
Python Data Audit



PyAudit: Python Data Audit Library API

Release 1.00

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Python Data Audit



Welcome to our **PyAudit: Python Data Audit Library API**! The PDF version can be downloaded from [HERE](#).

You can install the PyAudit from [PyPI](<https://pypi.org/project/PyAudit>):

```
pip install PyAudit
```


PREFACE

Chinese proverb

Good tools are prerequisite to the successful execution of a job. – old Chinese proverb

1.1 About

1.1.1 About this API

This document is the API book for our PyAudit: Python Data Audit Library [PyAudit] API. The PDF version can be downloaded from [HERE](#). **You may download and distribute it. Please be aware, however, that the note contains typos as well as inaccurate or incorrect description.**

The API assumes that the reader has a preliminary knowledge of `python` programing and `Linux`. And this document is generated automatically by using `sphinx`.

1.1.2 About the author

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- **Biography**

Wenqiang Feng is Data Scientist within DST’s Applied Analytics Group. Dr. Feng’s responsibilities include providing DST clients with access to cutting-edge skills and technologies, including Big Data analytic solutions, advanced analytic and data enhancement techniques and modeling.

Dr. Feng has deep analytic expertise in data mining, analytic systems, machine learning algorithms, business intelligence, and applying Big Data tools to strategically solve industry problems in a cross-functional business. Before joining DST, Dr. Feng was an IMA Data Science Fellow at The Institute for Mathematics and its Applications (IMA) at the University of Minnesota. While there, he helped startup companies make marketing decisions based on deep predictive analytics.

Dr. Feng graduated from University of Tennessee, Knoxville, with Ph.D. in Computational Mathematics and Master’s degree in Statistics. He also holds Master’s degree in Computational Mathematics from Missouri University of Science and Technology (MST) and Master’s degree in Applied Mathematics from the University of Science and Technology of China (USTC).

- **Declaration**

The work of Wenqiang Feng was supported by the IMA, while working at IMA. However, any opinion, finding, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the IMA, UTK and DST.

1.2 Feedback and suggestions

Your comments and suggestions are highly appreciated. I am more than happy to receive corrections, suggestions or feedbacks through email (Wenqiang Feng: von198@gmail.com and Ming Chen: ming.chen0919@gmail.com) for improvements.

HOW TO INSTALL

2.1 Install with `pip`

You can install the `PyAudit` from [PyPI](<https://pypi.org/project/PyAudit>):

```
pip install PyAudit
```

2.2 Install from Repo

2.2.1 Clone the Repository

```
git clone https://github.com/runawayhorse001/PyAudit.git
```

2.2.2 Install

```
cd PyAudit
pip install -r requirements.txt
python setup.py install
```

2.2.3 Uninstall

```
pip uninstall statspy
```

2.2.4 Test

```
cd PyAudit/test
python test.py
```

test.py

```
from PyAudit.basics import missing_rate, zero_rate, dtypes_class
from PyAudit.basics import feature_variance, freq_items_df, feature_len
from PyAudit.basics import corr_matrix, numeric_summary, category_
    ↳summary
import pandas as pd
import os, sys

output = os.path.abspath(os.path.join(sys.path[0])) + '/output'
print(output)
d = {'A': [1, 0, None, 3],
     'B': [1, 0, 0, 0],
     'C': ['a', None, 'c', 'd']}

# create DataFrame
df = pd.DataFrame(d)
print(missing_rate(df))
print(zero_rate(df))
print(feature_variance(df))
print(df)
print(feature_len(df))
print(numeric_summary(df, output))
print(category_summary(df, output))
print(corr_matrix(df, output))

d = {
    'num': list('1223334444'),
    'cat': list('wxyyyzzzz')
}
df = pd.DataFrame(d)
df = df.astype({"num": int, "cat": object})
print(freq_items_df(df, top_n=4))

# read df
df = pd.read_csv('Heart.csv', dtype={'Sex': bool})
print(df.head(5))
(num_fields, cat_fields, bool_fields, data_types, type_class) = dtypes_
    ↳class(df)
```

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```

print(num_fields)
print(cat_fields)
print(bool_fields)
print(data_types)
print(type_class)
print(missing_rate(df))
print(zero_rate(df))

print(freq_items_df(df, top_n=4))
print(feature_len(df))
print(numeric_summary(df, output))
print(category_summary(df, output))
print(corr_matrix(df, output))

```

Results:

```

feature  missing_rate
0      A      0.25
1      B      0.00
2      C      0.25
feature  zero_rate
0      A  0.333333
1      B  0.750000
2      C  0.000000
feature  feature_variance
0      A      1.0
1      B      0.5
2      C      1.0
  Age    Sex  ChestPain  RestBP  Chol  ...  Oldpeak  Slope  Ca
→  Thal  AHD
0   63   True   typical    145   233  ...    2.3     3  0.0
→  fixed   No
1   67   True  asymptomatic    160   286  ...    1.5     2  3.0
→  normal Yes
2   67   True  asymptomatic    120   229  ...    2.6     2  2.0
→reversible Yes
3   37   True   nonanginal    130   250  ...    3.5     3  0.0
→  normal   No
4   41  False  nontypical    130   204  ...    1.4     1  0.0
→  normal   No

[5 rows x 14 columns]
['Age', 'RestBP', 'Chol', 'Fbs', 'RestECG', 'MaxHR', 'ExAng', 'Oldpeak
→', 'Slope', 'Ca']
['ChestPain', 'Thal', 'AHD']

```

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```

['Sex']
      feature  dtypes
0      Age    int64
1      Sex     bool
2  ChestPain  object
3      RestBP  int64
4      Chol   int64
5      Fbs    int64
6  RestECG   int64
7      MaxHR  int64
8      ExAng  int64
9      Oldpeak float64
10     Slope   int64
11      Ca    float64
12     Thal   object
13     AHD    object

      feature  dtypes  class
0      Age    int64  numeric
1      Sex     bool   bool
2  ChestPain  object  category
3      RestBP  int64  numeric
4      Chol   int64  numeric
5      Fbs    int64  numeric
6  RestECG   int64  numeric
7      MaxHR  int64  numeric
8      ExAng  int64  numeric
9      Oldpeak float64  numeric
10     Slope   int64  numeric
11      Ca    float64  numeric
12     Thal   object  category
13     AHD    object  category

      feature  missing_rate
0      Age    0.000000
1      Sex    0.000000
2  ChestPain  0.000000
3      RestBP  0.000000
4      Chol   0.000000
5      Fbs    0.000000
6  RestECG   0.000000
7      MaxHR  0.000000
8      ExAng  0.000000
9      Oldpeak 0.000000
10     Slope   0.000000
11      Ca    0.013201
12     Thal   0.006601

```

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13	AHD	0.000000
----	-----	----------

Process finished with <code>exit</code> code 0
--

PYTHON DATA AUDIT FUNCTIONS

3.1 Basic Functions

3.1.1 dtypes_class

`PyAudit.basics.dtypes_class(df_in)`
numerical, categorical and bool name list in the DataFrame

Parameters `df_in` – input pandas DataFrame

Returns numerical, categorical and bool name list

Author Wenqiang Feng and Ming Chen

Email von198@gmail.com

```
>>> from PyAudit.basics import dtypes_class
>>> df = pd.read_csv('Heart.csv', dtype={'Sex': bool})
>>> (num_fields, cat_fields, bool_fields, data_types, type_class),
    => dtypes_class(df)
>>> num_fields
['Age', 'RestBP', 'Chol', 'Fbs', 'RestECG', 'MaxHR', 'ExAng',
 => 'Oldpeak', 'Slope', 'Ca']
```

3.1.2 missing_rate

`PyAudit.basics.missing_rate(df_in)`
calculate missing rate for each feature in the DataFrame

Parameters `df_in` – input pandas DataFrame

Returns missing rate

Author Wenqiang Feng and Ming Chen

Email von198@gmail.com

```
>>> import pandas as pd
>>> d = {'A': [1, 0, None, 3],
        'B': [1, 0, 0, 0],
        'C': ['a', None, 'c', 'd']}
>>> # create DataFrame
>>> df = pd.DataFrame(d)
>>> from PyAudit.basics import missing_rate
>>> missing_rate(df)
      feature  missing_rate
0          A           0.25
1          B           0.00
2          C           0.25
```

3.1.3 zero_rate

`PyAudit.basics.zero_rate(df_in)`

calculate the percentage of 0 value for each feature in the DataFrame

Parameters `df_in` – input pandas DataFrame

Returns zero rate

Author Wenqiang Feng and Ming Chen

Email von198@gmail.com

```
>>> import pandas as pd
>>> d = {'A': [1, 0, None, 3],
        'B': [1, 0, 0, 0],
        'C': ['a', None, 'c', 'd']}
>>> # create DataFrame
>>> df = pd.DataFrame(d)
>>> from PyAudit.basics import zero_rate
>>> zero_rate(df)
      feature  zero_rate
0          A   0.333333
1          B   0.750000
2          C   0.000000
```

3.1.4 feature_variance

`PyAudit.basics.feature_variance(df_in)`

calculate the variance for each feature

Parameters `df_in` – input pandas DataFrame

Returns feature variance

Author Wenqiang Feng and Ming Chen

Email von198@gmail.com

```
>>> import pandas as pd
>>> d = {'A': [1, 0, None, 3],
        'B': [1, 0, 0, 0],
        'C': ['a', None, 'c', 'd']}
>>> # create DataFrame
>>> df = pd.DataFrame(d)
>>> from PyAudit.basics import zero_rate
>>> zero_rate(df)
      feature  feature_variance
0          A                1.0
1          B                0.5
2          C                1.0
```

3.1.5 freq_items_df

`PyAudit.basics.freq_items_df(df_in, top_n=3)`

find out the top n values and the corresponding frequency for each feature

Parameters

- **df_in** – input pandas DataFrame
- **top_n** – the number of the top values

Returns top n values and the corresponding frequency for each feature

Author Wenqiang Feng and Ming Chen

Email von198@gmail.com

```
>>> d = {
>>>     'num': list('1223334444'),
>>>     'cat': list('wxyyyzzzz')
>>> }
>>> df = pd.DataFrame(d)
>>> df = df.astype({"num": int, "cat": object})
>>> print(freq_items_df(df, top_n=4))
      feature  top_items  top_freqs
0        num  [4, 3, 2, 1]  [4, 3, 2, 1]
1        cat  [z, y, x, w]  [4, 3, 2, 1]
```

3.1.6 feature_len

`PyAudit.basics.feature_len(df_in)`

find out the min and max length of values for each feature

Parameters `df_in` – input pandas DataFrame

Returns min and max length DataFrame

Author Wenqiang Feng and Ming Chen

Email von198@gmail.com

```
>>> d = {'A': [1, 0, None, 3],
>>>        'B': [1, 0, 0, 0],
>>>        'C': ['a', None, 'c', 'd']}
>>> # create DataFrame
>>> df = pd.DataFrame(d)
>>> print(df)
   A  B  C
0  1  1  a
1  0  0 None
2 NaN 0  c
3  3  0  d
>>> print(feature_len(df))
  feature  min_length  max_length
0        A           3           3
1        B           1           1
2        C           1           4
```

3.1.7 correlation matrix

`PyAudit.basics.corr_matrix(df_in, output_dir)`

generate correlation matrix for numerical dataframe

Parameters

- `df_in` – input pandas DataFrame
- `output_dir` – output path

Returns correlation matrix

Author Wenqiang Feng and Ming Chen

Email von198@gmail.com

```
>>> d = {'A': [1, 0, None, 3],
>>>        'B': [1, 0, 0, 0],
```

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```

>>> 'C': ['a', None, 'c', 'd']}
>>> # create DataFrame
>>> df = pd.DataFrame(d)
>>> print(corr_matrix(df))
           A          B
A  1.000000 -0.188982
B -0.188982  1.000000

```

3.2 Summary Functions

3.2.1 numeric_summary

`PyAudit.basics.numeric_summary(df_in, output_dir, top_n=4, deciles=False)`
generate statistical summary for numerical DataFrame

Parameters

- **df_in** – input pandas DataFrame
- **deciles** – flag for percentiles style

Returns statistical summary for numerical data

Author Wenqiang Feng and Ming Chen

Email von198@gmail.com

```

>>> d = {'A': [1, 0, None, 3],
>>>       'B': [1, 0, 0, 0],
>>>       'C': ['a', None, 'c', 'd']}
>>> # create DataFrame
>>> df = pd.DataFrame(d)
>>> print(numeric_summary(df))
  feature data_type  min_digits  ...  zero_rate  pos_rate  neg_
↪ rate
  A      A    float64          3  ...    0.333333  0.666667  ↪
↪ 0.0
  B      B    int64          3  ...    0.750000  0.250000  ↪
↪ 0.0

```

3.2.2 category_summary

`PyAudit.basics.category_summary(df_in, output_dir, top_n=4, deciles=False)`
generate statistical summary for numerical DataFrame

Parameters

- **df_in** – input pandas DataFrame
- **deciles** – flag for percentiles style

Returns statistical summary for numerical data

Author Wenqiang Feng and Ming Chen

Email von198@gmail.com

```
>>> d = {'A': [1, 0, None, 3],
>>>        'B': [1, 0, 0, 0],
>>>        'C': ['a', None, 'c', 'd']}
>>> # create DataFrame
>>> df = pd.DataFrame(d)
>>> print(numeric_summary(df))
   feature data_type  min_digits  ...  top_values  top_freqs  _
->missing_rate
   C      C      object          1  ...   [a, d, c]  [1, 1, 1]  _
->      0.25
```

AUDITING DEMOS

This is a demo to show how to audit `pd.DataFrame` using `PyAudit`:

For example:

```
#import python libraries
import os
import sys
import pandas as pd

# import PyAudit module
from PyAudit.basics import corr_matrix, numeric_summary, category_
    ↳summary

# Audit output path
output = os.path.abspath(os.path.join(sys.path[0])) + '/output'

# load DataFrame
df = pd.read_csv('Heart.csv', dtype={'Sex': bool})
print(df.head(5))

# generate the audit results (.csv files in output folder)
numeric_summary(df, output)
category_summary(df, output)
corr_matrix(df, output)
```

Result:

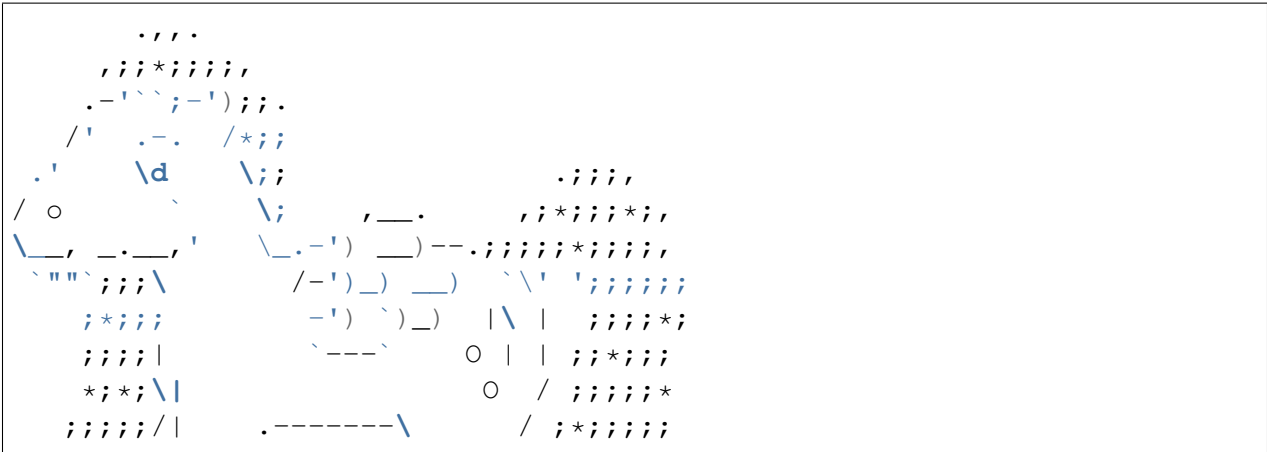
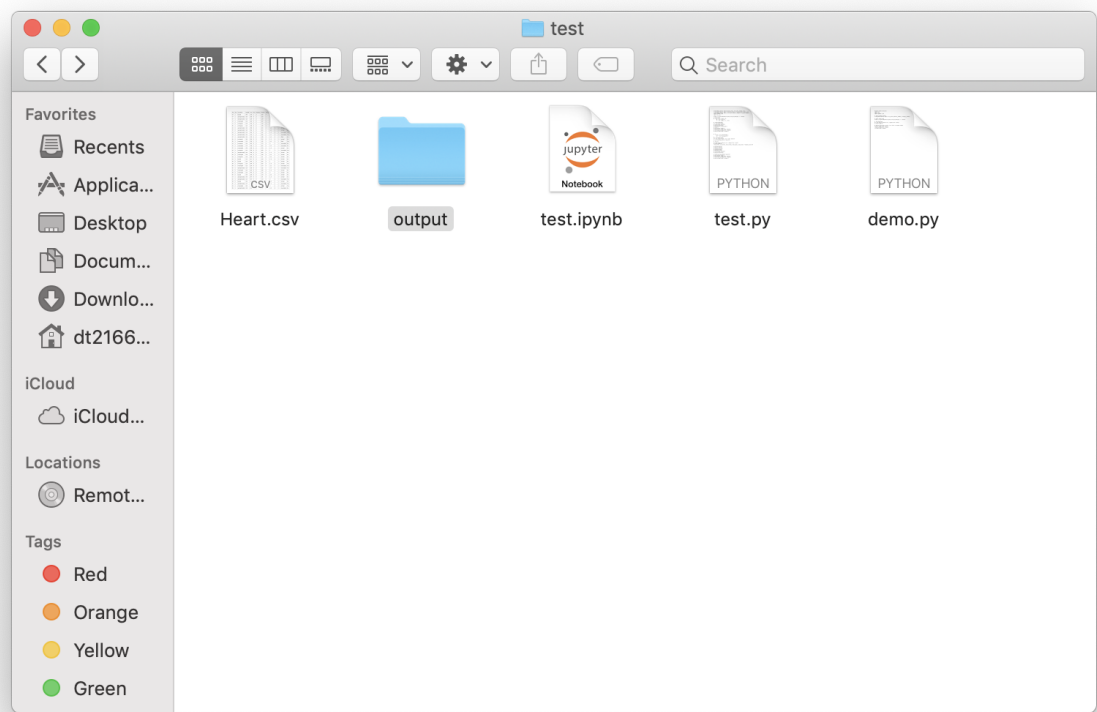
	Age	Sex	ChestPain	RestBP	Chol	...	Oldpeak	Slope	Ca	↳
↳	Thal	AHD								
0	63	True	typical	145	233	...	2.3	3	0.0	↳
↳	fixed	No								
1	67	True	asymptomatic	160	286	...	1.5	2	3.0	↳
↳	normal	Yes								
2	67	True	asymptomatic	120	229	...	2.6	2	2.0	↳
↳	reversable	Yes								

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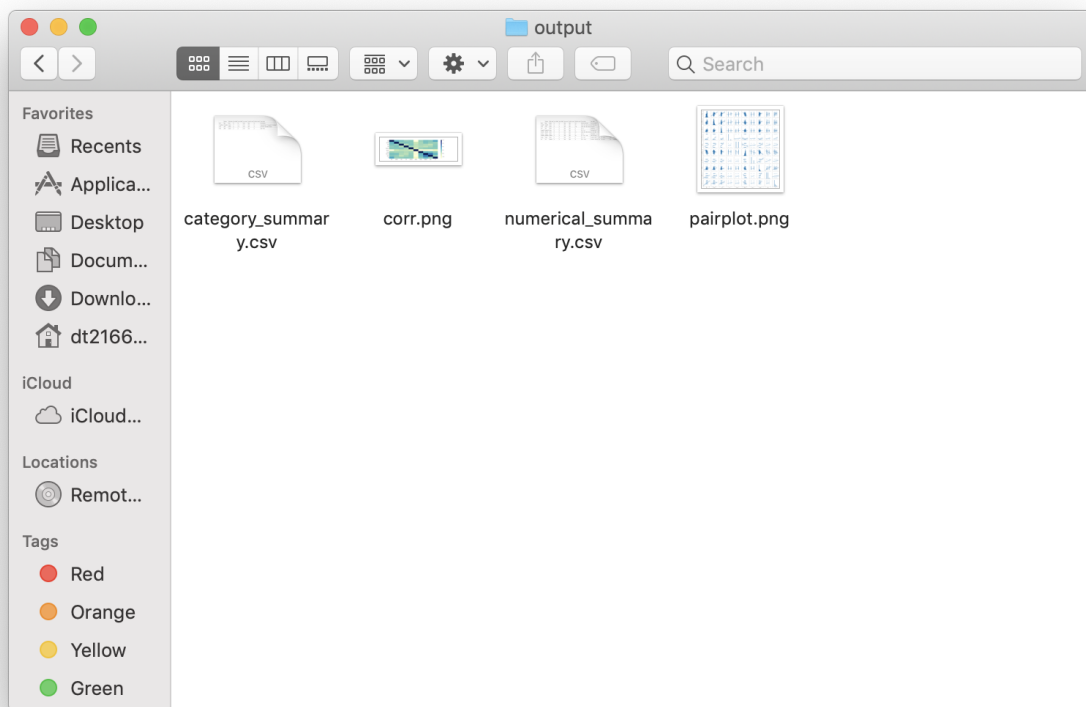
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3	37	True	nonangular	130	250	...	3.5	3	0.0	⌵
↪	normal	No								
4	41	False	nontypical	130	204	...	1.4	1	0.0	⌵
↪	normal	No								

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MAIN REFERENCE

BIBLIOGRAPHY

[PyAudit] Wenqiang Feng and Ming Chen. [Python Data Audit Library API](#), 2019.

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