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# Python Data Audit



## **PyAudit: Python Data Audit Library API**

**Wenqiang Feng and Ming Chen**

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# Python Data Audit



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



## PREFACE

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### Chinese proverb

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

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## 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](mailto:von198@gmail.com) and Ming Chen: [ming.chen0919@gmail.com](mailto:ming.chen0919@gmail.com)) for improvements.



## HOW TO INSTALL

### 2.1 Clone the Repository

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

### 2.2 Install

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

### 2.3 Uninstall

```
pip uninstall statspy
```

### 2.4 Test

```
cd PyAudit/test
python test1.py
```

test1.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
```

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```

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)

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))

```

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```
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
→reversable 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']
['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
```

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```

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
13     AHD        0.000000

```

Process finished with `exit` 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

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```
>>> 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

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```
>>> 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

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```
>>> 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

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```
>>> 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

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```
>>> 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
```

## 3.2 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

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```

>>> 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](mailto: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							



## DEMOS

This is a usage of `PyAudit.basics.dtypes_class()`:

For example:

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

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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

This is a usage of `PyAudit.basics.feature_variance()`:

For example:

```

    . . . .
    . . . * . . . .
    . - ' ' ' ; - ' ) ; ; .
    / ' . . . / * ; ;
    . ' \d \; ;
/ o \ \; ; , _ . . . . .
\ _ , _ . _ , ' \ _ . - ' ) _ ) -- . ; ; ; ; * ; ; ; ;
' " " ; ; ; \ / - ' ) _ ) \ ' ' ; ; ; ; ;
; * ; ; ; - ' ) ' ) _ ) | \ | ; ; ; * ;
; ; ; ; | \ _ _ _ _ \ o | | ; ; * ; ;
* ; * ; \ | o / ; ; ; ; *
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' " " " " \ ' " " " " ; '

```

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CHAPTER

**FIVE**

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**MAIN REFERENCE**



## BIBLIOGRAPHY

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





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