

# KEY\_Lesson12\_Pandas-Subsetting

February 4, 2020

## 1 Subsetting Pandas DataFrames

You now know how to read external datasets into `pandas`. Let's put those skills to use and read in the `tips` dataset again:

```
[0]: # mount Google Drive
from google.colab import drive
drive.mount('/content/gdrive')
path = '/content/gdrive/My Drive/SummerExperience-master/'
```

Drive already mounted at `/content/gdrive`; to attempt to forcibly remount, call `drive.mount("/content/gdrive", force_remount=True)`.

```
[0]: # import the pandas package
import pandas as pd
# load tips
tips = pd.read_csv(path + 'SampleData/tips.csv')
```

Take a look again at the beginning of the `tips` DataFrame:

```
[0]: # view the beginning of tips
tips.head()
```

```
[0]:
```

	total_bill	tip	sex	smoker	day	time	size
0	16.99	1.01	Female	No	Sun	Dinner	2
1	10.34	1.66	Male	No	Sun	Dinner	3
2	21.01	3.50	Male	No	Sun	Dinner	3
3	23.68	3.31	Male	No	Sun	Dinner	2
4	24.59	3.61	Female	No	Sun	Dinner	4

What if we decided we didn't want to keep all of the data recorded in this dataset? To do that, we need to learn how to **subset DataFrames**. Subsetting means taking a dataset and pulling out a small portion of it that we're interested in.

First, we'll look at a single column (you can use `head` to keep the printed result short):

```
[0]: tips['day'].head(10)
```

```
[0]: 0    Sun
      1    Sun
      2    Sun
      3    Sun
      4    Sun
      5    Sun
      6    Sun
      7    Sun
      8    Sun
      9    Sun
      Name: day, dtype: object
```

We use the square brackets [ ] after the name of the `DataFrame` to tell `pandas` that we want to look at one of the columns. We put the name of the column in quotes to tell `pandas` exactly which column we want to look at. Try subsetting the `total_bill` column:

```
[0]: # subset the total_bill column
      tips['total_bill'].head(10)
```

```
[0]: 0    16.99
      1    10.34
      2    21.01
      3    23.68
      4    24.59
      5    25.29
      6     8.77
      7    26.88
      8    15.04
      9    14.78
      Name: total_bill, dtype: float64
```

`pandas` simply showed us the result of subsetting the column, but it didn't save the result anywhere. Try saving the `total_bill` column to a new variable, `bills`:

```
[0]: # save the total_bill column to a variable
      bills = tips['total_bill']
```

We can also pull out multiple columns at a time to create a new `DataFrame`. If we were only interested in the `total_bill` and `tip`, we can subset them like this:

```
[0]: tips[['total_bill', 'tip']].head(10)
```

```
[0]:   total_bill  tip
      0      16.99  1.01
      1      10.34  1.66
      2      21.01  3.50
      3      23.68  3.31
      4      24.59  3.61
```

5	25.29	4.71
6	8.77	2.00
7	26.88	3.12
8	15.04	1.96
9	14.78	3.23

Does that look familiar? Instead of putting a single string between the square brackets, we put a whole list of strings -- you can tell it's a list by the second set of square brackets. Now you try: subset the columns `total_bill`, `tip`, and `time` and save the result to a variable called `tips_subset`:

```
[0]: # subset three columns and save to a new variable
tips_subset = tips[['total_bill', 'tip', 'time']]

# take a look at the beginning of the new DataFrame
tips_subset.head()
```

```
[0]:   total_bill   tip     time
0      16.99   1.01  Dinner
1      10.34   1.66  Dinner
2      21.01   3.50  Dinner
3      23.68   3.31  Dinner
4      24.59   3.61  Dinner
```

Now we've learned how to subset columns. How do we subset rows? We use a `method` of `DataFrame` called `iloc`. When you see `iloc`, think "index location" -- because we want to get the location where the row is a certain index. Let's try it:

```
[0]: tips.iloc[1]
```

```
[0]: total_bill    10.34
tip              1.66
sex              Male
smoker           No
day              Sun
time             Dinner
size              3
Name: 1, dtype: object
```

That showed us the row with an index of 1. Similarly to subsetting columns, we can also subset multiple rows:

```
[0]: tips.iloc[[0,1,2]]
```

```
[0]:   total_bill   tip     sex smoker  day    time  size
0      16.99   1.01  Female     No   Sun  Dinner     2
1      10.34   1.66   Male     No   Sun  Dinner     3
2      21.01   3.50   Male     No   Sun  Dinner     3
```

That gave us a smaller `DataFrame` where the rows have an index of 0, 1, or 2. We can do the same thing with slicing syntax:

```
[0]: tips.iloc[0:3]
```

```
[0]:   total_bill  tip  sex smoker  day  time  size
0      16.99  1.01 Female    No  Sun  Dinner    2
1      10.34  1.66  Male    No  Sun  Dinner    3
2      21.01  3.50  Male    No  Sun  Dinner    3
```

Notice that this does the same thing as calling `head` with a value of 3:

```
[0]: tips.head(3)
```

```
[0]:   total_bill  tip  sex smoker  day  time  size
0      16.99  1.01 Female    No  Sun  Dinner    2
1      10.34  1.66  Male    No  Sun  Dinner    3
2      21.01  3.50  Male    No  Sun  Dinner    3
```

What if we want to grab some rows in the middle of the `DataFrame`? Try subsetting rows 100 through 105:

```
[0]: # subset rows 100 through 105
tips.iloc[100:106]
```

```
[0]:   total_bill  tip  sex smoker  day  time  size
100      11.35  2.50 Female    Yes  Fri  Dinner    2
101      15.38  3.00 Female    Yes  Fri  Dinner    2
102      44.30  2.50 Female    Yes  Sat  Dinner    3
103      22.42  3.48 Female    Yes  Sat  Dinner    2
104      20.92  4.08 Female    No  Sat  Dinner    2
105      15.36  1.64  Male    Yes  Sat  Dinner    2
```

We can even subset rows and columns in the same line of code. What do you think the following cell will do?

```
[0]: tips.iloc[5:10][['total_bill', 'day', 'time']]
```

```
[0]:   total_bill  day  time
5      25.29  Sun  Dinner
6       8.77  Sun  Dinner
7      26.88  Sun  Dinner
8      15.04  Sun  Dinner
9      14.78  Sun  Dinner
10     10.27  Sun  Dinner
```

Now you try! Subset rows 11 and 12 and columns `total_bill` and `tip`:

```
[0]: # subset rows and columns
tips.iloc[5:10][['total_bill', 'day', 'time']]
```

```
[0]:   total_bill  day    time
5       25.29  Sun  Dinner
6        8.77  Sun  Dinner
7       26.88  Sun  Dinner
8       15.04  Sun  Dinner
9       14.78  Sun  Dinner
10      10.27  Sun  Dinner
```

Sometimes we don't know exactly which row(s) we want to subset ahead of time. What if we want to subset rows that have a certain value in the `time` column? We don't want to scroll through hundreds of rows to find them. The good news is: we don't have to! Let's use the `method` called `query`. Inside the parentheses of `query` we'll enclose a statement in quotes with the name of the column and an expression.

```
[0]: tips.query('time == "Lunch"')
```

```
[0]:   total_bill  tip  sex smoker  day  time  size
77       27.20  4.00  Male    No  Thur  Lunch    4
78       22.76  3.00  Male    No  Thur  Lunch    2
79       17.29  2.71  Male    No  Thur  Lunch    2
80       19.44  3.00  Male   Yes  Thur  Lunch    2
81       16.66  3.40  Male    No  Thur  Lunch    2
82       10.07  1.83  Female  No  Thur  Lunch    1
83       32.68  5.00  Male   Yes  Thur  Lunch    2
84       15.98  2.03  Male    No  Thur  Lunch    2
85       34.83  5.17  Female  No  Thur  Lunch    4
86       13.03  2.00  Male    No  Thur  Lunch    2
87       18.28  4.00  Male    No  Thur  Lunch    2
88       24.71  5.85  Male    No  Thur  Lunch    2
89       21.16  3.00  Male    No  Thur  Lunch    2
117      10.65  1.50  Female  No  Thur  Lunch    2
118      12.43  1.80  Female  No  Thur  Lunch    2
119      24.08  2.92  Female  No  Thur  Lunch    4
120      11.69  2.31  Male    No  Thur  Lunch    2
121      13.42  1.68  Female  No  Thur  Lunch    2
122      14.26  2.50  Male    No  Thur  Lunch    2
123      15.95  2.00  Male    No  Thur  Lunch    2
124      12.48  2.52  Female  No  Thur  Lunch    2
125      29.80  4.20  Female  No  Thur  Lunch    6
126       8.52  1.48  Male    No  Thur  Lunch    2
127      14.52  2.00  Female  No  Thur  Lunch    2
128      11.38  2.00  Female  No  Thur  Lunch    2
129      22.82  2.18  Male    No  Thur  Lunch    3
130      19.08  1.50  Male    No  Thur  Lunch    2
```

131	20.27	2.83	Female	No	Thur	Lunch	2
132	11.17	1.50	Female	No	Thur	Lunch	2
133	12.26	2.00	Female	No	Thur	Lunch	2
..	...	...	...	...	...	...	
142	41.19	5.00	Male	No	Thur	Lunch	5
143	27.05	5.00	Female	No	Thur	Lunch	6
144	16.43	2.30	Female	No	Thur	Lunch	2
145	8.35	1.50	Female	No	Thur	Lunch	2
146	18.64	1.36	Female	No	Thur	Lunch	3
147	11.87	1.63	Female	No	Thur	Lunch	2
148	9.78	1.73	Male	No	Thur	Lunch	2
149	7.51	2.00	Male	No	Thur	Lunch	2
191	19.81	4.19	Female	Yes	Thur	Lunch	2
192	28.44	2.56	Male	Yes	Thur	Lunch	2
193	15.48	2.02	Male	Yes	Thur	Lunch	2
194	16.58	4.00	Male	Yes	Thur	Lunch	2
195	7.56	1.44	Male	No	Thur	Lunch	2
196	10.34	2.00	Male	Yes	Thur	Lunch	2
197	43.11	5.00	Female	Yes	Thur	Lunch	4
198	13.00	2.00	Female	Yes	Thur	Lunch	2
199	13.51	2.00	Male	Yes	Thur	Lunch	2
200	18.71	4.00	Male	Yes	Thur	Lunch	3
201	12.74	2.01	Female	Yes	Thur	Lunch	2
202	13.00	2.00	Female	Yes	Thur	Lunch	2
203	16.40	2.50	Female	Yes	Thur	Lunch	2
204	20.53	4.00	Male	Yes	Thur	Lunch	4
205	16.47	3.23	Female	Yes	Thur	Lunch	3
220	12.16	2.20	Male	Yes	Fri	Lunch	2
221	13.42	3.48	Female	Yes	Fri	Lunch	2
222	8.58	1.92	Male	Yes	Fri	Lunch	1
223	15.98	3.00	Female	No	Fri	Lunch	3
224	13.42	1.58	Male	Yes	Fri	Lunch	2
225	16.27	2.50	Female	Yes	Fri	Lunch	2
226	10.09	2.00	Female	Yes	Fri	Lunch	2

[68 rows x 7 columns]

The above cell showed us all the rows where `time` is equal to "Lunch". We had to enclose "Lunch" in quotes above because it's not the name of a column, but a value within the `time` column.

Now you try: subset the rows where the waitress is female and save it to a variable, `female`:

```
[0]: # subset rows with a female waitress and save it to a variable
female = tips.query('sex == "Female"')

# take a look at the beginning
female.head()
```

```
[0]:      total_bill  tip    sex smoker  day    time  size
     0         16.99  1.01  Female    No  Sun  Dinner    2
     4         24.59  3.61  Female    No  Sun  Dinner    4
    11         35.26  5.00  Female    No  Sun  Dinner    4
    14         14.83  3.02  Female    No  Sun  Dinner    2
    16         10.33  1.67  Female    No  Sun  Dinner    3
```

Now lets do the same for males. Subset the male waiter data and save it to a variable, `male`:

```
[0]: # subset the male waiters and save it
male = tips.query('sex == "Male"')

# look at the beginning
male.head()
```

```
[0]:      total_bill  tip  sex smoker  day    time  size
     1         10.34  1.66  Male    No  Sun  Dinner    3
     2         21.01  3.50  Male    No  Sun  Dinner    3
     3         23.68  3.31  Male    No  Sun  Dinner    2
     5         25.29  4.71  Male    No  Sun  Dinner    4
     6          8.77  2.00  Male    No  Sun  Dinner    2
```

How would you determine the number of male waiters in this `DataFrame`? Think back to the last lesson when we used the `len` function.

```
[0]: # number of males
len(male)
```

```
[0]: 157
```

How about the number of female waitresses?

```
[0]: # number of females
len(female)
```

```
[0]: 87
```

We can use `query` on multiple columns at a time. Let's find out how many tables were served by a female waitress on a Sunday.

```
[0]: tips.query('sex == "Female" and day == "Sun"')
```

```
[0]:      total_bill  tip    sex smoker  day    time  size
     0         16.99  1.01  Female    No  Sun  Dinner    2
     4         24.59  3.61  Female    No  Sun  Dinner    4
    11         35.26  5.00  Female    No  Sun  Dinner    4
    14         14.83  3.02  Female    No  Sun  Dinner    2
    16         10.33  1.67  Female    No  Sun  Dinner    3
    18         16.97  3.50  Female    No  Sun  Dinner    3
```

51	10.29	2.60	Female	No	Sun	Dinner	2
52	34.81	5.20	Female	No	Sun	Dinner	4
114	25.71	4.00	Female	No	Sun	Dinner	3
115	17.31	3.50	Female	No	Sun	Dinner	2
155	29.85	5.14	Female	No	Sun	Dinner	5
157	25.00	3.75	Female	No	Sun	Dinner	4
158	13.39	2.61	Female	No	Sun	Dinner	2
162	16.21	2.00	Female	No	Sun	Dinner	3
164	17.51	3.00	Female	Yes	Sun	Dinner	2
178	9.60	4.00	Female	Yes	Sun	Dinner	2
186	20.90	3.50	Female	Yes	Sun	Dinner	3
188	18.15	3.50	Female	Yes	Sun	Dinner	3

We used the ampersand symbol (&) or the keyword **and** to chain together two statements inside the `query` function. Both statements have to be true for a row to be included.

Besides checking whether values are equal using `==`, we can also use greater than, less than, greater than or equal, etc. Try subsetting the rows where the bill is greater than \$15 and the tip is less than \$2:

```
[0]: # subset by bill and tip
tips.query('total_bill > 15 & tip < 2')
```

```
[0]:
```

	total_bill	tip	sex	smoker	day	time	size
0	16.99	1.01	Female	No	Sun	Dinner	2
8	15.04	1.96	Male	No	Sun	Dinner	2
12	15.42	1.57	Male	No	Sun	Dinner	2
57	26.41	1.50	Female	No	Sat	Dinner	2
105	15.36	1.64	Male	Yes	Sat	Dinner	2
130	19.08	1.50	Male	No	Thur	Lunch	2
146	18.64	1.36	Female	No	Thur	Lunch	3
190	15.69	1.50	Male	Yes	Sun	Dinner	2
237	32.83	1.17	Male	Yes	Sat	Dinner	2
242	17.82	1.75	Male	No	Sat	Dinner	2

Instead of the ampersand (&) we can use the pipe (|) or the keyword **or** to represent a query where *one* of the two conditions must be fulfilled. Try subsetting where the bill is greater than \$15 or the tip is greater than \$5:

```
[0]: # subset by bill or tip
tips.query('total_bill > 15 | tip > 5')
```

```
[0]:
```

	total_bill	tip	sex	smoker	day	time	size
0	16.99	1.01	Female	No	Sun	Dinner	2
2	21.01	3.50	Male	No	Sun	Dinner	3
3	23.68	3.31	Male	No	Sun	Dinner	2
4	24.59	3.61	Female	No	Sun	Dinner	4
5	25.29	4.71	Male	No	Sun	Dinner	4



7	26.88	3.12	Male	No	Sun	Dinner	4
8	15.04	1.96	Male	No	Sun	Dinner	2
11	35.26	5.00	Female	No	Sun	Dinner	4
12	15.42	1.57	Male	No	Sun	Dinner	2
13	18.43	3.00	Male	No	Sun	Dinner	4
15	21.58	3.92	Male	No	Sun	Dinner	2
17	16.29	3.71	Male	No	Sun	Dinner	3
18	16.97	3.50	Female	No	Sun	Dinner	3
19	20.65	3.35	Male	No	Sat	Dinner	3
20	17.92	4.08	Male	No	Sat	Dinner	2
21	20.29	2.75	Female	No	Sat	Dinner	2
22	15.77	2.23	Female	No	Sat	Dinner	2
23	39.42	7.58	Male	No	Sat	Dinner	4
24	19.82	3.18	Male	No	Sat	Dinner	2
25	17.81	2.34	Male	No	Sat	Dinner	4
28	21.70	4.30	Male	No	Sat	Dinner	2
29	19.65	3.00	Female	No	Sat	Dinner	2
31	18.35	2.50	Male	No	Sat	Dinner	4
32	15.06	3.00	Female	No	Sat	Dinner	2
33	20.69	2.45	Female	No	Sat	Dinner	4
34	17.78	3.27	Male	No	Sat	Dinner	2
35	24.06	3.60	Male	No	Sat	Dinner	3
36	16.31	2.00	Male	No	Sat	Dinner	3
37	16.93	3.07	Female	No	Sat	Dinner	3
38	18.69	2.31	Male	No	Sat	Dinner	3
..	...	...	...	...	...	...	...
193	15.48	2.02	Male	Yes	Thur	Lunch	2
194	16.58	4.00	Male	Yes	Thur	Lunch	2
197	43.11	5.00	Female	Yes	Thur	Lunch	4
200	18.71	4.00	Male	Yes	Thur	Lunch	3
203	16.40	2.50	Female	Yes	Thur	Lunch	2
204	20.53	4.00	Male	Yes	Thur	Lunch	4
205	16.47	3.23	Female	Yes	Thur	Lunch	3
206	26.59	3.41	Male	Yes	Sat	Dinner	3
207	38.73	3.00	Male	Yes	Sat	Dinner	4
208	24.27	2.03	Male	Yes	Sat	Dinner	2
210	30.06	2.00	Male	Yes	Sat	Dinner	3
211	25.89	5.16	Male	Yes	Sat	Dinner	4
212	48.33	9.00	Male	No	Sat	Dinner	4
214	28.17	6.50	Female	Yes	Sat	Dinner	3
216	28.15	3.00	Male	Yes	Sat	Dinner	5
219	30.14	3.09	Female	Yes	Sat	Dinner	4
223	15.98	3.00	Female	No	Fri	Lunch	3
225	16.27	2.50	Female	Yes	Fri	Lunch	2
227	20.45	3.00	Male	No	Sat	Dinner	4
229	22.12	2.88	Female	Yes	Sat	Dinner	2
230	24.01	2.00	Male	Yes	Sat	Dinner	4

231	15.69	3.00	Male	Yes	Sat	Dinner	3
234	15.53	3.00	Male	Yes	Sat	Dinner	2
237	32.83	1.17	Male	Yes	Sat	Dinner	2
238	35.83	4.67	Female	No	Sat	Dinner	3
239	29.03	5.92	Male	No	Sat	Dinner	3
240	27.18	2.00	Female	Yes	Sat	Dinner	2
241	22.67	2.00	Male	Yes	Sat	Dinner	2
242	17.82	1.75	Male	No	Sat	Dinner	2
243	18.78	3.00	Female	No	Thur	Dinner	2

[165 rows x 7 columns]

Congrats on making it to the end of this lesson -- we learned a lot!

- How to use square brackets to subset columns.
- How to use `iloc` to subset rows.
- How to use `iloc` and square brackets at the same time.
- How to use `query` to find rows where the column has a certain value.

[0]: