5. DataFrame Analysis

Questions

- What are some common attributes of Pandas `DataFrame`s?
- What are some common methods of Pandas `DataFrame`s?
- How can you do arithmetic between two Pandas columns?

Objectives

- Learn how to access `DataFrame` attributes.
- Learn how to get statistics on a loaded `DataFrame`.
- Learn how to sum two Pandas `DataFrame` columns together.

DataFrame Attributes

- `DataFrame` are python objects
    - They have access to dozens of attributes and methods that can be used to inspect, wrangle or analyze the data.

Attribute	Description
`shape`	Returns a tuple representing the dimensionality of the `DataFrame`.
`size`	Returns an int representing the number of elements in this object.
`dtypes`	Returns the data types in the `DataFrame`.
`columns`	Returns a `Series` of the header names from the `DataFrame`

- See Pandas doc for list of attributes and methods
- In Jupyter (and most other IDEs), you can use `tab` to see which attributes and objects are available on an object
- use `help` function or the `?` character to get more details about a method or attribute

```
In [19]: import pandas as pd
         df = pd.read_csv("data/types_dataframe.csv")
         df.shape

Out[19]: (8, 7)
```

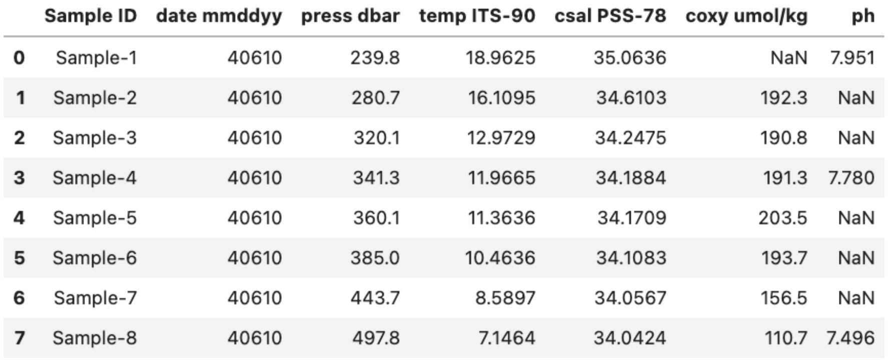
```
In [20]: df.columns
```

```
Out[20]: Index(['Sample ID', 'date mmddyy', 'press dbar', 'temp ITS-90',
         'csal PSS-78',
                'coxy umol/kg', 'ph'],
               dtype='object')
```

Inspecting Data Types

- `DataFrame` types determine methods that can be used on the data
  - You can compute the mean of a numeric value but not an Object column (i.e. words).
  - Common friction point in data analysis (compute average price)

- The `dtypes` attribute is an attribute that provides access to the type of each column
  - Note the column `date mmddyy`



	Sample ID	date mmddyy	press dbar	temp ITS-90	csal PSS-78	coxy umol/kg	ph
0	Sample-1	40610	239.8	18.9625	35.0636	NaN	7.951
1	Sample-2	40610	280.7	16.1095	34.6103	192.3	NaN
2	Sample-3	40610	320.1	12.9729	34.2475	190.8	NaN
3	Sample-4	40610	341.3	11.9665	34.1884	191.3	7.780
4	Sample-5	40610	360.1	11.3636	34.1709	203.5	NaN
5	Sample-6	40610	385.0	10.4636	34.1083	193.7	NaN
6	Sample-7	40610	443.7	8.5897	34.0567	156.5	NaN
7	Sample-8	40610	497.8	7.1464	34.0424	110.7	7.496

In [6]:

```
df.dtypes
```

Out[6]:

```
Sample ID          object
date mmddyy         int64
press dbar        float64
temp ITS-90       float64
csal PSS-78       float64
coxy umol/kg      float64
ph                float64
dtype: object
```

Data Types

- Pandas data types:

Python Type	Equivalent Pandas Type	Description
`string`	`object`	Columns contain partially or completely made up from strings
`int`	`int64`	Columns with numeric (integer) values. The 64 here refers to size of the memory space allocated to this type (precision)
`float`	`float64`	Columns with floating points numbers (numbers with decimal points)
`bool`	`bool`	True/False values
`datetime`	`datetime`	Date and/or time values

Data Types Inference

- Pandas attempts to figure out the column's data type when reading in the data.
    - Type is inferred purely based on the data format.
- Datatypes can be specified when loading the data or after loading the data.
- For Example, we can convert the `date mmddyy` column into a new `Series` with the `datetime` type.
    - use the `to_datetime` function with the data and the date `format` ('%m%d%y' in this case) as inputs.
        - `datetime` uses python date formats

In [7]:

```
pd.to_datetime(df['date mmddyy'], format='%m%d%y')
```

Out[7]:

```
0   2010-04-06
1   2010-04-06
2   2010-04-06
3   2010-04-06
4   2010-04-06
5   2010-04-06
6   2010-04-06
7   2010-04-06
Name: date mmddyy, dtype: datetime64[ns]
```

In [9]:

```python
# Add the data a as new column (same syntax as adding to a collection i
# and remove old column
df["date"] = pd.to_datetime(df['date mmddyy'], format='%m%d%y')
df = df.drop(columns=["date mmddyy"])
df.dtypes
```

Out[9]:

```
Sample ID                  object
press dbar                float64
temp ITS-90               float64
csal PSS-78               float64
coxy umol/kg              float64
ph                        float64
date               datetime64[ns]
dtype: object
```

In [10]:

```
df
```

Out[10]:

	Sample ID	press dbar	temp ITS-90	csal PSS-78	coxy umol/kg	ph	date
0	Sample-1	239.8	18.9625	35.0636	NaN	7.951	2010-04-06
1	Sample-2	280.7	16.1095	34.6103	192.3	NaN	2010-04-06
2	Sample-3	320.1	12.9729	34.2475	190.8	NaN	2010-04-06
3	Sample-4	341.3	11.9665	34.1884	191.3	7.780	2010-04-06
4	Sample-5	360.1	11.3636	34.1709	203.5	NaN	2010-04-06
5	Sample-6	385.0	10.4636	34.1083	193.7	NaN	2010-04-06
6	Sample-7	443.7	8.5897	34.0567	156.5	NaN	2010-04-06
7	Sample-8	497.8	7.1464	34.0424	110.7	7.496	2010-04-06

`DataFrame` Methods

- `DataFrame` and `Series` (e.g., single column) have access to a variety of built-in methods
    - Accessible through the notation `some_var_name.method_name()`

Method	Description
`head()`	Return the first `n=5` rows by default. The value of `n` can be changed.
`tail()`	Return the last `n=5` rows by default. The value of `n` can be changed.
`min()`, `max()`	Computes the numeric or alphanumeric min, max in a Series or DataFrame.
`sum()`, `mean()`, `std()`, `var()`	Computes the sum, mean, standard deviation, and variance in a `Series` or DataFrame.
`nlargest()`	Return the first n rows of the `Series` or `DataFrame`, ordered by the specified columns in descending order.
`count()`	Returns the number of non-NaN values in a `Series` or `DataFrame`.
`value_counts()`	Returns the frequency for each value in the `Series`.
`describe()`	Computes column-wise statistics.

```
In [8]: df.mean(numeric_only=True)
```

```
/var/folders/5l/gk6s2xx10qs0mkg4_9_vyp3h0000gn/T/ipykernel_9653
7/3698961737.py:1: FutureWarning: The default value of numeric_
only in DataFrame.mean is deprecated. In a future version, it w
ill default to False. In addition, specifying 'numeric_only=Non
e' is deprecated. Select only valid columns or specify the valu
e of numeric_only to silence this warning.
  df.mean()
```

```
Out[8]: date mmddyy     40610.000000
        press dbar        358.562500
        temp ITS-90        12.196838
        csal PSS-78        34.311013
        coxy umol/kg      176.971429
        ph                  7.742333
        dtype: float64
```

```
In [9]: df.mean(numeric_only=True)
```

```
Out[9]: date mmddyy      40610.000000
        press dbar         358.562500
        temp ITS-90         12.196838
        csal PSS-78         34.311013
        coxy umol/kg       176.971429
        ph                   7.742333
        dtype: float64
```

In [10]:

```
# Accessing a single column
df['press dbar']
```

Out[10]:

```
0    239.8
1    280.7
2    320.1
3    341.3
4    360.1
5    385.0
6    443.7
7    497.8
Name: press dbar, dtype: float64
```

In [11]:

```python
# Accessing a single column
df['press dbar'].mean()
```

Out[11]:

```
358.5625
```

`describe()` Method

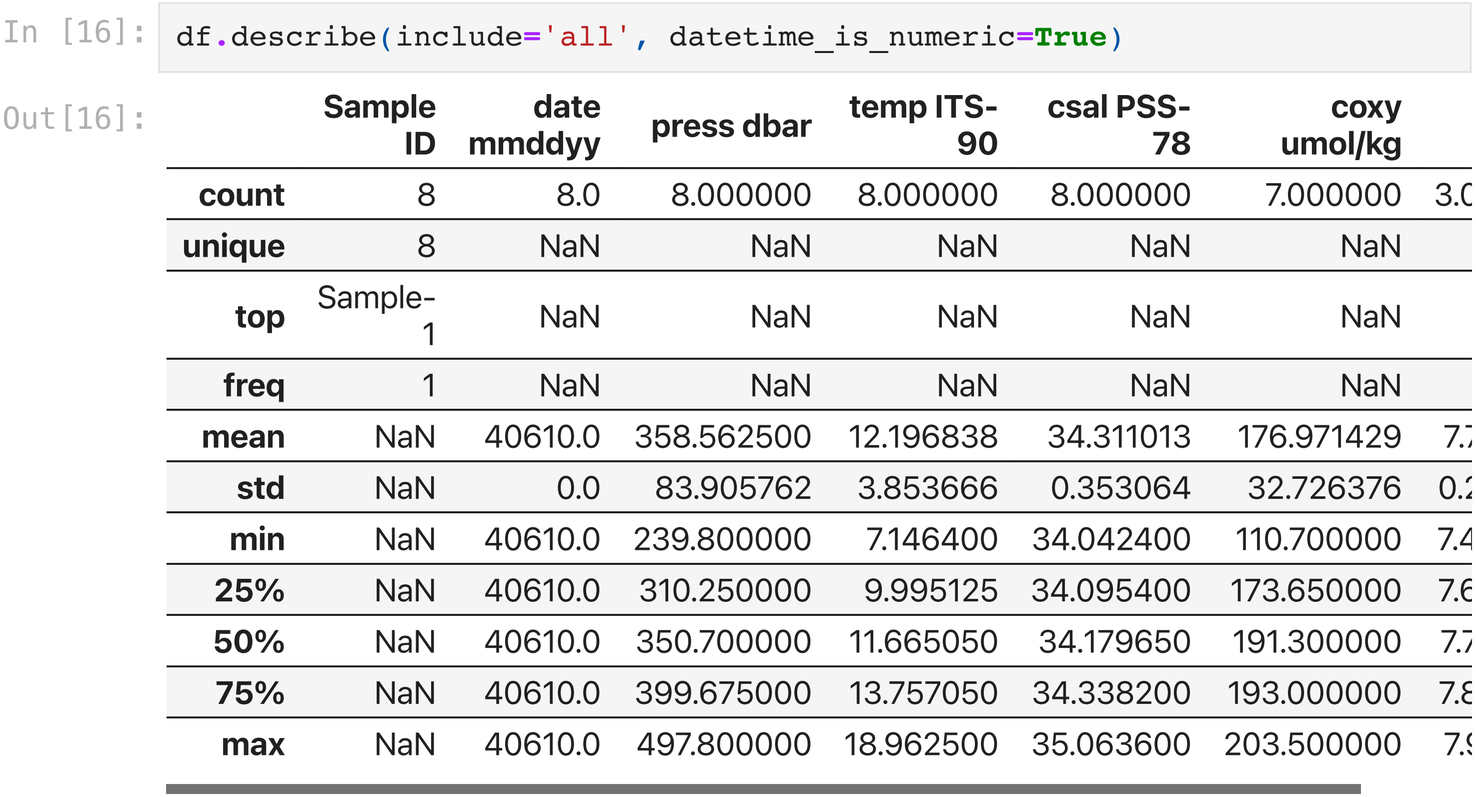
- The `describe()` method provides a range of descriptive statistics of a dataframe
- Statistics to summarize the central tendency, dispersion, and shape of a dataset's distribution
- By default, uses only numeric columns.
    - change behavior using the `include='all'` param.

In [17]:

```
df
```

Out[17]:

	Sample ID	date mmddyy	press dbar	temp ITS-90	csal PSS-78	coxy umol/kg	ph
0	Sample-1	40610	239.8	18.9625	35.0636	NaN	7.951
1	Sample-2	40610	280.7	16.1095	34.6103	192.3	NaN
2	Sample-3	40610	320.1	12.9729	34.2475	190.8	NaN
3	Sample-4	40610	341.3	11.9665	34.1884	191.3	7.780
4	Sample-5	40610	360.1	11.3636	34.1709	203.5	NaN
5	Sample-6	40610	385.0	10.4636	34.1083	193.7	NaN
6	Sample-7	40610	443.7	8.5897	34.0567	156.5	NaN
7	Sample-8	40610	497.8	7.1464	34.0424	110.7	7.496



In [16]:
```
df.describe(include='all', datetime_is_numeric=True)
```

Out[16]:

	Sample ID	date mmddyy	press dbar	temp ITS-90	csal PSS-78	coxy umol/kg	
count	8	8.0	8.000000	8.000000	8.000000	7.000000	3.0
unique	8	NaN	NaN	NaN	NaN	NaN	
top	Sample-1	NaN	NaN	NaN	NaN	NaN	
freq	1	NaN	NaN	NaN	NaN	NaN	
mean	NaN	40610.0	358.562500	12.196838	34.311013	176.971429	7.7
std	NaN	0.0	83.905762	3.853666	0.353064	32.726376	0.2
min	NaN	40610.0	239.800000	7.146400	34.042400	110.700000	7.4
25%	NaN	40610.0	310.250000	9.995125	34.095400	173.650000	7.6
50%	NaN	40610.0	350.700000	11.665050	34.179650	191.300000	7.7
75%	NaN	40610.0	399.675000	13.757050	34.338200	193.000000	7.8
max	NaN	40610.0	497.800000	18.962500	35.063600	203.500000	7.9

Key points

- `DataFrame`s and `Series` have a plethora of attributes and variables to access data
    - See Pandas `doc`, or use `tab` to explore.
- Use `.dtypes` to get the types of each column in a `DataFrame`.
- To get general statistics on the DataFrame you can use the `describe` method.

Exercise 1

Find the mean temperatre (`"temp ITS-90"`) of the `nlargest` observation where `n = 5`. To achieve this, you can use the method `nlargest`, which takes two parameters, `n` the number of values to show and `columns` is the list of columns on which we would like to sort the data.