

---

# **data\_tools Documentation**

***Release 0.0.4***

**Nicolàs Palacio**

**Jul 26, 2018**



# CONTENTS

<b>1</b>	<b>Disclaimer</b>	<b>3</b>
<b>2</b>	<b>Dependencies</b>	<b>5</b>
<b>3</b>	<b>Installation</b>	<b>7</b>
<b>4</b>	<b>Modules</b>	<b>9</b>
4.1	data_tools.diffusion . . . . .	9
4.2	data_tools.models . . . . .	9
4.3	data_tools.plots . . . . .	10
4.4	data_tools.sets . . . . .	14
4.5	data_tools.strings . . . . .	15
	<b>Python Module Index</b>	<b>17</b>
	<b>Index</b>	<b>19</b>



Data tools: a collection of Python functions and classes designed to make data scientists' life easier.

Copyright (C) 2018 Nicolás Palacio

Contact: [nicolaspalacio91@gmail.com](mailto:nicolaspalacio91@gmail.com)



## DISCLAIMER

This package is still under development and will be periodically updated with new features. Contributions are very welcome (fork + pull request). If you find any bug or suggestion for upgrades, please use the [issue system](#).

GNU-GLPv3: This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

A full copy of the GNU General Public License can be found on file [LICENSE.md](#). If not, see <http://www.gnu.org/licenses/>.





## DEPENDENCIES

- NumPy
- Matplotlib
- Pandas
- SciPy
- Scikit-learn



## INSTALLATION

First download/clone `data_tools` from the [GitHub repository](#). From the terminal:

```
git clone https://github.com/Nic-Nic/data_tools.git
cd data_tools
```

Then you can install it by running `setup.py` as follows:

```
python setup.py sdist
```

Or using `pip`:

```
pip install .
```



## 4.1 data\_tools.diffusion

Diffusion solvers module.

`data_tools.diffusion.euler_explicit1D(x0, dt, dx2, d=1, bcs='periodic')`  
Computes diffusion on a 1D space over a time-step using Euler explicit method

- **Arguments:**

- `x0 []`: .
- `dt []`: .
- `dx2 []`: .
- `d []`: .
- `bcs []`: .

- **Returns:**

- `[]`: .

## 4.2 data\_tools.models

Model classes module.

**class** `data_tools.models.Lasso(Cs=500, cv=10, sampler='skf', solver='liblinear', **kwargs)`  
Wrapper class inheriting from `sklearn.linear_model.LogisticRegressionCV` with L1 regularization.

- **Arguments:**

- `Cs [int]`: Optional, 500 by default. Integer or list of float values of regularization parameters to test. If an integer is passed, it will determine the number of values taken from a logarithmic scale between  $1e-4$  and  $1e4$ . Note that the value of the parameter is defined as the inverse of the regularization strength.
- `cv [int]`: Optional, 10 by default. Denotes the number of cross validation (CV) folds.
- `sampler [str]`: Optional, 'skf' by default. Determines which sampling method is used to generate the test and training sets for CV. Methods available are K-Fold ('kf'), Shuffle Split ('ss') and their stratified variants ('skf' and 'sss' respectively).

- *solver* [str]: Optional, 'liblinear' by default. Determines which solver algorithm to use. Note that L1 regularization can only be handled by 'liblinear' and 'saga'. Additionally if the classification is multinomial, only the latter option is available.
- *\*\*kwargs*: Optional. Any other keyword argument accepted by the `sklearn.linear_model.LogisticRegressionCV` class.

Other keyword arguments and functions available from the parent class `LogisticRegressionCV` can be found in [Scikit-Learn's reference](#).

**fit\_data** (*x*, *y*, *silent=False*)

Fits the data to the logistic model.

- **Arguments:**

- *x* [pandas.DataFrame]: Contains the values/measurements [float] of the features (columns) for each sample/replicate (rows).
- *y* [pandas.Series]: List or any iterable containing the observed class of each sample (must have the same order as in *x*).
- *silent* [bool]: Optional, `False` by default. Determines whether messages are printed or not.

**plot\_coef** (*filename=None*, *figsize=None*)

Plots the non-zero coefficients for the fitted predictor features.

- **Arguments:**

- *filename* [str]: Optional, `None` by default. If passed, indicates the file name or path where to store the figure. Format must be specified (e.g.: .png, .pdf, etc)
- *figsize* [tuple]: Optional, `None` by default (default matplotlib size). Any iterable containing two values denoting the figure size (in inches) as [width, height].

- **Returns:**

- [matplotlib.figure.Figure]: Figure object containing the bar plot of the non-zero coefficients.

**plot\_score** (*filename=None*, *figsize=None*)

Plots the mean score across all folds obtained during CV. The optimum C parameter chosen and its score are highlighted.

- **Arguments:**

- *filename* [str]: Optional, `None` by default. If passed, indicates the file name or path where to store the figure. Format must be specified (e.g.: .png, .pdf, etc)
- *figsize* [tuple]: Optional, `None` by default (default matplotlib size). Any iterable containing two values denoting the figure size (in inches) as [width, height].

- **Returns:**

- [matplotlib.figure.Figure]: Figure object containing the score plot.

## 4.3 data\_tools.plots

Plotting functions module.

`data_tools.plots.density` (*df*, *cvf=0.25*, *title=None*, *filename=None*, *figsize=None*)

Generates a density plot of the values on a data frame (row-wise).

- **Arguments:**

- *df* [pandas.DataFrame]: Contains the values to generate the plot. Each row is considered as an individual sample while each column contains a measured value.
- *cvf* [float]: Optional, 0.25 by default. Co-variance factor used in the gaussian kernel estimation. A higher value increases the smoothness.
- *title* [str]: Optional, *None* by default. Defines the plot title.
- *filename* [str]: Optional, *None* by default. If passed, indicates the file name or path where to store the figure. Format must be specified (e.g.: .png, .pdf, etc)
- *figsize* [tuple]: Optional, *None* by default (default matplotlib size). Any iterable containing two values denoting the figure size (in inches) as [width, height].

- **Returns:**

- [matplotlib.figure.Figure]: the figure object containing the density plot.

`data_tools.plots.piano_consensus(df, nchar=40, boxes=True, title=None, filename=None, figsize=None)`

Generates a GSEA consensus score plot like R package `piano`'s `consensusScores` function, but prettier. The main input is assumed to be a `pandas.DataFrame` whose data is the same as the `rankMat` from the result of `consensusScores`.

- **Arguments:**

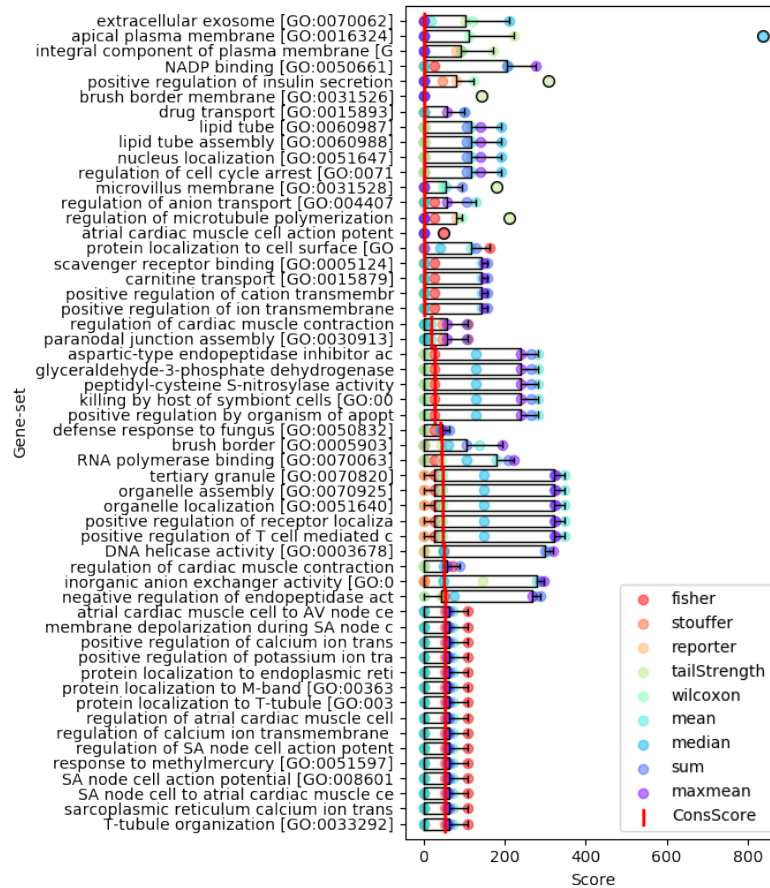
- *df* [pandas.DataFrame]: Values contained correspond to the scores of the gene-sets (consensus and each individual methods). Index must contain the gene-set labels. Columns are assumed to be `ConsRank` (ignored), `ConsScore` followed by the individual methods (e.g.: `mean`, `median`, `sum`, etc).
- *nchar* [int]: Optional, 40 by default. Number of string characters of the gene-set labels of the plot.
- *boxes* [bool]: Optional, *True* by default. Determines whether to show the boxplots of the gene-sets or not.
- *title* [str]: Optional, *None* by default. Defines the plot title.
- *filename* [str]: Optional, *None* by default. If passed, indicates the file name or path where to store the figure. Format must be specified (e.g.: .png, .pdf, etc)
- *figsize* [tuple]: Optional, *None* by default (default matplotlib size). Any iterable containing two values denoting the figure size (in inches) as [width, height].

- **Returns:**

- [matplotlib.figure.Figure]: the figure object containing a combination of box and scatter plots of the gene-set scores.

- **Example:**

```
>>> piano_consensus(df, figsize=[7, 8])
```



`data_tools.plots.venn` (*N*, labels=['A', 'B', 'C', 'D'], c=['C0', 'C1', 'C2', 'C3'], title=None, filename=None, figsize=None)

Plots a Venn diagram from a list of sets *N*. Number of sets must be between 2 and 4 (inclusive).

- **Arguments:**

- *N* [list]: Or any iterable type containing [set] objects.
- *labels* [list]: Optional, ['A', 'B', 'C', 'D'] by default. Labels for the sets following the same order as provided in *N*.
- *c* [list]: Optional, ['C0', 'C1', 'C2', 'C3'] by default (matplotlib default colors). Any iterable containing color arguments tolerated by matplotlib (e.g.: ['r', 'b'] for red and blue). Must contain at least the same number of elements as *N* (if more are provided, they will be ignored).
- *title* [str]: Optional, None by default. Defines the plot title.
- *filename* [str]: Optional, None by default. If passed, indicates the file name or path where to store the figure. Format must be specified (e.g.: .png, .pdf, etc)
- *figsize* [tuple]: Optional, None by default (default matplotlib size). Any iterable containing two values denoting the figure size (in inches) as [width, height].

- **Returns:**

- [*matplotlib.figure.Figure*]: the figure object containing a combination of box and scatter plots of the gene-set scores.



- **Example:**

```
>>> N = [{0, 1}, {2, 3}, {1, 3, 4}] # Sets A, B, C
>>> venn(N)
```



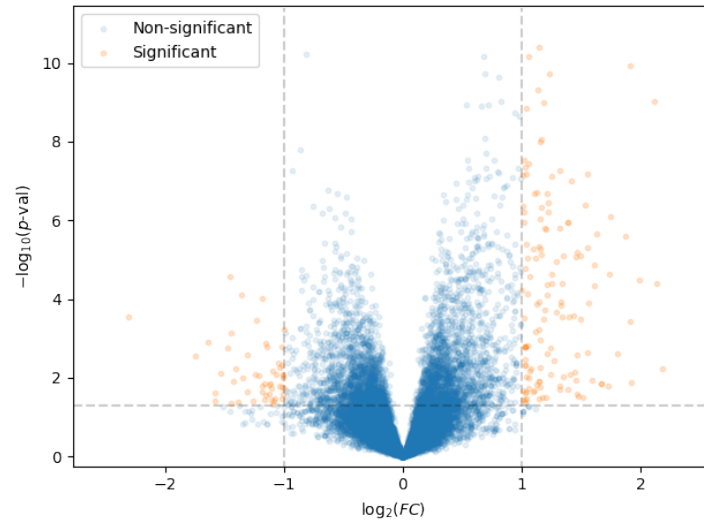
`data_tools.plots.volcano` (*logfc*, *logpval*, *thr\_pval*=0.05, *thr\_fc*=2.0, *c*=('C0', 'C1'), *legend*=True, *title*=None, *filename*=None, *figsize*=None)  
Generates a volcano plot from the differential expression data provided.

- **Arguments:**

- *logfc* [list]: Or any iterable type. Contains the log (usually base 2) fold-change values. Must have the same length as *logpval*.
- *logpval* [list]: Or any iterable type. Contains the -log p-values (usually base 10). Must have the same length as *logfc*.
- *thr\_pval* [float]: Optional, 0.05 by default. Specifies the p-value (non log-transformed) threshold to consider a measurement as significantly differentially expressed.
- *thr\_fc* [float]: Optional, 2. by default. Specifies the FC (non log-transformed) threshold to consider a measurement as significantly differentially expressed.
- *c* [tuple]: Optional, ('C0', 'C1') by default (matplotlib default colors). Any iterable containing two color arguments tolerated by matplotlib (e.g.: ['r', 'b'] for red and blue). First one is used for non-significant points, second for the significant ones.
- *legend* [bool]: Optional, True by default. Indicates whether to show the plot legend or not.
- *title* [str]: Optional, None by default. Defines the plot title.
- *filename* [str]: Optional, None by default. If passed, indicates the file name or path where to store the figure. Format must be specified (e.g.: .png, .pdf, etc)
- *figsize* [tuple]: Optional, None by default (default matplotlib size). Any iterable containing two values denoting the figure size (in inches) as [width, height].

- **Returns:**
  - [matplotlib.figure.Figure]: Figure object containing the volcano plot.
- **Example:**

```
>>> volcano(my_log_fc, my_log_pval)
```



## 4.4 data\_tools.sets

Set operations module.

`data_tools.sets.bit_or(a, b)`

Returns the bit operation OR between two bit-strings *a* and *b*. NOTE: *a* and *b* must have the same size.

- **Arguments:**
  - *a* [tuple]: Or any iterable type.
  - *b* [tuple]: Or any iterable type.
- **Returns:**
  - [tuple]: OR operation between *a* and *b* element-wise.
- **Examples:**

```
>>> a, b = (0, 0, 1), (1, 0, 1)
>>> bit_or(a, b)
(1, 0, 1)
```

`data_tools.sets.find_min(A)`

Finds and returns the subset of vectors whose sum is minimum from a given set *A*.

- **Arguments:**
  - *A* [set]: Set of vectors ([tuple] or any iterable).
- **Returns:**
  - [set]: Subset of vectors in *A* whose sum is minimum.

- **Examples:**

```
>>> A = {(0, 1, 1), (0, 1, 0), (1, 0, 0), (1, 1, 1)}
>>> find_min(A)
set([(0, 1, 0), (1, 0, 0)])
```

`data_tools.sets.in_all(x, N)`

Checks if a vector  $x$  is present in all sets contained in a list  $N$ .

- **Arguments:**

- $x$  [tuple]: Or any hashable type as long as is the same contained in the sets of  $N$ .
- $N$  [list]: Or any iterable type containing [set] objects.

- **Returns:**

- [bool]: True if  $x$  is found in all sets of  $N$ , False otherwise.

- **Examples:**

```
>>> N = [{(0, 0), (0, 1)}, # <- set A
...      {(0, 0), (1, 1), (1, 0)}] # <- set B
>>> x = (0, 0)
>>> in_all(x, N)
True
>>> y = (0, 1)
>>> in_all(y, N)
False
```

`data_tools.sets.subsets(N)`

Function that computes all possible logical relations between all sets on a list  $N$  and returns all subsets. This is, the subsets that would represent each intersecting area on a Venn diagram.

- **Arguments:**

- $N$  [list]: Or any iterable type containing [set] objects.

- **Returns:**

- [dict]: Collection of subsets according to the logical relations between the sets in  $N$ . The keys are binary codes that denote the logical relation (see examples below).

- **Examples:**

```
>>> N = [{0, 1, 2}, {2, 3, 4}]
>>> subsets(N)
{'11': set([2]), '10': set([0, 1]), '01': set([3, 4])}
>>> N = [{0, 1}, {2, 3}, {1, 3, 4}]
>>> subsets(N)
{'010': set([2]), '011': set([3]), '001': set([4]), '111': set([
]), '110': set([]), '100': set([0]), '101': set([1])}
```

## 4.5 data\_tools.strings

String operations module.

`data_tools.strings.is_numeric(s)`

Determines if a string can be considered a numeric value. NaN is also considered, since it is float type.

- **Arguments:**
  - *s* [str]: String to be evaluated.
- **Returns:**
  - [bool]: True/False depending if the condition is satisfied.
- **Examples:**

```
>>> is_numeric('4')
True
>>> is_numeric('-3.2')
True
>>> is_numeric('number')
False
>>> is_numeric('NaN')
True
```

`data_tools.strings.join_str_lists(a, b, sep="")`

Joins element-wise two lists (or any 1D iterable) of strings with a given separator (if provided). Length of the input lists must be equal.

- **Arguments:**
  - *a* [list]: Contains the first elements [str] of the joint strings.
  - *b* [list]: Contains the second elements [str] of the joint strings.
  - *sep* [str]: Optional ' ' (non separated) by default. Determines the separator between the joint strings.
- **Returns:**
  - [list]: List of the joint strings.
- **Example:**

```
>>> a = ['a', 'b']
>>> b = ['1', '2']
>>> join_str_lists(a, b, sep='_')
['a_1', 'b_2']
```

## PYTHON MODULE INDEX

### d

`data_tools.diffusion`, [9](#)  
`data_tools.models`, [9](#)  
`data_tools.plots`, [10](#)  
`data_tools.sets`, [14](#)  
`data_tools.strings`, [15](#)



## INDEX

### B

`bit_or()` (in module `data_tools.sets`), 14

### D

`data_tools.diffusion` (module), 9

`data_tools.models` (module), 9

`data_tools.plots` (module), 10

`data_tools.sets` (module), 14

`data_tools.strings` (module), 15

`density()` (in module `data_tools.plots`), 10

### E

`euler_explicit1D()` (in module `data_tools.diffusion`), 9

### F

`find_min()` (in module `data_tools.sets`), 14

`fit_data()` (`data_tools.models.Lasso` method), 10

### I

`in_all()` (in module `data_tools.sets`), 15

`is_numeric()` (in module `data_tools.strings`), 15

### J

`join_str_lists()` (in module `data_tools.strings`), 16

### L

`Lasso` (class in `data_tools.models`), 9

### P

`piano_consensus()` (in module `data_tools.plots`), 11

`plot_coef()` (`data_tools.models.Lasso` method), 10

`plot_score()` (`data_tools.models.Lasso` method), 10

### S

`subsets()` (in module `data_tools.sets`), 15

### V

`venn()` (in module `data_tools.plots`), 12

`volcano()` (in module `data_tools.plots`), 13