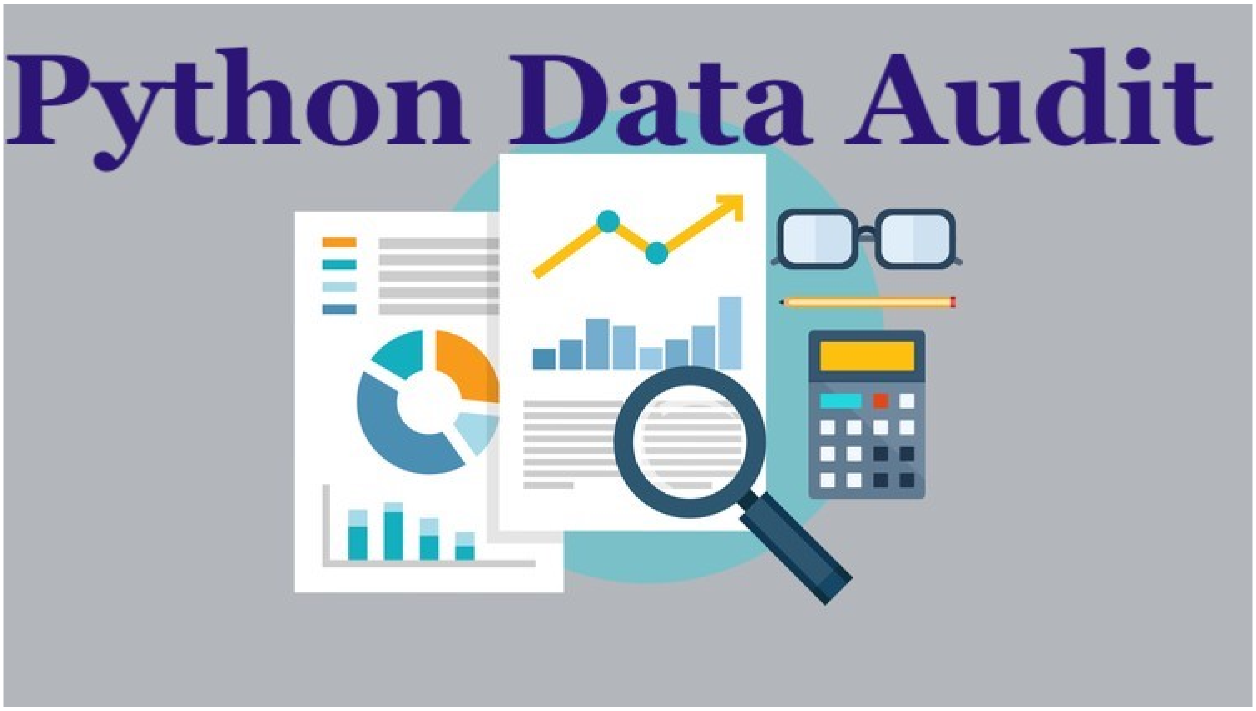

PyAudit: Python Data Audit Library API

Wenqiang Feng and Ming Chen

April 30, 2019

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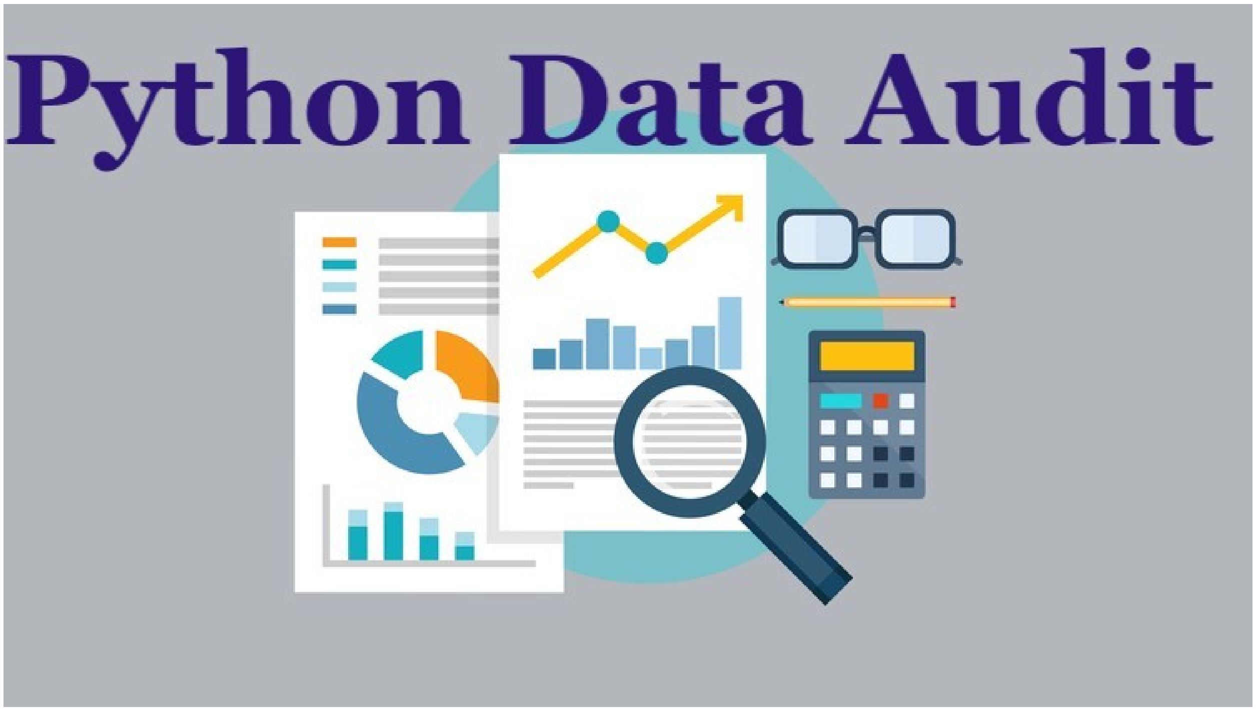

Welcome to our **PyAudit: Python Data Audit Library API**! The PDF version can be downloaded from HERE.

CHAPTER

ONE

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.

CHAPTER TWO

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('wxxyyyzzzz')
}
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
```

CHAPTER THREE

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

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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

Author Wenqiang Feng and Ming Chen

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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

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('wxxyyyzzzz')
>>>    }
>>> 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  1.0  1     a
    1  0.0  0  None
    2  NaN  0     c
    3  3.0  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 DateFrame

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 DateFrame

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
```

CHAPTER FOUR

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  / ;;;;;*
   ;;;;;/|    .-------\      / ;*;;;;;
  ;;;*;/ \    |        '.   (`. ;;;*;;;
  ;;;;;'. ;   |          )   \ | ;;;;;;
  ,;*;;;;\/   |.        /   /` | ';;;*;
   ;;;;;;/    |/       /   /__/   ';;;
   '*wf*/     |       /    |      ;*;
        `""""`        `""""`     ;'
```

CHAPTER

FIVE

MAIN REFERENCE

BIBLIOGRAPHY

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

PYTHON MODULE INDEX

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