Pandas_2

Data analysis with Pandas

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2024-02-16

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Series

```
import pandas as pd

import numpy as np

from pandas import Series, DataFrame
```

```
obj = pd.Series([4,2, 312, -3])

obj
```

```
0      4
1      2
2    312
3     -3
dtype: int64
```

```
obj2 = pd.Series([4,2, 312, -3], index = ['a', 'b', 'c', 'd'])

obj2
```

```
a      4
b      2
c    312
d     -3
dtype: int64
```

```
obj2.index
```

```
Index(['a', 'b', 'c', 'd'], dtype='object')
```

```
obj2[obj2 > 0]
```

```
a      4
b      2
c    312
dtype: int64
```

```
np.exp(obj2)
```

```
a     5.459815e+01
b     7.389056e+00
c    3.161392e+135
d     4.978707e-02
dtype: float64
```

```
'b' in obj2
```

```
True
```

```
'e' in obj2
```

```
False
```

```
sdata = {'ohio': 232, 'Texas': 332, 'Oregon': 34343}

obj3 = pd.Series(sdata)

obj3
```

```
ohio        232
Texas       332
Oregon    34343
dtype: int64
```

```
obj3.to_dict()
```

```
{'ohio': 232, 'Texas': 332, 'Oregon': 34343}
```

```
states = ['California', 'ohio', 'orgeon']

obj4 = pd.Series(sdata, index = states)

obj4
```

```
California      NaN
ohio          232.0
orgeon          NaN
dtype: float64
```

```
pd.isna(obj4) # is null
```

```
California     True
ohio          False
orgeon         True
dtype: bool
```

```
pd.notna(obj4)  #not null
```

```
California    False
ohio           True
orgeon        False
dtype: bool
```

```
obj3 + obj4
```

```
California      NaN
Oregon          NaN
Texas           NaN
ohio          464.0
orgeon          NaN
dtype: float64
```

```
obj4.name = 'population'

obj4.index.name = 'state'

obj4
```

```
state
California      NaN
ohio          232.0
orgeon          NaN
Name: population, dtype: float64
```

```
obj
```

```
0      4
1      2
2    312
3     -3
dtype: int64
```

```
# altering the index in place

obj.index = ['Kunal', 'Rahul', 'Raghav', 'Ryan']
```

```
obj
```

```
Kunal       4
Rahul       2
Raghav    312
Ryan       -3
dtype: int64
```

DataFrame

```
data = {'state': ['ohio', 'ohio', 'nevada',],
        'year': [2000, 2001, 2002,],
        'pop': [1.2, 1.3, 1.4,]}

frame = pd.DataFrame(data)
```

```
frame
```

	state	year	pop
0	ohio	2000	1.2
1	ohio	2001	1.3
2	nevada	2002	1.4

```
frame.head()
```

	state	year	pop
0	ohio	2000	1.2
1	ohio	2001	1.3
2	nevada	2002	1.4

```
frame.tail()
```

	state	year	pop
0	ohio	2000	1.2
1	ohio	2001	1.3
2	nevada	2002	1.4

```
# passing another column in the dataframe

frame2 = pd.DataFrame(data, columns = ['state', 'year', 'pop', 'debt'])

frame2
```

	state	year	pop	debt
0	ohio	2000	1.2	NaN
1	ohio	2001	1.3	NaN
2	nevada	2002	1.4	NaN

```
# changing the order of columns


frame2 = pd.DataFrame(data, columns = [ 'year', 'pop', 'debt', 'state'])
```

```
frame2
```

	state	year	pop	debt
0	ohio	2000	1.2	NaN
1	ohio	2001	1.3	NaN
2	nevada	2002	1.4	NaN

```
frame2.year
```

```
0    2000
1    2001
2    2002
Name: year, dtype: int64
```

```
frame2.loc[1]
```

```
year     2001
pop       1.3
debt      NaN
state    ohio
Name: 1, dtype: object
```

```
frame2.iloc[2]
```

```
year       2002
pop         1.4
debt        NaN
state    nevada
Name: 2, dtype: object
```

```
frame2.pop
```

```
<bound method DataFrame.pop of    year  pop debt   state
0  2000  1.2  NaN    ohio
1  2001  1.3  NaN    ohio
2  2002  1.4  NaN  nevada>
```

```
frame2.year
```

```
0    2000
1    2001
2    2002
Name: year, dtype: int64
```

```
# assigning values

frame2['debt'] = 14.5

frame2
```

	year	pop	debt	state
0	2000	1.2	14.5	ohio
1	2001	1.3	14.5	ohio
2	2002	1.4	14.5	nevada

```
# assiging a new column (resuls in new column if it does not exist before)

frame2['eastern'] = frame2['state']  =='ohio'

frame2
```

	year	pop	debt	state	eastern
0	2000	1.2	14.5	ohio	True
1	2001	1.3	14.5	ohio	True
2	2002	1.4	14.5	nevada	False

```
# transposing
frame2.T
```

	0	1	2
year	2000	2001	2002
pop	1.2	1.3	1.4
debt	14.5	14.5	14.5
state	ohio	ohio	nevada
eastern	True	True	False

```
pd.DataFrame(data)
```

	state	year	pop
0	ohio	2000	1.2
1	ohio	2001	1.3
2	nevada	2002	1.4

```
frame2.index.name = 'year'
```

```
frame2.columns.name = 'state'  # starts with state column
```

```
frame2
```

state year	year	pop	debt	state	eastern
0	2000	1.2	14.5	ohio	True
1	2001	1.3	14.5	ohio	True
2	2002	1.4	14.5	nevada	False

```
frame2.to_numpy()
```

```
array([[2000, 1.2, 14.5, 'ohio', True],
       [2001, 1.3, 14.5, 'ohio', True],
       [2002, 1.4, 14.5, 'nevada', False]], dtype=object)
```

index objects

```
obj4 = pd.Series(np.arange(3), index = ['a', 'b', 'c'])
```

```
index = obj4.index
```

```
index
```

```
Index(['a', 'b', 'c'], dtype='object')
```

```
index [1:]
```

```
Index(['b', 'c'], dtype='object')
```

```
# index objects are immutable
```

```
index[1]= 'd' #type error
```

```
labels = pd.Index(np.arange(3))

labels
```

```
Index([0, 1, 2], dtype='int32')
```

```
obj2 = pd.Series([1.5, -2.5, 0], index = labels)


obj2
```

```
0    1.5
1   -2.5
2    0.0
dtype: float64
```

```
obj2.index is labels
```

```
True
```

```
frame2
```

state year	year	pop	debt	state	eastern
0	2000	1.2	14.5	ohio	True
1	2001	1.3	14.5	ohio	True
2	2002	1.4	14.5	nevada	False

```
frame2.columns
```

```
Index(['year', 'pop', 'debt', 'state', 'eastern'], dtype='object', name='state')
```

```
2003 in frame2.index
```

```
False
```

```
# unlike python, a pandas index can contain duplicate labels

pd.Index (['foo', 'boo', 'bar', 'baa', 'etc', 'foo'])
```

```
Index(['foo', 'boo', 'bar', 'baa', 'etc', 'foo'], dtype='object')
```

Reindexing

```
obj = pd.Series([4.5,48, -3,2,3.9], index= ['a', 'b', 'c', 'd', 'e'])

obj
```

```
a     4.5
b    48.0
c    -3.0
d     2.0
e     3.9
dtype: float64
```

```
# reindexing
obj2 = obj.reindex(['b', 'a', 'c', 'd', 'e'])

obj2
```

```
b    48.0
a     4.5
c    -3.0
d     2.0
e     3.9
dtype: float64
```

```
# time series data fill
obj3 = pd.Series(['blue', 'purple', 'yellow'], index = [0, 2, 4])
```

```
obj3
```

```
0      blue
2    purple
4    yellow
dtype: object
```

```
# forward filling the values using ffill
obj3.reindex(np.arange(6), method='ffill')
```

```
0      blue
1      blue
2    purple
3    purple
4    yellow
5    yellow
dtype: object
```

```
# backward fill
obj3.reindex(np.arange(6), method = 'bfill')
```

```
0      blue
1    purple
2    purple
3    yellow
4    yellow
5       NaN
dtype: object
```

```
frame = pd.DataFrame(np.arange(9).reshape((3, 3)),
                     index = ['a', 'b', 'c'],
                     columns= ['ohio', 'texas', 'burmingham'])

frame
```

	ohio	texas	burmingham
a	0	1	2
b	3	4	5
c	6	7	8

```
frame2 = frame.reindex(index=['a', 'b', 'c', 'd'])

frame2
```

	ohio	texas	burmingham
a	0.0	1.0	2.0
b	3.0	4.0	5.0
c	6.0	7.0	8.0
d	NaN	NaN	NaN

```
# reindexing columns with column keyword

states = ['london', 'texus', 'surrey']

frame.reindex(columns = states)
```

	london	texus	surrey
a	NaN	NaN	NaN
b	NaN	NaN	NaN
c	NaN	NaN	NaN

Dropping entries from Axis

```
obj = pd.Series(np.arange(5.), index = ['a', 'b', 'c', 'd', 'e'])

obj
```

```
a    0.0
b    1.0
```

```
c    2.0
d    3.0
e    4.0
dtype: float64
```

```
new_obj = obj.drop('c')
new_obj
```

```
a    0.0
b    1.0
d    3.0
e    4.0
dtype: float64
```

```
obj.drop(['d', 'e'])
```

```
a    0.0
b    1.0
c    2.0
dtype: float64
```

```
# in DataFrame
data = pd.DataFrame(np.arange(16).reshape((4,4)),
                    index=['québec', 'montréal', 'toronto', 'sainte-anne'],
                    columns = ['one', 'two', 'three', 'four'])
data
```

	one	two	three	four
québec	0	1	2	3
montréal	4	5	6	7
toronto	8	9	10	11
sainte-anne	12	13	14	15

```
# using drop method
data.drop(index=['toronto', 'sainte-anne'])
```

	one	two	three	four
québec	0	1	2	3
montréal	4	5	6	7

```
# dropping using axis method (axis = 1 = columns)

data.drop('two', axis=1)
```

	one	three	four
québec	0	2	3
montréal	4	6	7
toronto	8	10	11
sainte-anne	12	14	15

```
data.drop(['three', 'four'], axis='columns')
```

	one	two
québec	0	1
montréal	4	5
toronto	8	9
sainte-anne	12	13

Indexing, Selecting, and Filtering

```
obj = pd.Series(np.arange(4.), index= ['a', 'b', 'c', 'd'])

obj
```

```
a    0.0
b    1.0
c    2.0
d    3.0
dtype: float64
```

```
obj['b']
```

```
1.0
```

```
obj[1]
```

```
1.0
```

```
obj[2:4]
```

```
c    2.0
d    3.0
dtype: float64
```

```
obj[obj<2]
```

```
a    0.0
b    1.0
dtype: float64
```

```
obj.loc[['b', 'c']]
```

```
b    1.0
c    2.0
dtype: float64
```

```
obj1 = pd.Series([1,2,3], index = [2,0,1])

obj2 = pd.Series([1,2,3], index = ['a', 'b', 'c'])

obj1
```

```
2    1
0    2
1    3
dtype: int64
```

```
obj2
```

```
a    1
b    2
c    3
dtype: int64
```

```
# loc fails as index doesnot contain integers
obj2.loc[[0, 1]]
```

```
# fix this

obj2.loc['b':'c']
```

```
b    2
c    3
dtype: int64
```

```
# so, prefer using iloc with integers

obj1.iloc[[0,1,2]]
```

```
2    1
0    2
1    3
dtype: int64
```

```
obj2.iloc[[0,1,2]]
```

```
a    1
b    2
c    3
dtype: int64
```

```
# assigning values

obj2.loc['b':'c'] = 5

obj2
```

```
a    1
b    5
c    5
dtype: int64
```

```
data
```

	one	two	three	four
québec	0	1	2	3
montréal	4	5	6	7
toronto	8	9	10	11
sainte-anne	12	13	14	15

```
data[:2]
```

	one	two	three	four
québec	0	1	2	3
montréal	4	5	6	7

```
# booleans
data < 5
```

	one	two	three	four
québec	True	True	True	True
montréal	True	False	False	False
toronto	False	False	False	False
sainte-anne	False	False	False	False

```
# assigning values
data[data < 5] = 0

data
```

	one	two	three	four
québec	0	0	0	0
montréal	0	5	6	7
toronto	8	9	10	11
sainte-anne	12	13	14	15

selection of DataFrame with loc and iloc

```
data
```

	one	two	three	four
québec	0	0	0	0
montréal	0	5	6	7
toronto	8	9	10	11
sainte-anne	12	13	14	15

```
data.loc['montréal']
```

```
one      0
two      5
three    6
four     7
Name: montréal, dtype: int32
```

```
data.loc[['montréal', 'québec']]
```

	one	two	three	four
montréal	0	5	6	7

	one	two	three	four
québec	0	0	0	0

```
data.loc['montréal', ['two', 'three']]
```

```
two      5
three    6
Name: montréal, dtype: int32
```

```
# similar operations with iloc
data.iloc[2]
```

```
one       8
two       9
three    10
four     11
Name: toronto, dtype: int32
```

```
data.iloc[[2,1]]  #third row and second row
```

	one	two	three	four
toronto	8	9	10	11
montréal	0	5	6	7

```
data.iloc[2,[3,0,1]] #third row (three elements in order)
```

```
four    11
one      8
two      9
Name: toronto, dtype: int32
```

```
data.iloc[[1,2],[3,0,1]]
```

	four	one	two
montréal	7	0	5
toronto	11	8	9

integer indexing pitfalls

```
series = pd.Series(np.arange(3.))
```

```
series
```

```
0    0.0
1    1.0
2    2.0
dtype: float64
```

```
# fails here but works fine with iloc and loc
series[-1]
```

```
# value error; key error: -1
```

```
series.iloc[-1]
```

```
2.0
```

```
# non-integer doesnot do this ambiguity

series2 = pd.Series(np.arange(3.0), index = ['a', 'b', 'c'])
```

```
series2[-1]
```

```
2.0
```

Pitfalls with chained indexing

```
data.loc[:, 'one'] = 1

data
```

	one	two	three	four
québec	1	0	0	0
montréal	1	5	6	7
toronto	1	9	10	11
sainte-anne	1	13	14	15

```
data.iloc[2] = 5
```

```
data
```

	one	two	three	four
québec	1	0	0	0
montréal	1	5	6	7
toronto	5	5	5	5
sainte-anne	1	13	14	15

```
data.loc[data['four'] > 5]  = 3

data
```

	one	two	three	four
québec	1	0	0	0
montréal	3	3	3	3
toronto	5	5	5	5
sainte-anne	3	3	3	3

```
# the data gets modified, but it is not the way that was asked for

# fixing it with loc operation
```

```
data.loc[data.three == 10, "three"] = 9

data
```

	one	two	three	four
québec	1	0	0	0
montréal	3	3	3	3
toronto	5	5	5	5
sainte-anne	3	3	3	3

Arithmetic and Data Alignment

```
s1 = pd.Series([7.3, -2.5, 3.4, 1.5], index = ['a', 'c', 'd', 'e'])

s2 = pd.Series([1.2, -3, -.3, -.33, -43.2], index = ['e', 'j', 'o', 't', 'y'])

s1
```

```
a    7.3
c   -2.5
d    3.4
e    1.5
dtype: float64
```

```
s2
```

```
e     1.20
j    -3.00
o    -0.30
t    -0.33
y   -43.20
dtype: float64
```

```
# adding these- missing values donot overlap

s1+s2
```

```
a    NaN
c    NaN
d    NaN
e    2.7
j    NaN
o    NaN
t    NaN
y    NaN
dtype: float64
```

```
# in case of DataFrame, alignment is performed on both rows and columns

df1 = pd.DataFrame(np.arange(9.).reshape((3,3)),
                   columns = list('abc'),
                   index = ['ferozpur', 'faridkot', 'montréal'])

df2 = pd.DataFrame(np.arange(12.).reshape((4,3)),
                   columns = list('abc'),
                    index = ['faridkot', 'toronto', 'québec', 'montréal'])
```

```
df1
```

	a	b	c
ferozpur	0.0	1.0	2.0
faridkot	3.0	4.0	5.0
montréal	6.0	7.0	8.0

```
df2
```

	a	b	c
faridkot	0.0	1.0	2.0
toronto	3.0	4.0	5.0
québec	6.0	7.0	8.0
montréal	9.0	10.0	11.0

```
df1 + df2  #because the columns were same, it added those numbers
```

	a	b	c
faridkot	3.0	5.0	7.0
ferozpur	NaN	NaN	NaN
montréal	15.0	17.0	19.0
québec	NaN	NaN	NaN
toronto	NaN	NaN	NaN

```
# changing columns names will give all NAN (null values)
df3 = pd.DataFrame(np.arange(12.).reshape((4,3)),
                   columns = list('xyz'),
                    index = ['faridkot', 'toronto', 'québec', 'montréal'])
```

```
df1 + df3
```

	a	b	c	x	y	z
faridkot	NaN	NaN	NaN	NaN	NaN	NaN
ferozpur	NaN	NaN	NaN	NaN	NaN	NaN
montréal	NaN	NaN	NaN	NaN	NaN	NaN
québec	NaN	NaN	NaN	NaN	NaN	NaN
toronto	NaN	NaN	NaN	NaN	NaN	NaN

Arithmetic methods with fill values

```
df2
```

	a	b	c
faridkot	0.0	1.0	2.0
toronto	3.0	4.0	5.0
québec	6.0	7.0	8.0
montréal	9.0	10.0	11.0

```
df2.loc['faridkot', 'y'] = np.nan
```

```
df2
```

	a	b	c	y
faridkot	0.0	1.0	2.0	NaN
toronto	3.0	4.0	5.0	NaN
québec	6.0	7.0	8.0	NaN
montréal	9.0	10.0	11.0	NaN

```
help(pd.DataFrame._drop_axis)
```

```
Help on function _drop_axis in module pandas.core.generic:

_drop_axis(self: 'NDFrameT', labels, axis, level=None, errors: 'IgnoreRaise' = 'raise', only
    Drop labels from specified axis. Used in the ``drop`` method
    internally.

    Parameters
    ----------
    labels : single label or list-like
    axis : int or axis name
    level : int or level name, default None
        For MultiIndex
    errors : {'ignore', 'raise'}, default 'raise'
        If 'ignore', suppress error and existing labels are dropped.
    only_slice : bool, default False
        Whether indexing along columns should be view-only.
```

```
help(pd.DataFrame.drop)
```

```
print(dir(DataFrame))
```

```
['T', '_AXIS_LEN', '_AXIS_ORDERS', '_AXIS_TO_AXIS_NUMBER', '_HANDLED_TYPES', '__abs__', '__a
```

```
help(pd.DataFrame.describe)
```

```
help(pd.DataFrame._drop_axis)
```

```
df4 = df2
```

```
df4
```

	a	b	c	y
faridkot	0.0	1.0	2.0	NaN
toronto	3.0	4.0	5.0	NaN
québec	6.0	7.0	8.0	NaN
montréal	9.0	10.0	11.0	NaN

```
df1 + df4
```

	a	b	c	y
faridkot	3.0	5.0	7.0	NaN
ferozpur	NaN	NaN	NaN	NaN
montréal	15.0	17.0	19.0	NaN
québec	NaN	NaN	NaN	NaN
toronto	NaN	NaN	NaN	NaN

```
df4.fill_value = 0

df4
```

	a	b	c	y
faridkot	0.0	1.0	2.0	NaN
toronto	3.0	4.0	5.0	NaN
québec	6.0	7.0	8.0	NaN
montréal	9.0	10.0	11.0	NaN

```
1/df4
```

	a	b	c	y
faridkot	inf	1.000000	0.500000	NaN
toronto	0.333333	0.250000	0.200000	NaN
québec	0.166667	0.142857	0.125000	NaN
montréal	0.111111	0.100000	0.090909	NaN

```
df4.rdiv(1)
```

	a	b	c	y
faridkot	inf	1.000000	0.500000	NaN
toronto	0.333333	0.250000	0.200000	NaN
québec	0.166667	0.142857	0.125000	NaN
montréal	0.111111	0.100000	0.090909	NaN

```
df4.reindex(columns = df4.columns, fill_value=0) # not working
```

	a	b	c	y
faridkot	0.0	1.0	2.0	NaN
toronto	3.0	4.0	5.0	NaN
québec	6.0	7.0	8.0	NaN
montréal	9.0	10.0	11.0	NaN

Operations between DataFrame and Series

```
arr = np.arange(12.).reshape((3,4))

arr
```

```
array([[ 0.,  1.,  2.,  3.],
       [ 4.,  5.,  6.,  7.],
       [ 8.,  9., 10., 11.]])
```

```
arr[0]
```

```
array([0., 1., 2., 3.])
```

```
# broadcasting

arr - arr[0]   #subtracts from all rows
```

```
array([[0., 0., 0., 0.],
       [4., 4., 4., 4.],
       [8., 8., 8., 8.]])
```

```
frame
```

	ohio	texas	burmingham
a	0	1	2
b	3	4	5
c	6	7	8

```
help(pd.Series)
```

```
series
```

```
series1 = pd.Series(data = np.arange(3), index = ['a', 'b', 'c'])
```

```
series1
```

```
a    0
b    1
c    2
dtype: int32
```

```
frame-series1
```

	a	b	burmingham	c	ohio	texas
a	NaN	NaN	NaN	NaN	NaN	NaN
b	NaN	NaN	NaN	NaN	NaN	NaN
c	NaN	NaN	NaN	NaN	NaN	NaN

```
frame + series2
```

	a	b	burmingham	c	ohio	texas
a	NaN	NaN	NaN	NaN	NaN	NaN

	a	b	burmingham	c	ohio	texas
b	NaN	NaN	NaN	NaN	NaN	NaN
c	NaN	NaN	NaN	NaN	NaN	NaN

Function application and 'mapping'

```
frame2 = pd.DataFrame(np.random.standard_normal((4,3)),
                      columns = list('bde'),
                      index = ['utah', 'faridkot', 'shahkot', 'malsahian'])
frame2
```

	b	d	e
utah	-1.549165	0.443756	1.013167
faridkot	1.130587	-1.289388	-1.210530
shahkot	1.195553	0.274397	0.510043
malsahian	0.713024	-1.223282	1.857681

```
np.abs(frame2)  #converts non-negative values to positive
```

	b	d	e
utah	1.549165	0.443756	1.013167
faridkot	1.130587	1.289388	1.210530
shahkot	1.195553	0.274397	0.510043
malsahian	0.713024	1.223282	1.857681

```
help(np.abs)
```

```
Help on ufunc:

absolute = <ufunc 'absolute'>
    absolute(x, /, out=None, *, where=True, casting='same_kind', order='K', dtype=None, subo

    Calculate the absolute value element-wise.

    ``np.abs`` is a shorthand for this function.
```

```
Parameters
----------
x : array_like
    Input array.
out : ndarray, None, or tuple of ndarray and None, optional
    A location into which the result is stored. If provided, it must have
    a shape that the inputs broadcast to. If not provided or None,
    a freshly-allocated array is returned. A tuple (possible only as a
    keyword argument) must have length equal to the number of outputs.
where : array_like, optional
    This condition is broadcast over the input. At locations where the
    condition is True, the `out` array will be set to the ufunc result.
    Elsewhere, the `out` array will retain its original value.
    Note that if an uninitialized `out` array is created via the default
    ``out=None``, locations within it where the condition is False will
    remain uninitialized.
**kwargs
    For other keyword-only arguments, see the
    :ref:`ufunc docs <ufuncs.kwargs>`.

Returns
-------
absolute : ndarray
    An ndarray containing the absolute value of
    each element in `x`.  For complex input, ``a + ib``, the
    absolute value is :math:`\sqrt{ a^2 + b^2 }`.
    This is a scalar if `x` is a scalar.

Examples
--------
>>> x = np.array([-1.2, 1.2])
>>> np.absolute(x)
array([ 1.2,  1.2])
>>> np.absolute(1.2 + 1j)
1.5620499351813308

Plot the function over ``[-10, 10]``:

>>> import matplotlib.pyplot as plt

>>> x = np.linspace(start=-10, stop=10, num=101)
>>> plt.plot(x, np.absolute(x))
```

```
    >>> plt.show()

    Plot the function over the complex plane:

    >>> xx = x + 1j * x[:, np.newaxis]
    >>> plt.imshow(np.abs(xx), extent=[-10, 10, -10, 10], cmap='gray')
    >>> plt.show()

    The `abs` function can be used as a shorthand for ``np.absolute`` on
    ndarrays.

    >>> x = np.array([-1.2, 1.2])
    >>> abs(x)
    array([1.2, 1.2])
```

```
#DataFrame's apply method

def f1(x):
    return x.max() - x.min()

frame2.apply(f1)
```

```
b    2.744718
d    1.733145
e    3.068212
dtype: float64
```

```
# applying across columns

frame2.apply(f1, axis = 'columns')
```

```
utah         2.562332
faridkot     2.419976
shahkot      0.921156
malsahian    3.080963
dtype: float64
```

```
# modifying the function to return Series with multiple values
```

```
def f2(x):
    return pd.Series([x.min(), x.max()], index= ['min', 'max'])

frame.apply(f2)
```

	ohio	texas	burmingham
min	0	1	2
max	6	7	8

```
frame
```

	ohio	texas	burmingham
a	0	1	2
b	3	4	5
c	6	7	8

```
frame2.apply(f2)
```

	b	d	e
min	-1.549165	-1.289388	-1.210530
max	1.195553	0.443756	1.857681

```
# apply map function

def my_format(x):
    return f"{x:.2f}"

frame2.applymap(my_format)
```

	b	d	e
utah	-1.55	0.44	1.01
faridkot	1.13	-1.29	-1.21
shahkot	1.20	0.27	0.51
malsahian	0.71	-1.22	1.86

```
# applying map function in Series

frame2['e'].map(my_format)
```

```
utah          1.01
faridkot     -1.21
shahkot       0.51
malsahian     1.86
Name: e, dtype: object
```

Sorting and Ranking

```
obj2 = pd.Series(np.arange(4), index = ['d', 'a', 'b', 'c'])

obj2
```

```
d    0
a    1
b    2
c    3
dtype: int32
```

```
obj2.sort_index()
```

```
a    1
b    2
c    3
d    0
dtype: int32
```

```
# sorting in DataFrame can be done with either axis

frame = pd.DataFrame(np.arange(8).reshape((2, 4)),
                     index = ['three', 'one'],
                     columns = ['d', 'a', 'b', 'c'])
```

```
frame
```

	d	a	b	c
three	0	1	2	3
one	4	5	6	7

```
frame.sort_index()
```

	d	a	b	c
one	4	5	6	7
three	0	1	2	3

```
frame.sort_index(axis= 'columns')
```

	a	b	c	d
three	1	2	3	0
one	5	6	7	4

```
# data can be stored in descending order aswell

frame.sort_index(axis = 'columns', ascending = False)
```

	d	c	b	a
three	0	3	2	1
one	4	7	6	5

```
# sorting a series by its values

obj = pd.Series([4, 7, -3, -2])

obj.sort_values()
```

```
2   -3
3   -2
0    4
1    7
dtype: int64
```

```
# missing values get sorted to the end by default

obj = pd.Series([4, 3, 4, np.nan, 33, np.nan, -3, 3])

obj.sort_values()
```

```
6    -3.0
1     3.0
7     3.0
0     4.0
2     4.0
4    33.0
3     NaN
5     NaN
dtype: float64
```

```
# using na_position to bring missing values to the front
obj.sort_values(na_position= 'first')
```

```
3     NaN
5     NaN
6    -3.0
1     3.0
7     3.0
0     4.0
2     4.0
4    33.0
dtype: float64
```

```
# while sorting a DataFrame

frame = pd.DataFrame({'b': [1, 2, 3, 4, 5], 'a':[3, 43, 33, 1, 5]})
```

```
frame
```

	b	a
0	1	3
1	2	43
2	3	33
3	4	1
4	5	5

```
frame.sort_values('a')
```

	b	a
3	4	1
0	1	3
4	5	5
2	3	33
1	2	43

```
# ranking
obj = pd.Series([4, 5, -5, 7, 8, 0, 4])

obj.rank()
```

```
0    3.5
1    5.0
2    1.0
3    6.0
4    7.0
5    2.0
6    3.5
dtype: float64
```

```
# ranking in order the data is observed

obj.rank(method='first')
```

```
0    3.0
1    5.0
2    1.0
3    6.0
4    7.0
5    2.0
6    4.0
dtype: float64
```

```
obj.rank(ascending = False)
```

```
0    4.5
1    3.0
2    7.0
3    2.0
4    1.0
5    6.0
6    4.5
dtype: float64
```

```
# DataFrame for rank computation

frame
```

	b	a
0	1	3
1	2	43
2	3	33
3	4	1
4	5	5

```
frame.rank(axis = 'columns')
```

	b	a
0	1.0	2.0
1	1.0	2.0
2	1.0	2.0

	b	a
3	2.0	1.0
4	1.5	1.5

Axis indices with duplicate labels

```
obj = pd.Series(np.arange(5), index=['a', 'a', 'b','b', 'c' ])

obj
```

```
a    0
a    1
b    2
b    3
c    4
dtype: int32
```

```
obj.index.is_unique
```

```
False
```

```
obj['a']
```

```
a    0
a    1
dtype: int32
```

```
obj['c']
```

```
4
```

```
# DataFrame
df = pd.DataFrame(np.random.standard_normal((5, 3)),
                  index = ['a', 'a', 'b', 'c', 'b'])
```

```
df
```

	0	1	2
a	-1.817751	0.915854	-0.389590
a	0.603020	0.573012	1.070691
b	-0.903033	1.109707	0.874381
c	2.529357	-1.169854	0.676702
b	-0.368763	0.723758	0.375079

```
df.loc['b']
```

	0	1	2
b	-0.903033	1.109707	0.874381
b	-0.368763	0.723758	0.375079

```
df.loc['c']
```

```
0    2.529357
1   -1.169854
2    0.676702
Name: c, dtype: float64
```

Descriptive statistics

```
df.sum()
```

```
0    0.042830
1    2.152477
2    2.607263
dtype: float64
```

```
df.sum(axis = 'columns')
```

```
a   -1.291487
a    2.246723
b    1.081055
c    2.036205
b    0.730074
dtype: float64
```

```
df.describe()
```

	0	1	2
count	5.000000	5.000000	5.000000
mean	0.008566	0.430495	0.521453
std	1.659562	0.917106	0.570471
min	-1.817751	-1.169854	-0.389590
25%	-0.903033	0.573012	0.375079
50%	-0.368763	0.723758	0.676702
75%	0.603020	0.915854	0.874381
max	2.529357	1.109707	1.070691

```
df.cumsum()
```

	0	1	2
a	-1.817751	0.915854	-0.389590
a	-1.214731	1.488866	0.681101
b	-2.117763	2.598573	1.555481
c	0.411594	1.428719	2.232183
b	0.042830	2.152477	2.607263

Unique Values, Value counts, and Membership

```
obj = pd.Series(['c', 'd', 'a', 'b', 'n', 'm', 'g', "k", 'b', 'c', 'k'])

uniques = obj.unique()

uniques
```

```
array(['c', 'd', 'a', 'b', 'n', 'm', 'g', 'k'], dtype=object)
```

```
obj.value_counts()
```

```
c    2
b    2
k    2
d    1
a    1
n    1
m    1
g    1
Name: count, dtype: int64
```

```
pd.value_counts(obj.to_numpy(), sort = False)
```

```
c    2
d    1
a    1
b    2
n    1
m    1
g    1
k    2
Name: count, dtype: int64
```

```
# 'isin' is used for vectorized set memebership

obj
```

```
0    c
1    d
2    a
3    b
4    n
5    m
6    g
7    k
```

```
8     b
9     c
10    k
dtype: object
```

```
mask = obj.isin(['b', 'c'])

mask
```

```
0      True
1     False
2     False
3      True
4     False
5     False
6     False
7     False
8      True
9      True
10    False
dtype: bool
```

```
obj[mask]
```

```
0    c
3    b
8    b
9    c
dtype: object
```

```
to_match = pd.Series(['c', 'a', 'b', 'b', 'c'])

unique_vals = pd.Series(['c', 'b', 'a'])

indices = pd.Index(unique_vals).get_indexer(to_match)

indices
```

```
array([0, 2, 1, 1, 0], dtype=int64)
```

```
data = pd.DataFrame({'ça va': [1, 2, 3, 4, 5],
                     'oui, ça va' : [43,3, 2, 4, 2],
                     'et toi': [3, 2, 44, 1, 5]})

data
```

	ça va	oui, ça va	et toi
0	1	43	3
1	2	3	2
2	3	2	44
3	4	4	1
4	5	2	5

```
# computing value counts
data['ça va'].value_counts().sort_index()
```

```
ça va
1    1
2    1
3    1
4    1
5    1
Name: count, dtype: int64
```

```
data['et toi'].value_counts().sort_index()
```

```
et toi
1     1
2     1
3     1
5     1
44    1
Name: count, dtype: int64
```

```
result = data.apply(pd.value_counts).fillna(0)

result
```

	ça va	oui, ça va	et toi
1	1.0	0.0	1.0
2	1.0	2.0	1.0
3	1.0	1.0	1.0
4	1.0	1.0	0.0
5	1.0	0.0	1.0
43	0.0	1.0	0.0
44	0.0	0.0	1.0