

# KEY\_Lesson12\_Pandas-Subsetting

July 15, 2019

## 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.loc[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.loc[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]: