortName	Short name of the extension.

Attributes

name: str

Full name of the extension.

shortName: str

Short name of the extension.

class euromod.core.**Function**(**arg*)

Bases: base.SpineElement

Functions implemented in a country policy.

Overview

Table 8: Attributes

ID	Identifier number of the function.
comment	Comment specific to the function.
extensions	A list of *Extension* objects in a country.
name	Name of the function.
order	Order of the function in the specific spine.
parameters	A list of *Parameter* objects in a country.
polID	Identifier number of the reference policy.
private	Access type.
spineOrder	Order of the function in the spine.

Attributes

ID: str
Identifier number of the function.

comment: str
Comment specific to the function.

extensions: list[*Extension*] | None = None
A list of *Extension* objects in a country.

name: str
Name of the function.

order: str
Order of the function in the specific spine.

parameters: list[*Parameter*] | None = None
A list of *Parameter* objects in a country.

polID: str
Identifier number of the reference policy.

private: str
Access type.

spineOrder: str
Order of the function in the spine.

class euromod.core.**FunctionInSystem**(**arg*)

Bases: base.SystemElement

Functions implemented in a policy for a specific system.

Overview

Table 9: Attributes

ID	Identifier number of the function.
comment	Comment specific to the function.
extensions	A list of *Extension* objects in a country.
funID	Identifier number of the reference function at country level.
name	Name of the function.
order	Order of the function in the specific spine.
parameters	A list with *ParameterInSystem* objects specific to a function.
polID	Identifier number of the reference policy.
private	Access type.
spineOrder	Order of the function in the spine.
switch	Policy switch action.
sysID	Identifier number of the reference policy.

Attributes

ID: str
Identifier number of the function.

comment: str
Comment specific to the function.

extensions: list[*Extension*]
A list of *Extension* objects in a country.

funID: str
Identifier number of the reference function at country level.

name: str
Name of the function.

order: str
Order of the function in the specific spine.

parameters: list[*ParameterInSystem*] | None = None
A list with *ParameterInSystem* objects specific to a function.

polID: str
Identifier number of the reference policy.

private: str
Access type.

spineOrder: str
Order of the function in the spine.

switch: str
Policy switch action.

sysID: str
Identifier number of the reference policy.

class euromod.core.**Model**(*model_path: str*, *countries=None*)
Base class of the Euromod Connector instantiating the microsimulation model EUROMOD.

Parameters

- **model_path** (str) – Path to the EUROMOD project.
- **countries** (str, or list [str], optional) – Countries to load from the project folder. Names must be two-letter country codes, see the Eurostat Glossary:Country codes. If omitted, will load all the available countries in the project folder. Default is None.

Returns
A class containing the EUROMOD country models.

Return type
core.Model

Example

```
>>> from euromod import Model
>>> mod=Model(r"C:\EUROMOD_RELEASES_I6.0+")
```

Overview

Table 10: Attributes

countries	A `list` with *Country* objects.
extensions	A `list` with *Model* extensions.
model_path	Path to the EUROMOD project.

Attributes

countries: `list`[*Country*]

A `list` with *Country* objects.

extensions: `list`[*Extension*]

A `list` with *Model* extensions.

model_path: `str`

Path to the EUROMOD project.

class euromod.core.**Parameter**(**arg*)

Bases: `base.SpineElement`

Parameters set up in a function.

Overview

Table 11: Attributes

ID	Identifier number of the parameter.
comment	Comment specific to the parameter.
extensions	A `list` with *Extension* objects.
funID	Identifier number of the reference function at country level.
group	Parameter group value.
name	Name of the parameter.
order	Order of the parameter in the specific spine.
spineOrder	Order of the parameter in the spine.

Attributes

ID: str
Identifier number of the parameter.

comment: str
Comment specific to the parameter.

extensions: list[*Extension*] | None = None
A `list` with *Extension* objects.

funID: str
Identifier number of the reference function at country level.

group: str = ''
Parameter group value.

Type
str

name: str
Name of the parameter.

order: str
Order of the parameter in the specific spine.

spineOrder: str
Order of the parameter in the spine.

class euromod.core.**ParameterInSystem**

Bases: `base.SystemElement`

Parameters set up in a function for a specific system.

Overview

Table 12: Attributes

ID	Identifier number of the parameter.
comment	Comment specific to the parameter.
extensions	A `list` with *Extension* objects.
funID	Identifier number of the reference function at country level.
group	Parameter group number.
name	Name of the parameter.
order	Order of the parameter in the specific spine.
parID	Identifier number of the reference parameter at country level.
spineOrder	Order of the parameter in the spine.
sysID	Identifier number of the reference system.
value	Value of the parameter.

Attributes

ID: str
Identifier number of the parameter.

comment: str
Comment specific to the parameter.

extensions: list
A list with *Extension* objects.

funID: str
Identifier number of the reference function at country level.

group: str
Parameter group number.

Type
str

name: str
Name of the parameter.

order: str
Order of the parameter in the specific spine.

parID: str
Identifier number of the reference parameter at country level.

spineOrder: str
Order of the parameter in the spine.

sysID: str
Identifier number of the reference system.

value: str
Value of the parameter.

class euromod.core.**Policy**(**arg*)

Bases: base.SpineElement

Policy rules modeled in a country.

Overview

Table 13: Attributes

ID	Identifier number of the policy.
comment	Comment specific to the policy.
extensions	A list of policy-specific *Extension* objects.
functions	A list of policy-specific *Function* objects.
name	Name of the policy.
order	Order of the policy in the specific spine.
private	Access type. Default is 'no'.
spineOrder	Order of the policy in the spine.

Attributes

ID: str
Identifier number of the policy.

comment: str
Comment specific to the policy.

extensions: list[*Extension*] | None = None
A list of policy-specific *Extension* objects.

functions: list[*Function*] | None = None
A list of policy-specific *Function* objects.

name: str
Name of the policy.

order: str
Order of the policy in the specific spine.

private: str = 'no'
Access type. Default is 'no'.

spineOrder: str
Order of the policy in the spine.

class euromod.core.**PolicyInSystem**(**arg*)

Bases: base.SystemElement

Policy rules modeled in a system.

Overview

Table 14: Attributes

ID	Identifier number of the policy.
comment	Comment specific to the policy.
extensions	A list of policy-specific *Extension* objects.
functions	A list with *FunctionInSystem* objects specific to the system
name	Name of the policy.
order	Order of the policy in the specific spine.
polID	Identifier number of the reference policy at country level.
private	Access type. Default is 'no'.
spineOrder	Order of the policy in the spine.
switch	Policy switch action.
sysID	Identifier number of the reference system.

Attributes

ID: str
Identifier number of the policy.

comment: str
Comment specific to the policy.

extensions: list[*Extension*]
A list of policy-specific *Extension* objects.

functions: list[*FunctionInSystem*] | None = None
A list with *FunctionInSystem* objects specific to the system

name: str
Name of the policy.

order: str
Order of the policy in the specific spine.

polID: str
Identifier number of the reference policy at country level.

private: str
Access type. Default is 'no'.

spineOrder: str
Order of the policy in the spine.

switch: str
Policy switch action.

sysID: str
Identifier number of the reference system.

class euromod.core.**ReferencePolicy**(*info*, *parent*)

Bases: base.SpineElement

Object storing the reference policies.

Overview

Table 15: Attributes

extensions	A list of reference policy-specific *Extension* objects.
name	Name of the reference policy.

Attributes

extensions: list[*Extension*] | None = None

A list of reference policy-specific *Extension* objects.

name: str

Name of the reference policy.

class euromod.core.**Simulation**(*out*, *configSettings*, *constantsToOverwrite*)

Object storing the simulation results.

This is a class containing results from the simulation run and other related configuration information.

Overview

Table 16: Attributes

configSettings	A dict-type object with simulation settings.
constantsToOverwrite	A dict-type object with user-defined constants.
errors	A list with errors and warnings from the simulation run.
output_filenames	A list of file-names with simulation output.
outputs	A list with type pandas.DataFrame simulation results.

Attributes

configSettings: dict[str, str]

A dict-type object with simulation settings.

constantsToOverwrite: dict[tuple(str, str), str]

A dict-type object with user-defined constants.

errors: list[str]

A list with errors and warnings from the simulation run.

output_filenames: list[str] | [] = []

A list of file-names with simulation output.

outputs: list[pandas.DataFrame]

A list with type pandas.DataFrame simulation results. For indexing use an integer or a label from *output_filenames*.

class euromod.core.**System**(**arg*)

Bases: base.Euromod_Element

A EUROMOD specific tax-benefit system.

This class instantiates the EUROMOD tax benefit model for a specific system. A class instance is automatically generated and stored in the attribute *systems* of class *Country*.

This class contains subclasses of type *DatasetInSystem*, and *PolicyInSystem*.

Example

```
>>> from euromod import Model
>>> mod=Model(r"C:\EUROMOD_RELEASES_I6.0+")
>>> mod.countries[0].systems[-1]
```

Overview

Table 17: Attributes

ID	Identifier number of the system.
bestmatch_datasets	A `list` with best-match *Dataset* objects in the system.
comment	Comment specific to the system.
currencyOutput	Currency of the simulation results.
currencyParam	Currency of the monetary parameters in the system.
datasets	A `list` of *DatasetInSystem* objects in the system.
headDefInc	Main income definition.
name	Name of the system.
order	System order in the spine.
policies	A `list` of *PolicyInSystem* objects in the system.
private	Access type.
year	System year.

Table 18: Methods

run(data, dataset_id, constantsToOverwrite, verbose, outputpath, addons, switches, nowarnings)	Run the simulation of a EUROMOD tax-benefit system.

Attributes

ID: `str`

Identifier number of the system.

bestmatch_datasets: `list[Dataset] | None = None`

A `list` with best-match *Dataset* objects in the system.

comment: `str`

Comment specific to the system.

currencyOutput: `str`

Currency of the simulation results.

currencyParam: `str`

Currency of the monetary parameters in the system.

datasets: `list[DatasetInSystem] | None = None`

A `list` of *DatasetInSystem* objects in the system.

headDefInc: `str`

Main income definition.

name: str

Name of the system.

order: str

System order in the spine.

policies: list[*PolicyInSystem*] | None = None

A list of *PolicyInSystem* objects in the system.

private: str

Access type.

year: str

System year.

Methods

run(*data: pandas.DataFrame*, *dataset_id: str*, *constantsToOverwrite: Dict[Tuple[str, str], str] | None = None*, *verbose: bool = True*, *outputpath: str = ''*, *addons: List[Tuple[str, str]] = []*, *switches: List[Tuple[str, bool]] = []*, *nowarnings=False*)

Run the simulation of a EUROMOD tax-benefit system.

Parameters

- **data** (pandas.DataFrame) – input dataframe passed to the EUROMOD model.
- **dataset_id** (str) – ID of the dataset.
- **constantsToOverwrite** (Optional[dict [tuple [str, str], str]], optional) – A list of constants to overwrite. Note that the key is a tuple for which the first element is the name of the constant and the second string the groupnumber Default is None.
- **verbose** (bool, optional) – If True then information on the output will be printed. Default is True.
- **outputpath** (str, optional) – When an output path is provided, there will be anoutput file generated. Default is "".
- **addons** (list [tuple [str, str]], optional) – list of addons to be integrated in the spine, where the first element of the tuple is the name of the Addon and the second element is the name of the system in the Addon to be integrated. Default is [].
- **switches** (list [tuple [str, bool]], optional) – list of Extensions to be switched on or of. The first element of the tuple is the short name of the Addon. The second element is a boolean Default is [].
- **nowarnings** (bool, optional) – If True, the warning messages resulting from the simulations will be suppressed. Default is False.

Raises

Exception – Exception when simulation does not finish succesfully, i.e. without errors.

Returns

A class containing simulation output and error messages.

Return type

core.Simulation

Example

```
>>> # Load the dataset
>>> import pandas as pd
>>> data = pd.read_csv(r"C:\EUROMOD_RELEASES_I6.0+\Input\sl_demo_v4.txt",sep="
↪")
>>> # Load EUROMOD
>>> from euromod import Model
>>> mod=Model(r"C:\EUROMOD_RELEASES_I6.0+")
>>> # Run simulation
>>> out=mod.countries['SL'].systems['SL_1996'].run(data,'sl_demo_v4')
```

1.5 Release notes

1.5.1 v0.1.20a (18/06/2024)

Fix

- Changed the objects printing in the console window

Feature

- Added the "find" method to search for derived objects

Documentation

- Added new user guide
- Now hosting documentation on Read the Docs

1.5.2 v0.1.1a (18/06/2024)

- First release of `euromod`

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