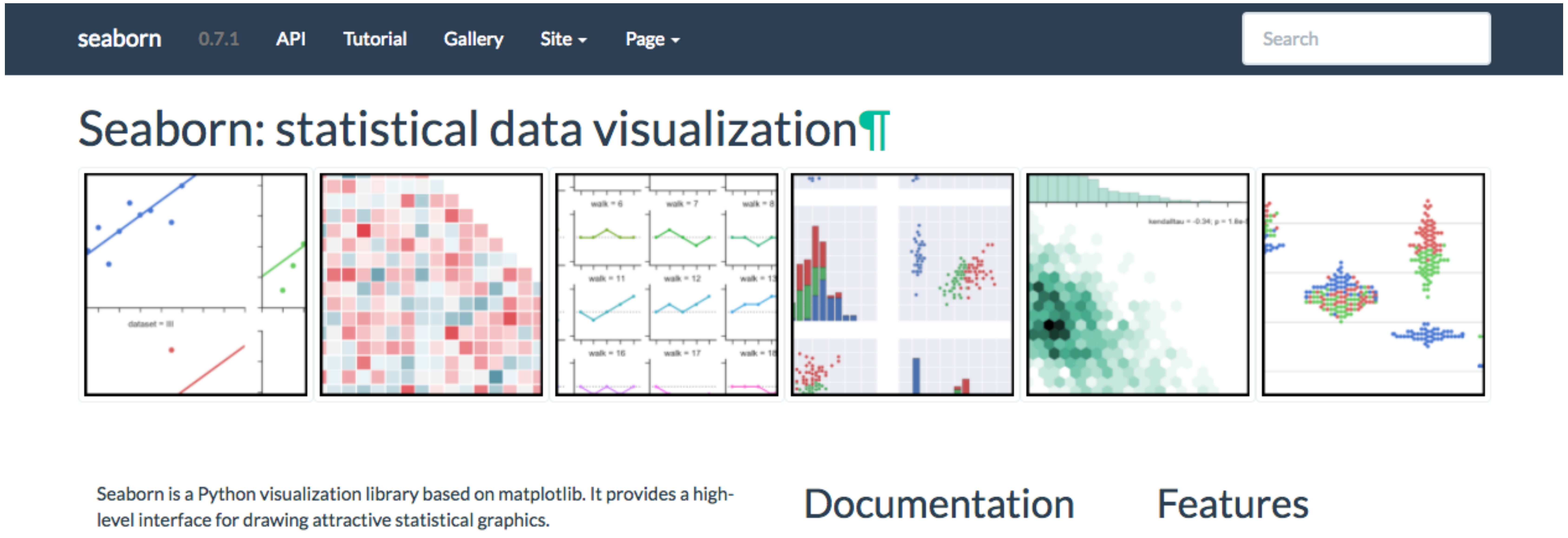
INTRODUCTION TO DATA VISUALIZATION WITH PYTHON

# Visualizing Regressions

## Seaborn



Seaborn: statistical data visualization¶

Seaborn is a Python visualization library based on matplotlib. It provides a high-level interface for drawing attractive statistical graphics.

Documentation

Features

https://stanford.edu/~mwaskom/software/seaborn/

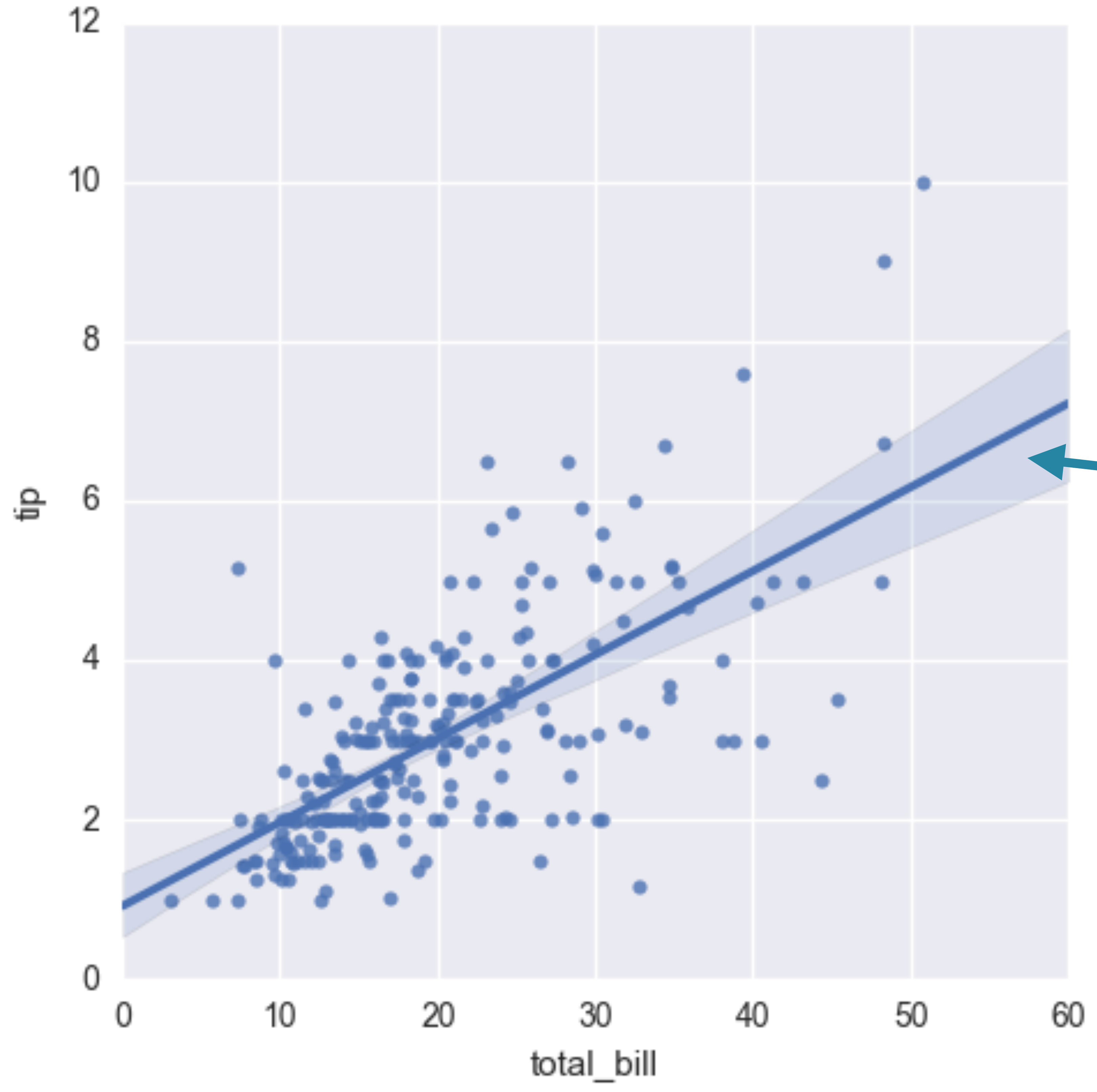
## Recap: Pandas DataFrames

- Labelled tabular data structure
- Labels on rows: *index*
- Labels on columns: *columns*
- Columns are Pandas *Series*

## Recap: Pandas DataFrames

| | 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 |
| ... | ... | ... | ... | ... | ... | ... | ... |

## Linear regression plots



95% confidence

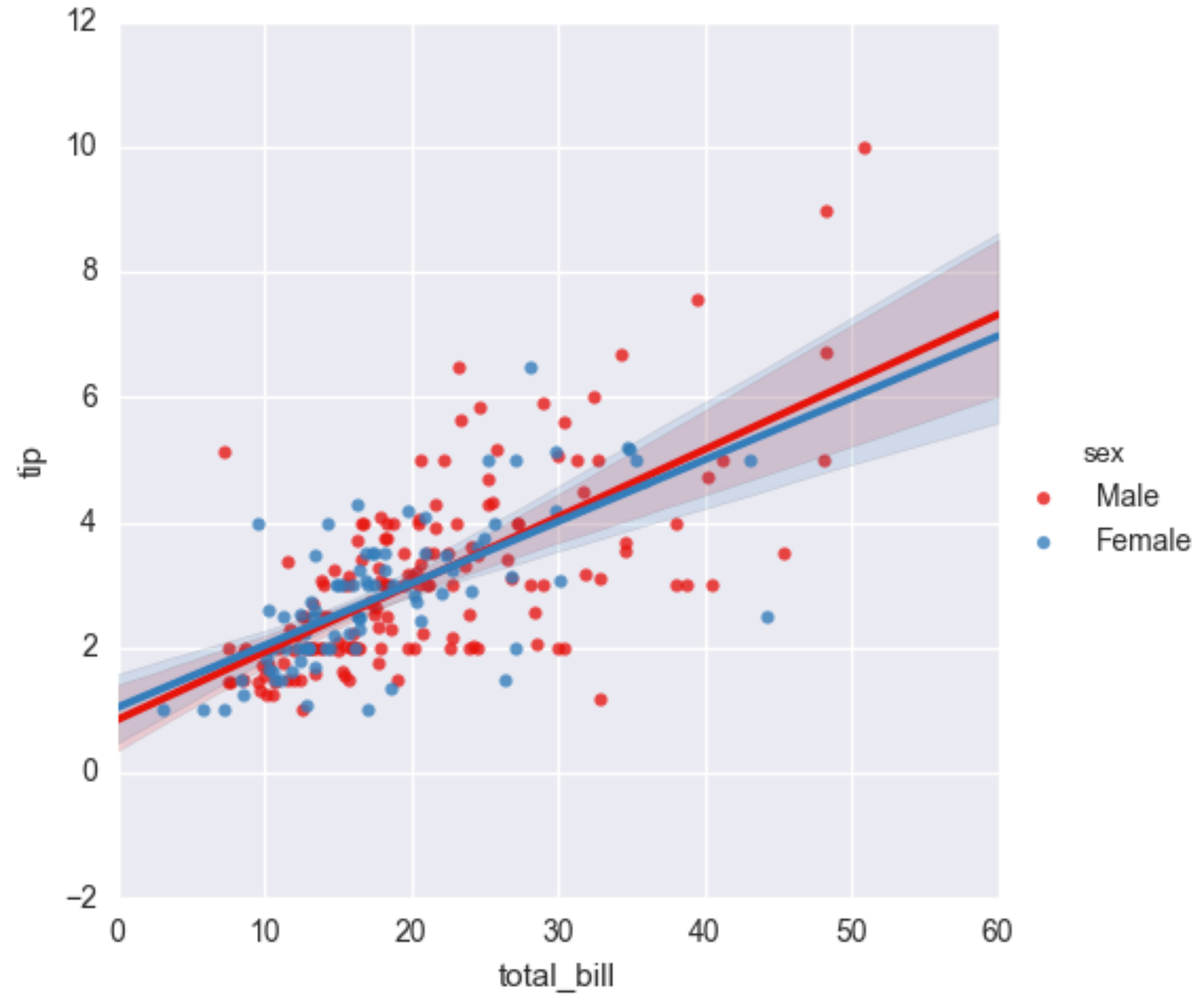
## Using lmplot()

```
In [1]: import pandas as pd

In [2]: import matplotlib.pyplot as plt

In [3]: import seaborn as sns

In [4]: tips =sns.load_dataset('tips')

In [5]: sns.lmplot(x= 'total_bill', y='tip', data=tips)

In [6]: plt.show()
```

## Factors

| | total_bil l | 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 |
| ... | ... | ... | ... | ... | ... | ... | ... |

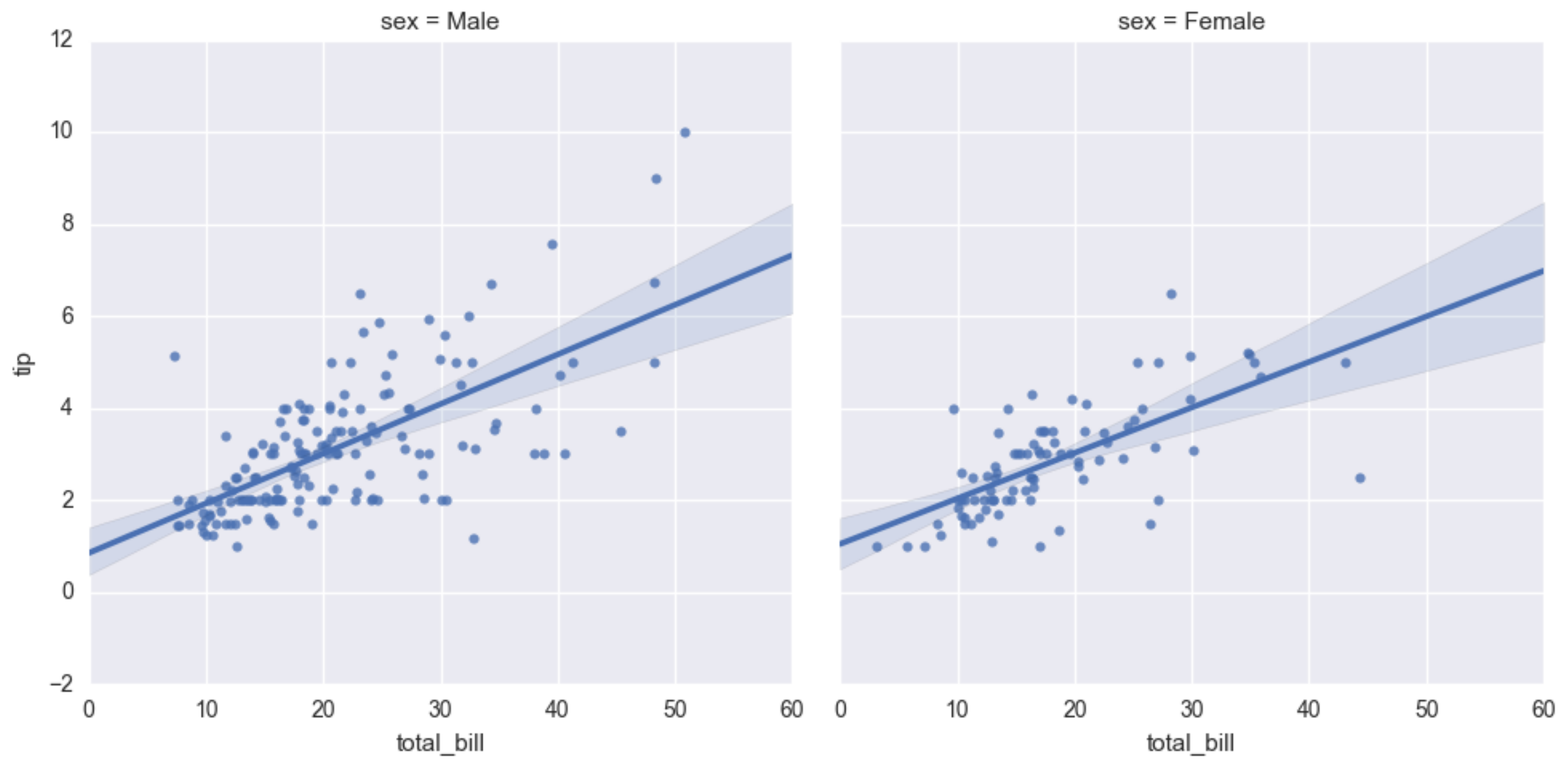
## Grouping factors (same plot)



## Using hue=...

```
In [7]: sns.lmplot(x='total_bill', y='tip', data=tips, hue='sex',
   ...:            palette='Set1')

In [8]: plt.show()
```

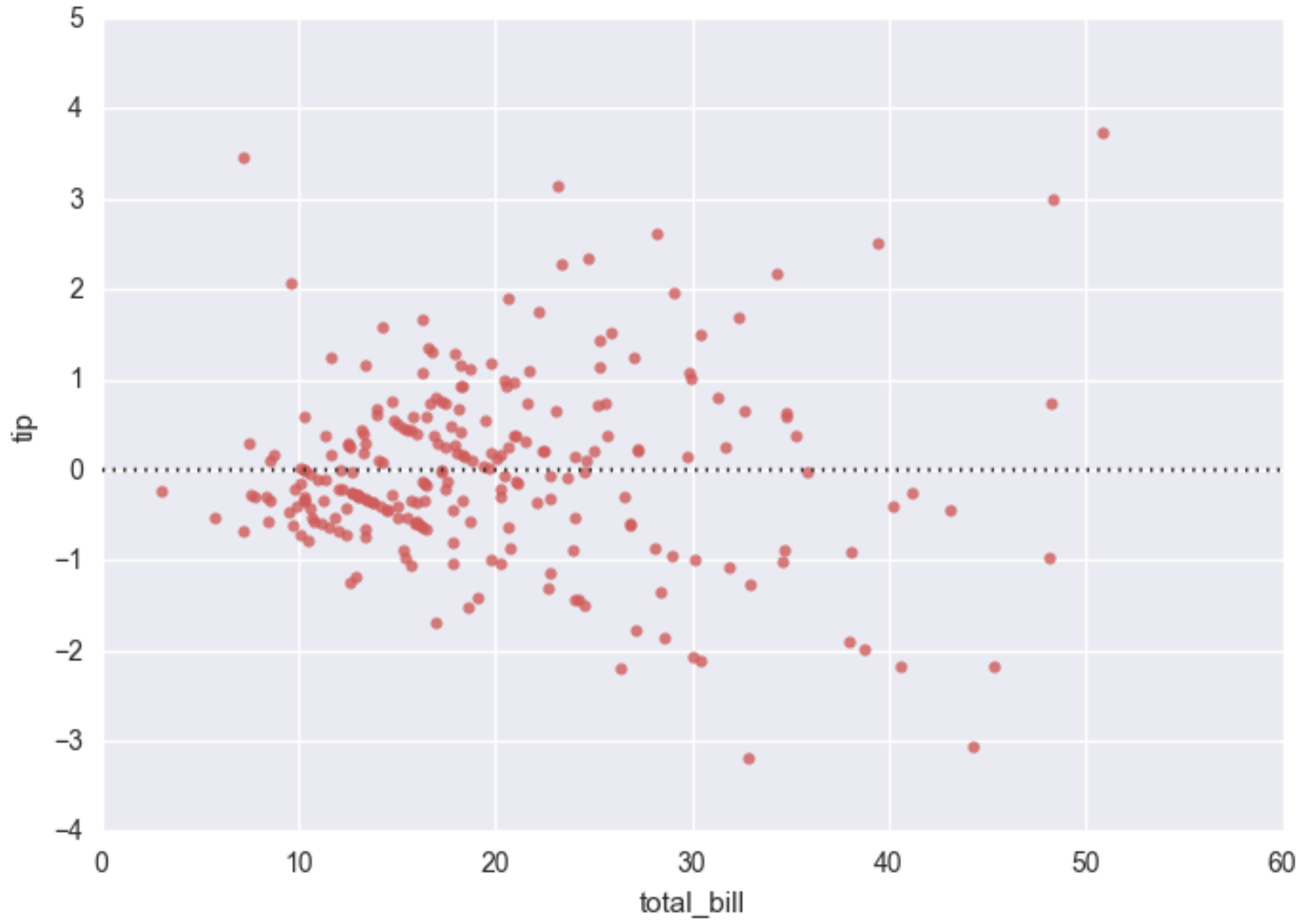
## Grouping factors (subplots)



## Using col=...

```
In [9]: sns.lmplot(x='total_bill', y='tip', data=tips, col='sex')

In [10]: plt.show()
```

## Residual plots



## Using residplot()

```
In [11]: sns.residplot(x='age',y='fare',data=tips,color='indianred')

In [12]: plt.show()
```

- Similar arguments as lmplot() but more flexible
    - x, y can be *arrays or strings*
    - data is DataFrame (optional)
- Optional arguments (e.g., color) as in Matplotlib

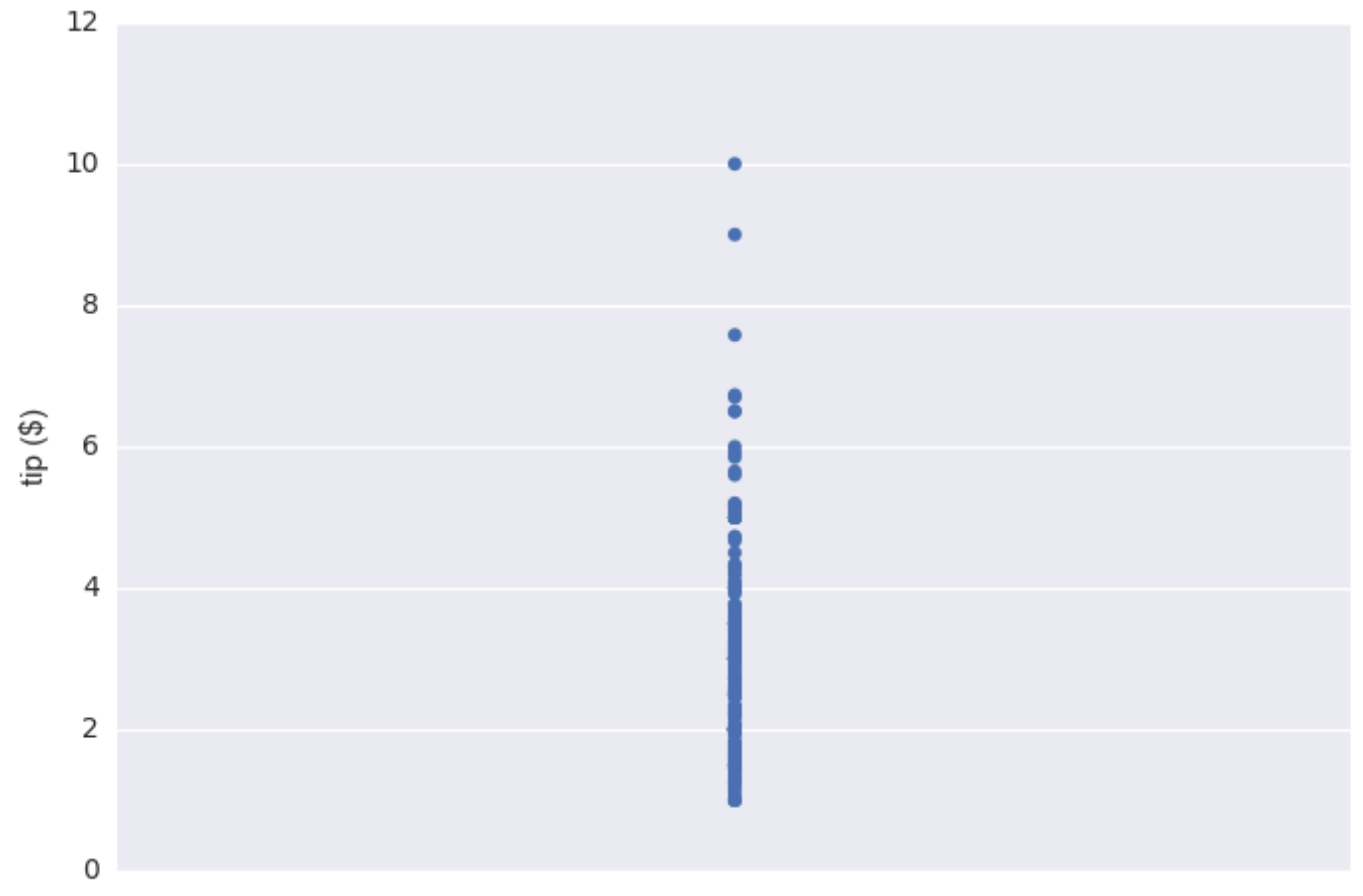
# Let’s practice!

## Visualizing univariate distributions

## Visualizing data

- Univariate → "one variable"
- Visualization techniques for sampled univariate data
    - Strip plots
    - Swarm plots
    - Violin plots

# Strip plot



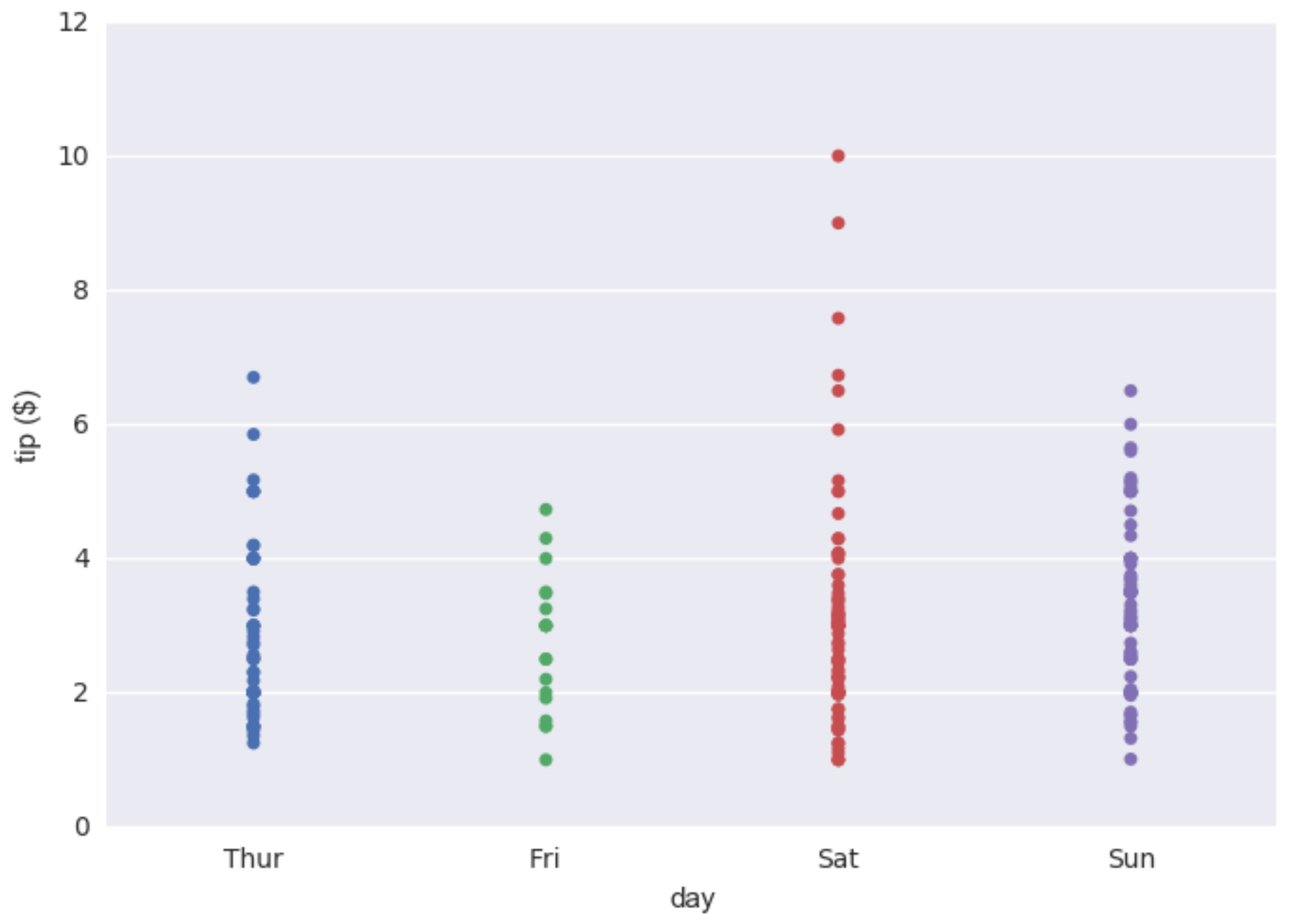
## Using stripplot()

```
In [1]: sns.stripplot(y= 'tip', data=tips)

In [2]: plt.ylabel('tip ($)')

In [3]: plt.show()
```

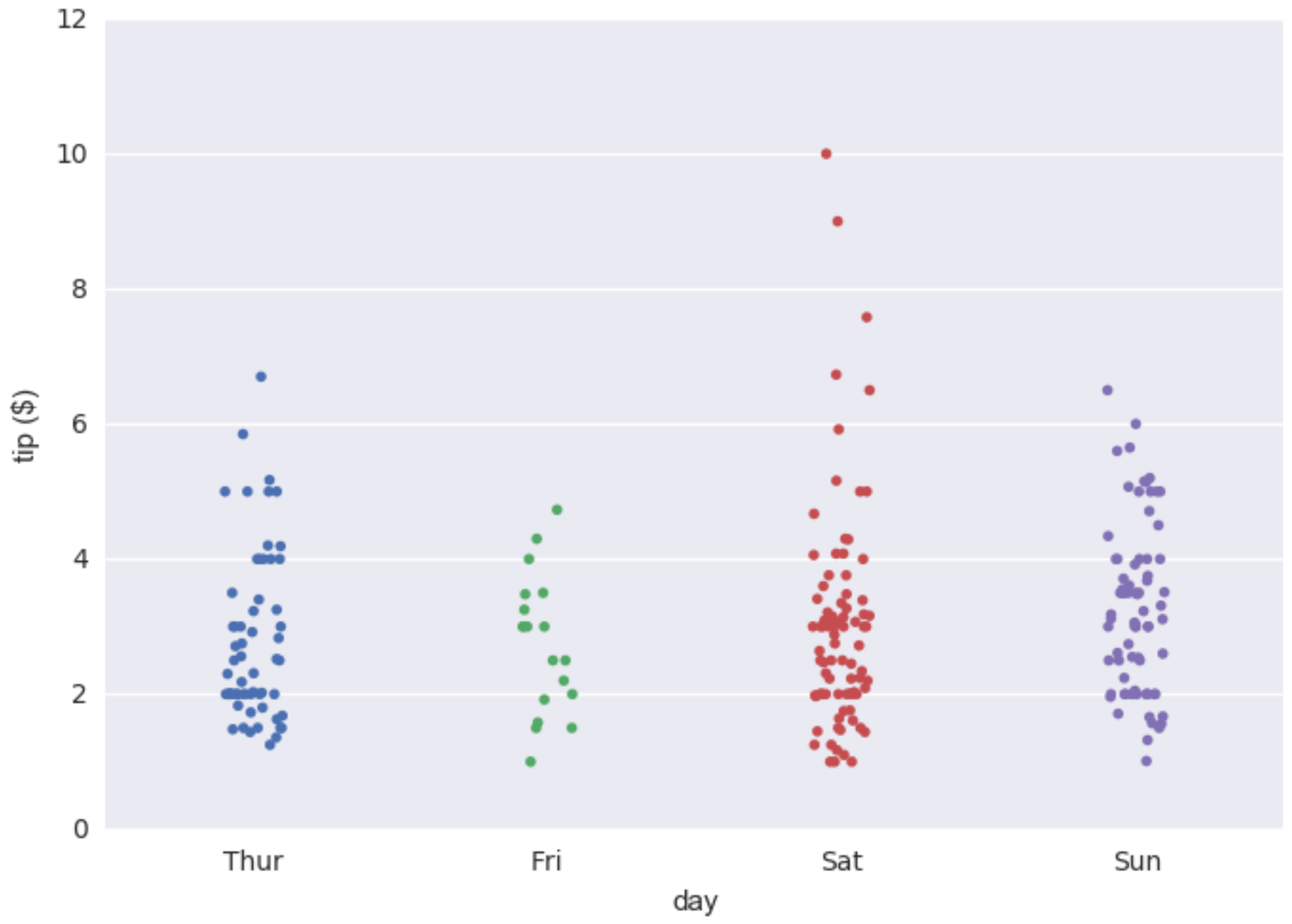
## Grouping with stripplot()

```
In [4]: sns.stripplot(x='day', y='tip', data=tip)

In [5]: plt.ylabel('tip ($)')

In [6]: plt.show()
```

## Grouped strip plot



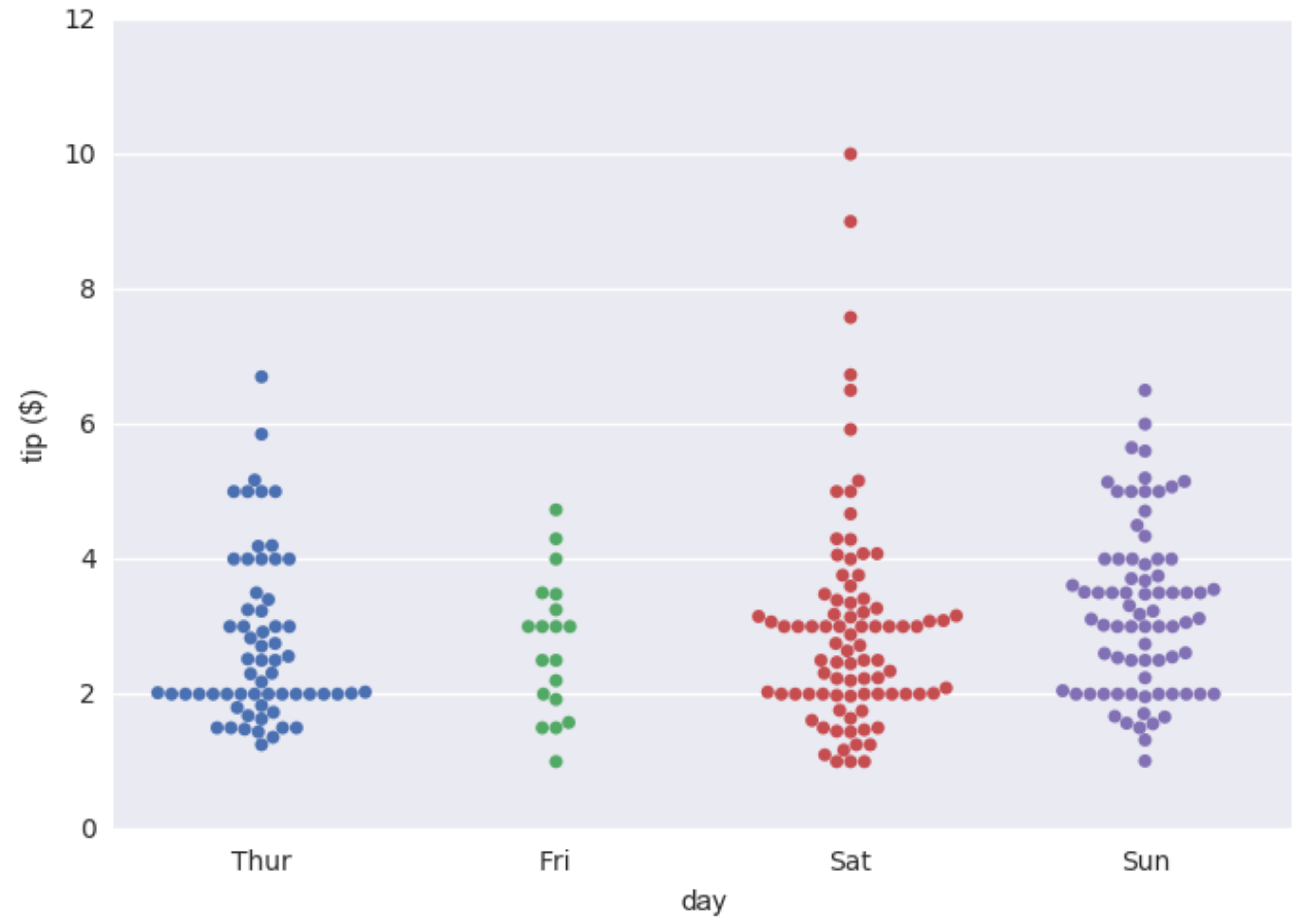
# Spreading out strip plots



## Spreading out strip plots

```
In [7]: sns.stripplot(x='day', y='tip', data=tip, size=4,
   ...:               jitter=True)

In [8]: plt.ylabel('tip ($)')

In [9]: plt.show()
```

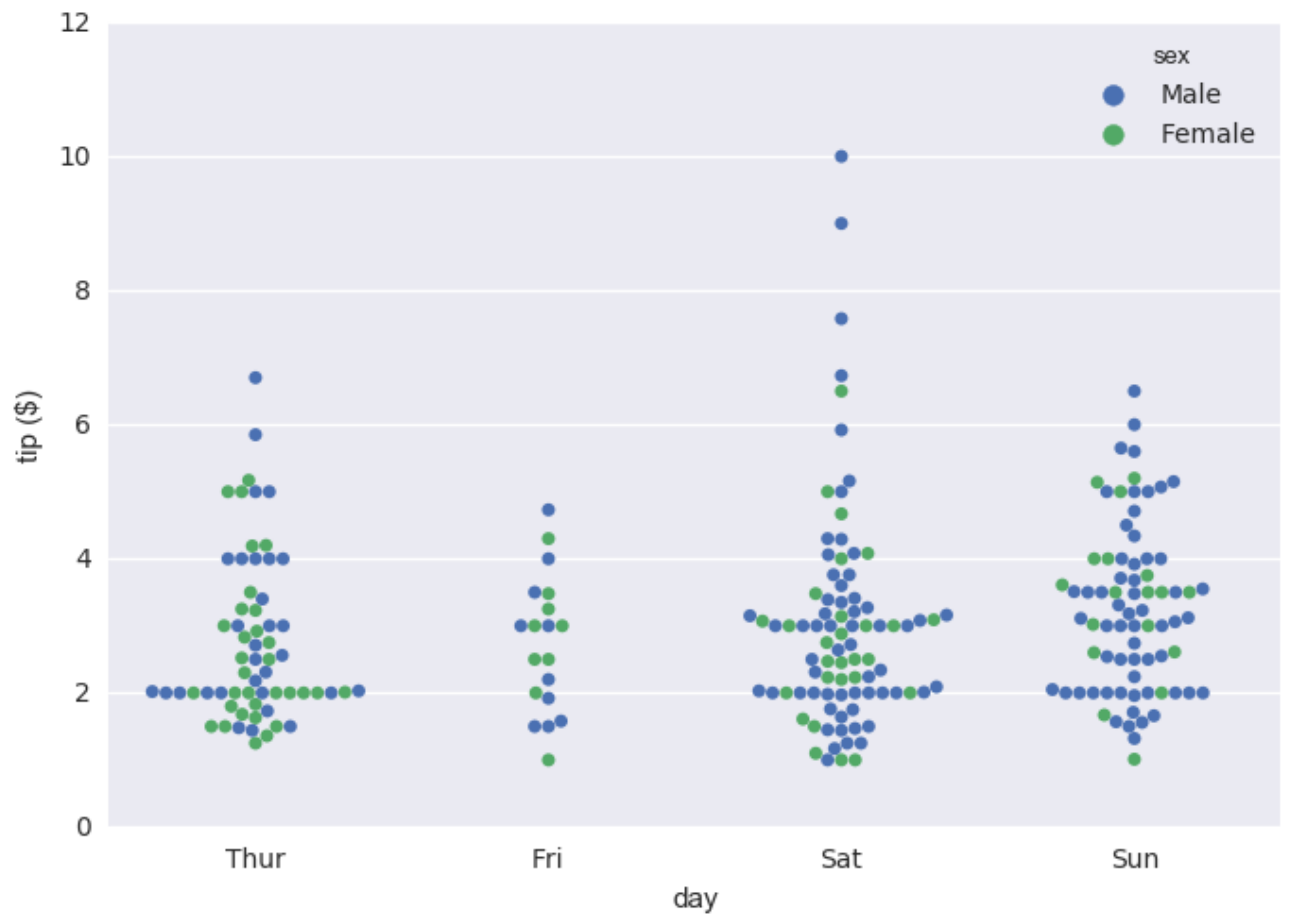
## Swarm plot



# Using swarmplot()

```
In [10]: sns.swarmplot(x='day', y='tip', data=tips)

In [11]: plt.ylabel('tip ($)')

In [12]: plt.show()
```

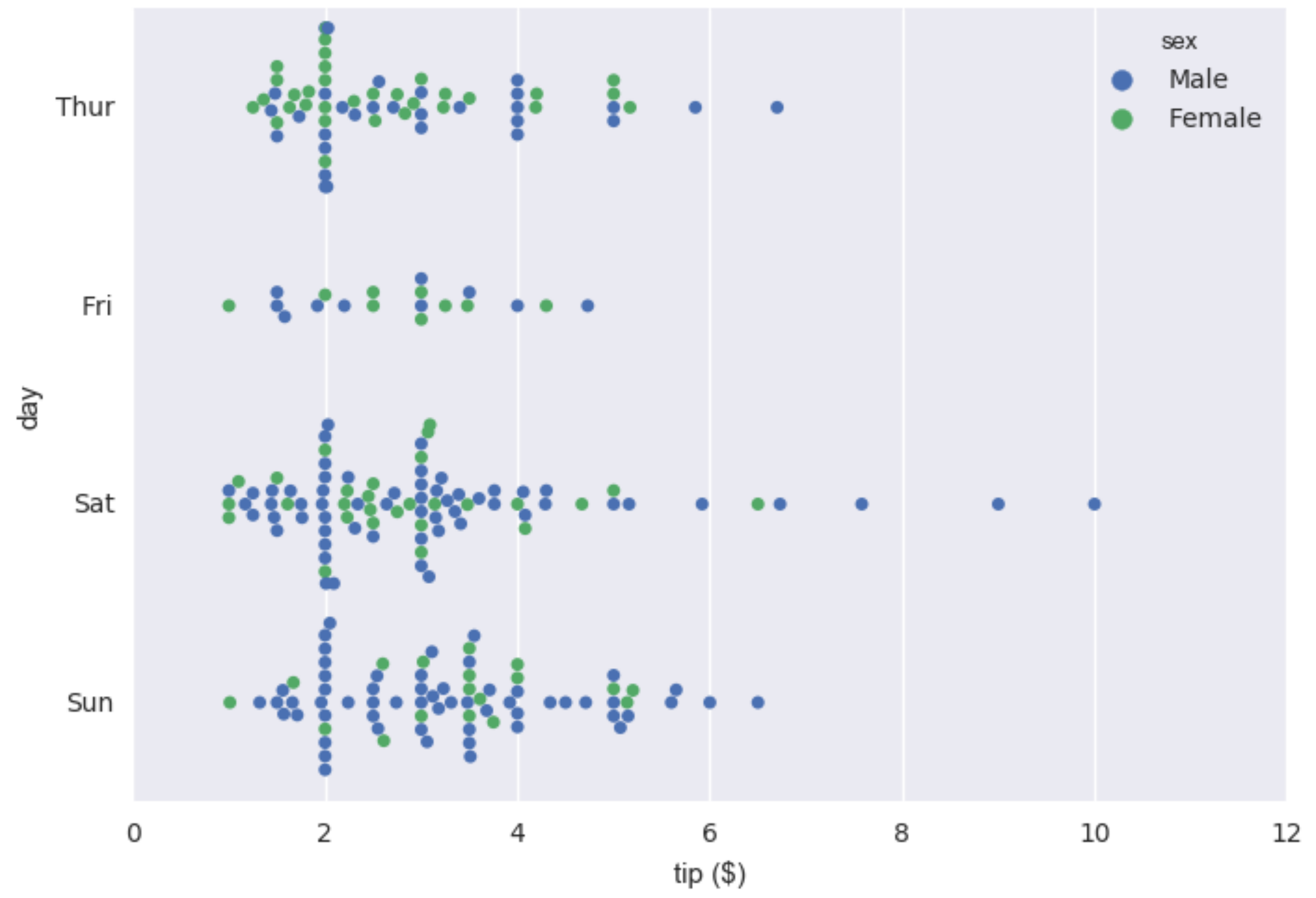
## More grouping



## More grouping with swarmplot()

```
In [13]: sns.swarmplot(x='day', y='tip', data=tips, hue='sex')

In [14]: plt.ylabel('tip ($)')

In [15]: plt.show()
```

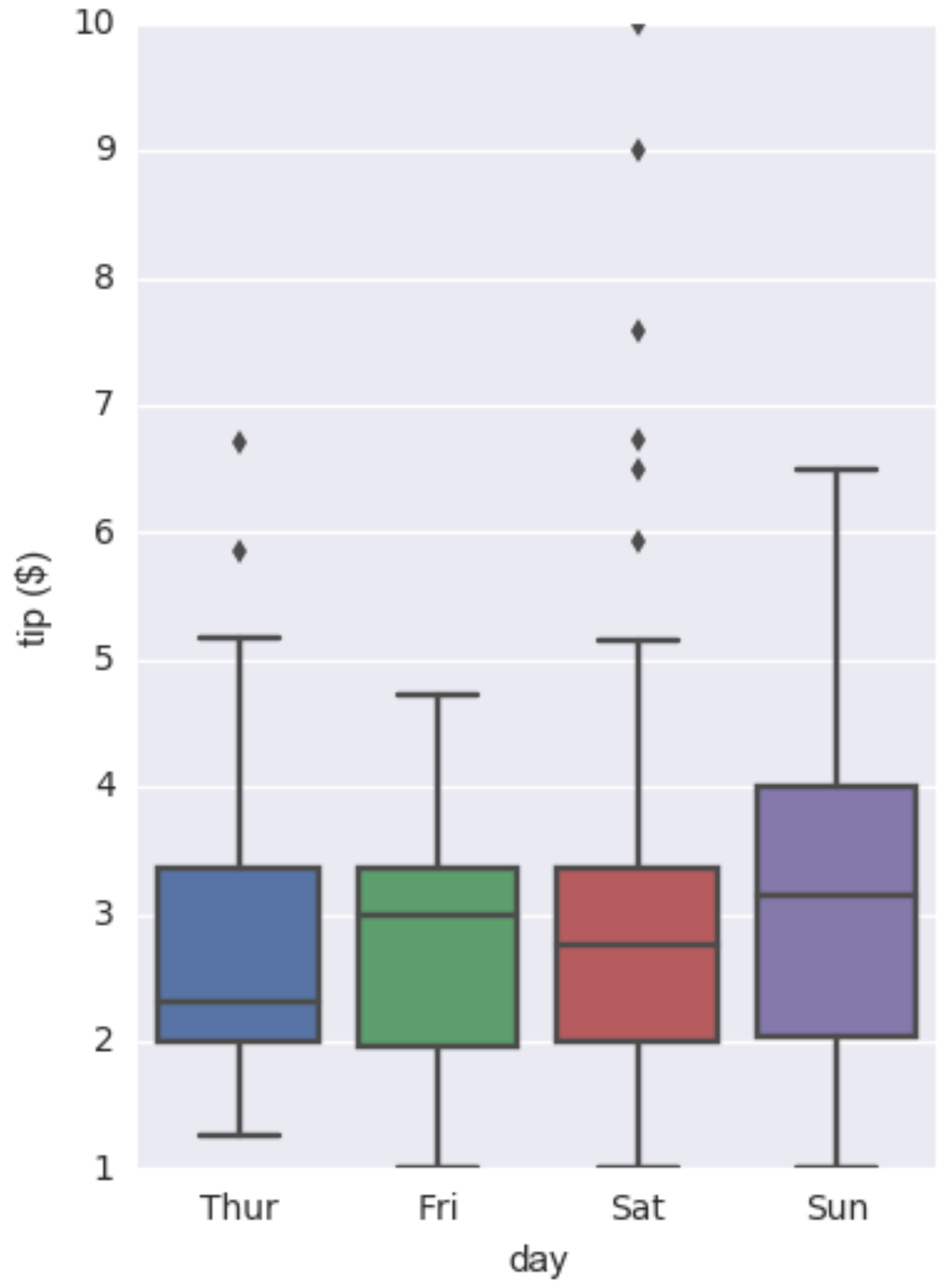
## Changing orientation

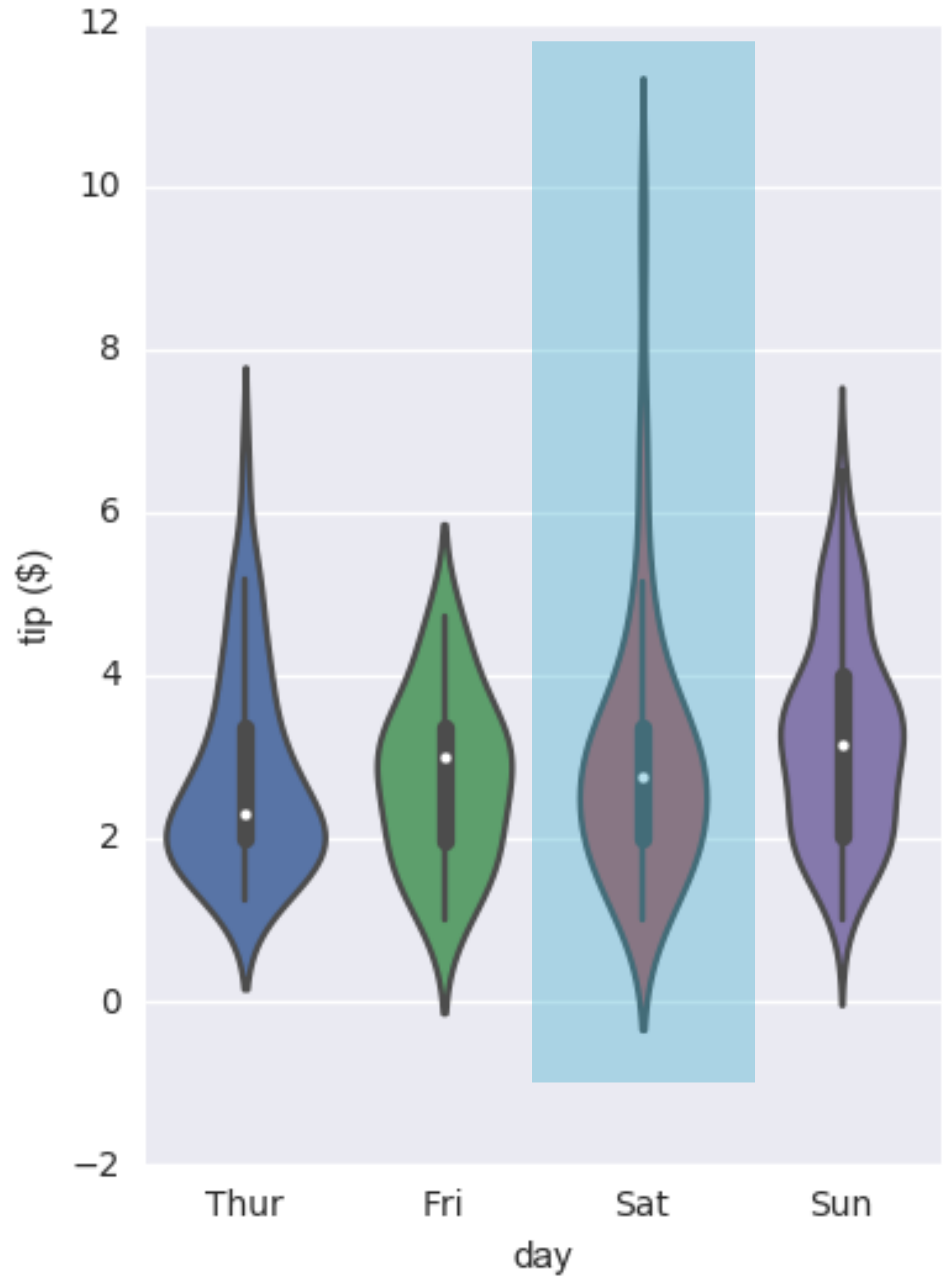


## Changing orientation

```
In [16]: sns.swarmplot(x='tip', y='day', data=tips, hue='sex',
    ...:               orient='h')

In [17]: plt.xlabel('tip ($)')

In [18]: plt.show()
```

# Violin plot

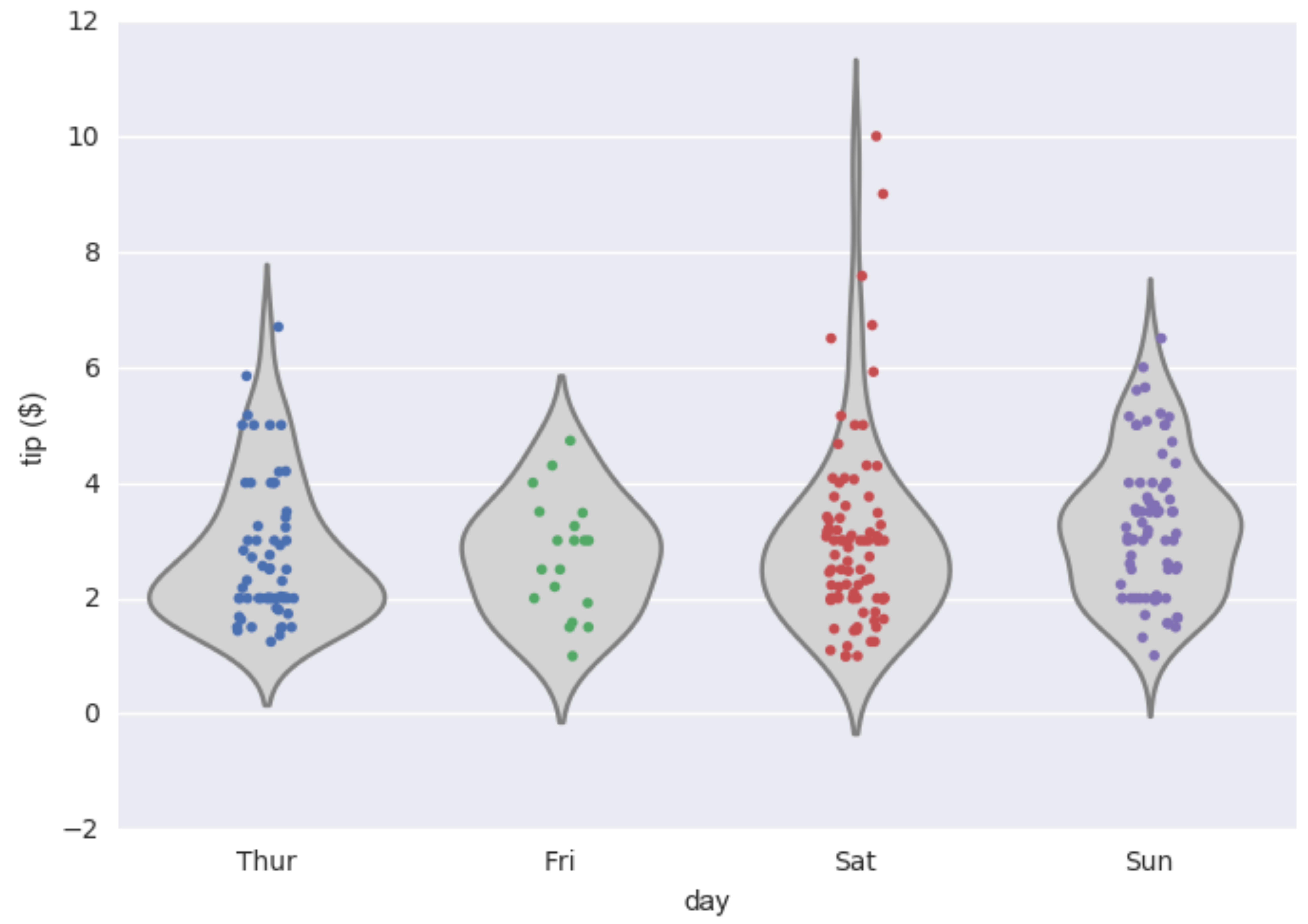

10
9
8
7
6
5
4
3
2
1
tip ($)
Thur
Fri
Sat
Sun
day


12
10
8
6
4
2
0
−2
tip ($)
Thur
Fri
Sat
Sun
day

## Using violinplot()

```
In [19]:  plt.subplot(1,2,1)

In [20]: sns.boxplot(x='day', y='tip', data=tips)

In [21]: plt.ylabel('tip ($)')

In [22]: plt.subplot(1,2,2)

In [23]: sns.violinplot(x='day', y='tip', data=tips)

In [24]: plt.ylabel('tip ($)')

In [25]: plt.tight_layout()

In [26]: plt.show()
```

# Combining plots



## Combining plots

```
In [27]: sns.violinplot(x='day', y='tip', data=tips, inner=None,
    ...:                color='lightgray')

In [28]: sns.stripplot(x='day', y='tip', data=tips, size=4,
    ...:               jitter=True)

In [29]: plt.ylabel('tip ($)')

In [30]: plt.show()
```

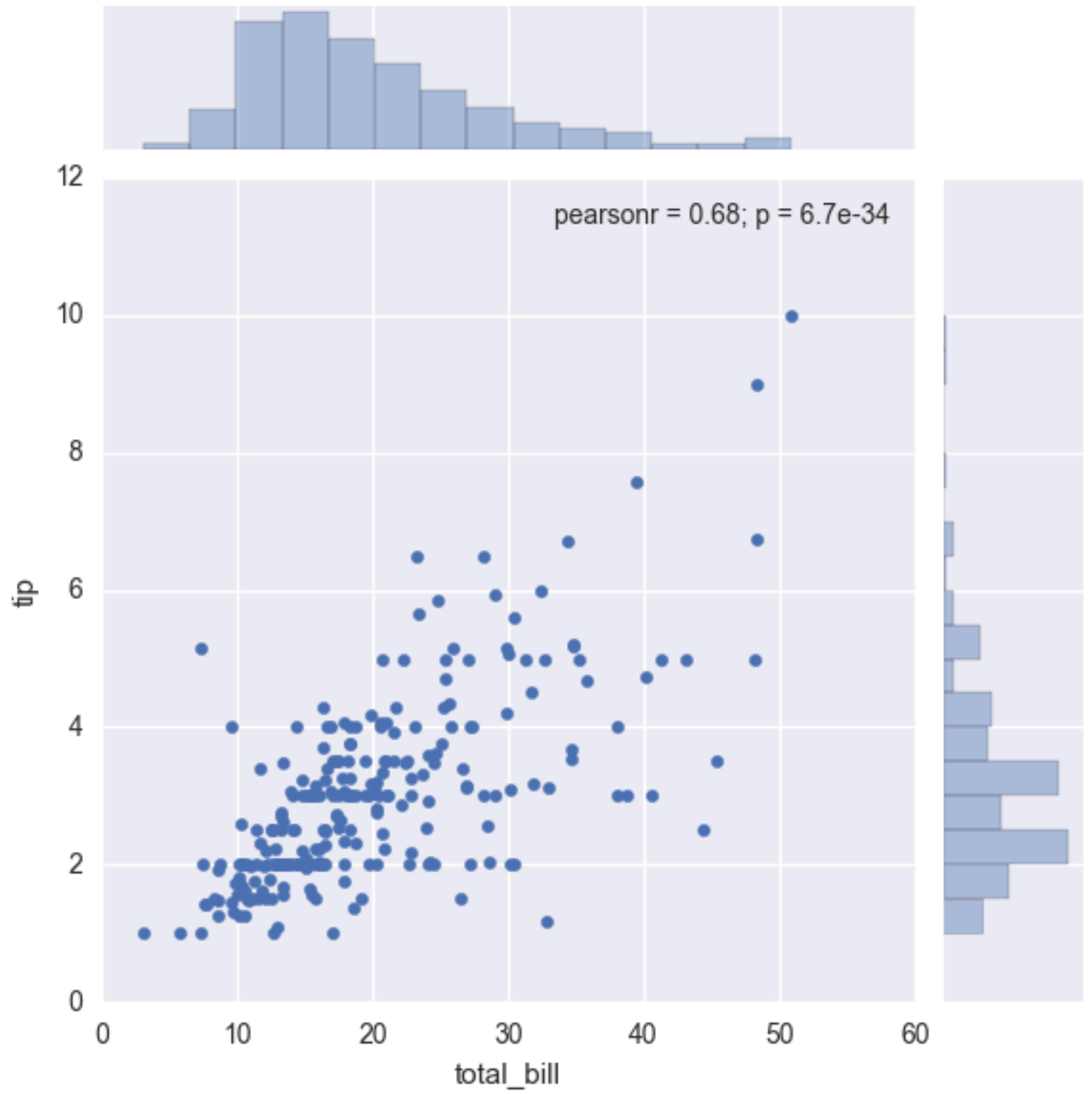
## Let’s practice!

# Visualizing Multivariate Distributions

## Visualizing data

- Bivariate → "two variables"
- Multivariate → "multiple variables"
- Visualizing relationships in multivariate data
  - Joint plots
  - Pair plots
  - Heat maps

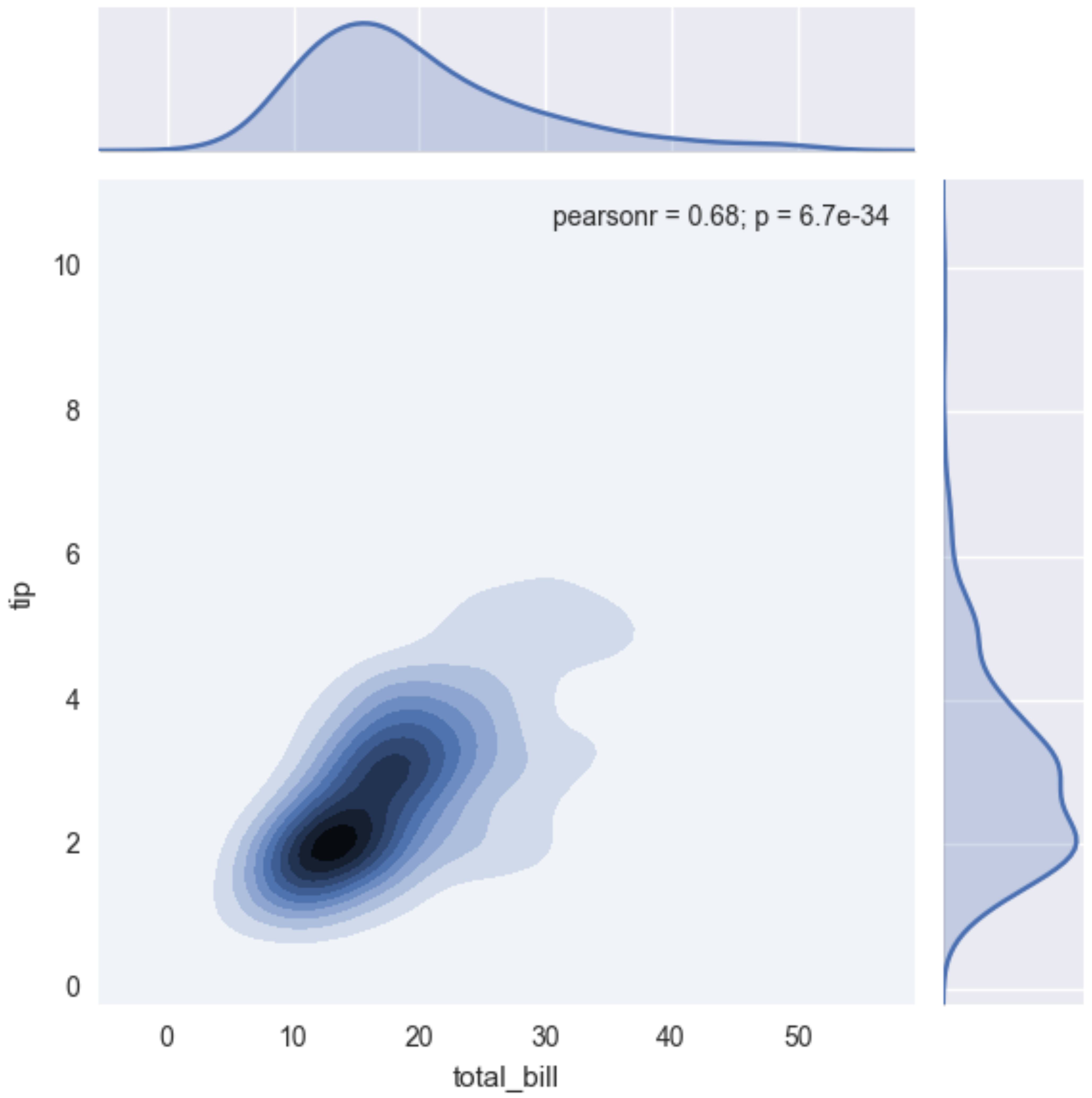
## Joint plot


pearsonr = 0.68; p = 6.7e-34
tip
total_bill
0
2
4
6
8
10
12
0
10
20
30
40
50
60

## Using jointplot()

```
In [1]: sns.jointplot(x= 'total_bill', y= 'tip', data=tips)

In [2]: plt.show()
```

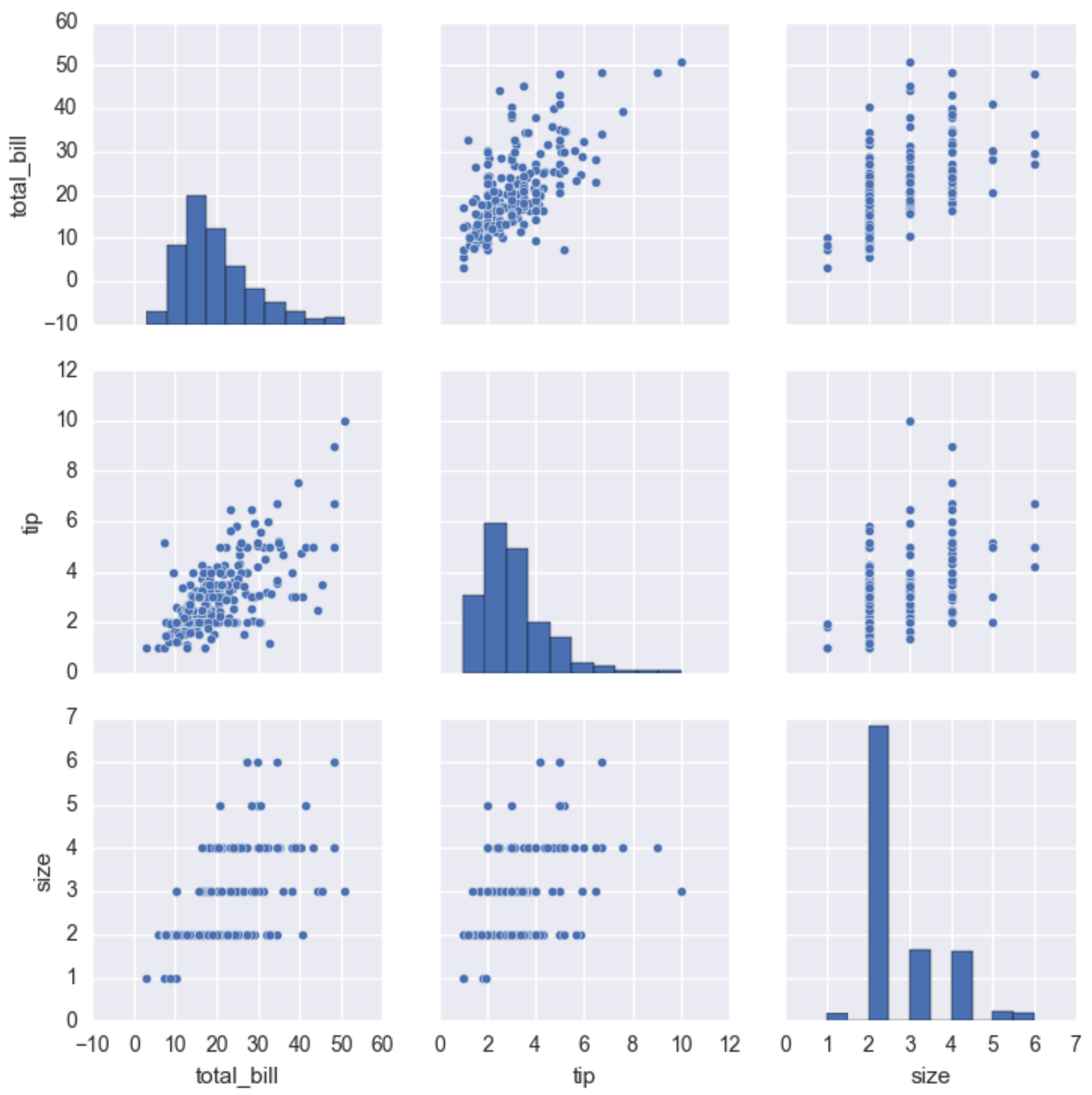
## Joint plot using KDE



## Using kde=True

```
In [3]: sns.jointplot(x='total_bill', y= 'tip', data=tips,
   ...:               kind='kde')

In [4]: plt.show()
```

## Pair plot



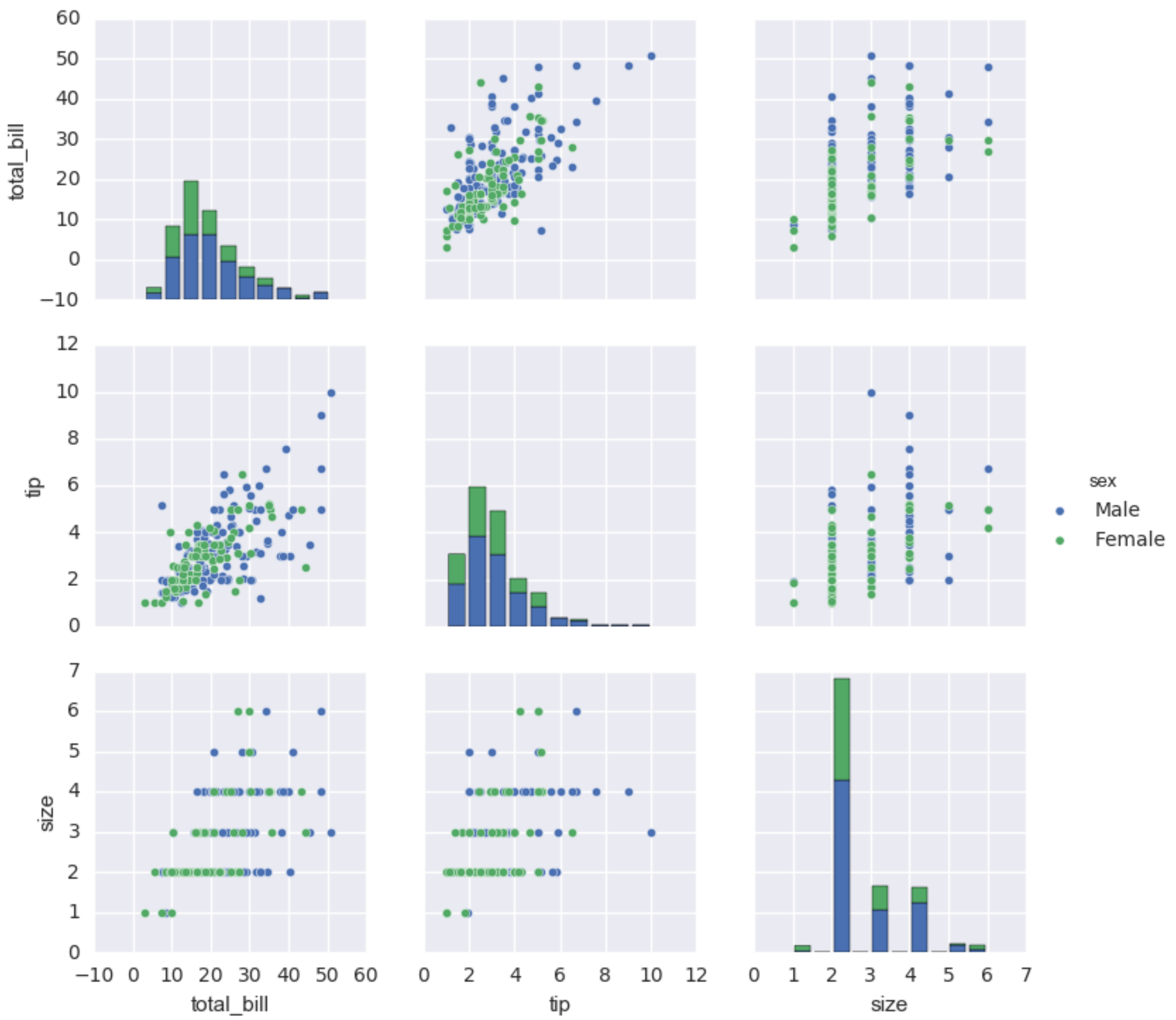
## Using pairplot()

```
In [5]: sns.pairplot(tips)

In [6]: plt.show()
```

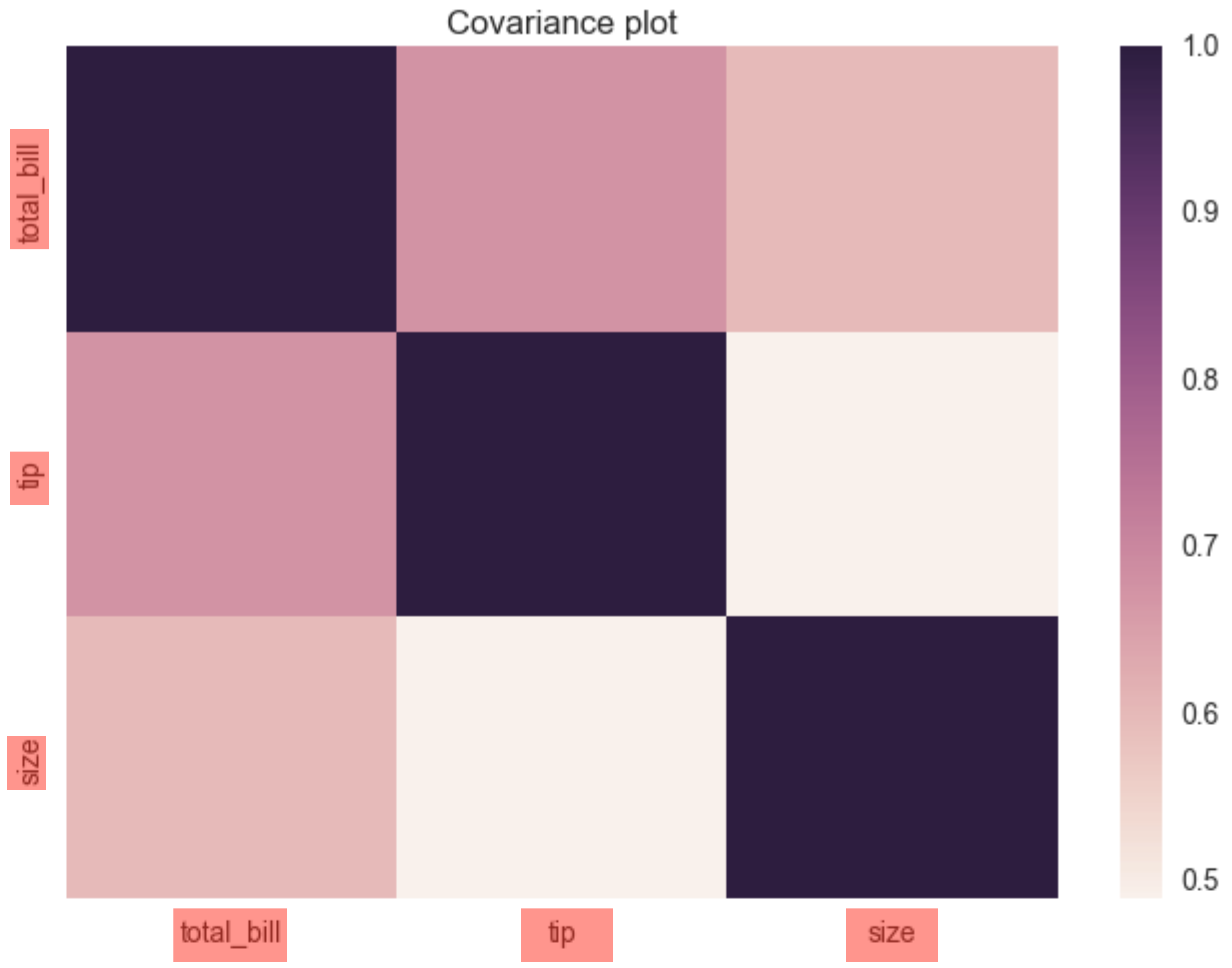
## Using pairplot() with hue

```
In [7]: sns.pairplot(tips, hue='sex')

In [8]: plt.show()
```

# Using pairplot() with hue



## Covariance heat map of tips data



## Using heatmap()

```
In [9]:  print(covariance)
            total_bill       tip      size
total_bill    1.000000  0.675734  0.598315
tip           0.675734  1.000000  0.489299
size          0.598315  0.489299  1.000000

In [10]: sns.heatmap(covariance)

In [11]: plt.title('Covariance plot')

In [12]: plt.show()
```

# Let’s practice!