seaborn

August 11, 2024

1 Seaborn

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

- Provides a layer of abstraction hence simpler to use
- better aesthetics
- more graphs included

1.0.1 Main Components of Seaborn

Types of Functions 1. Figure Level 2. Axis Level

Main Classification - Relational Plot - Distribution Plot - Categorical Plot - Regression Plot - Matrix Plot - Multiplots

[80]:
```
import seaborn as sns
import numpy as np
import plotly.express as px
```

1.1 1. Relational Plot

Generally used for - see the statistical relation between 2 or more variables. - Bivariate Analysis

Figure level - relplot()
Axis level - 1. scatterplot() 2. lineplot()

[2]:
```
tips = sns.load_dataset('tips')
tips
```

[2]:

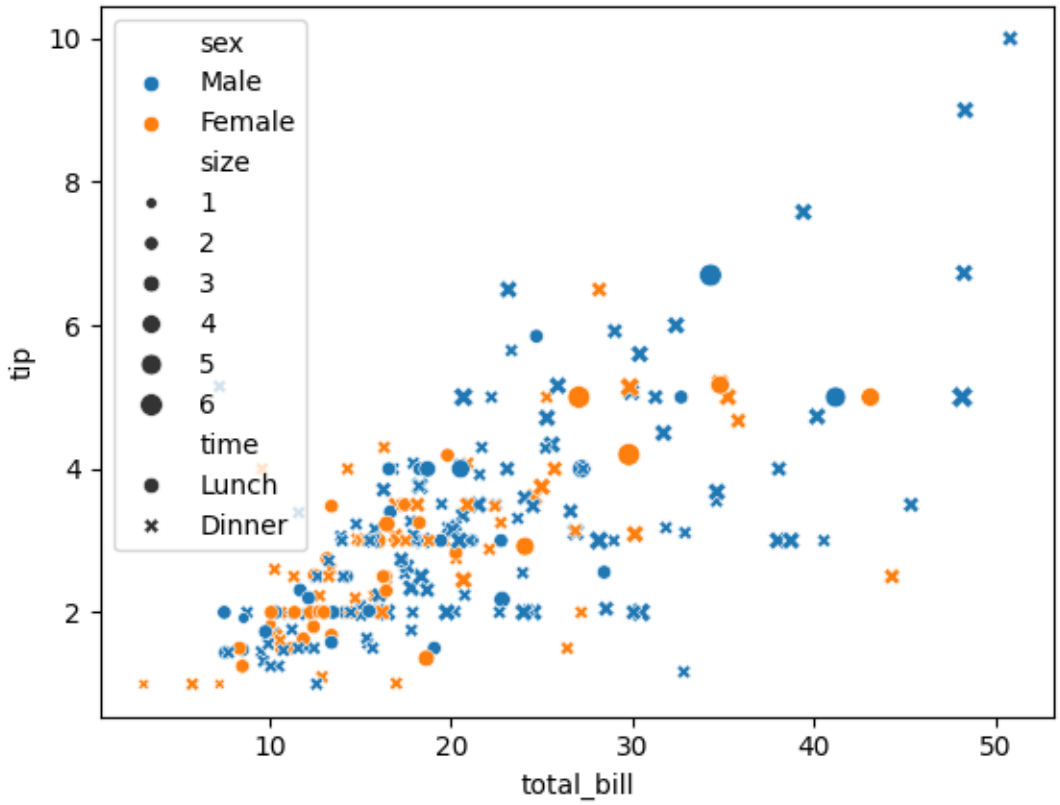
	total_bill	tip	sex	smoker	day	time	size
0	16.99	1.01	Female	No	Sun	Dinner	2
1	10.34	1.66	Male	No	Sun	Dinner	3
2	21.01	3.50	Male	No	Sun	Dinner	3
3	23.68	3.31	Male	No	Sun	Dinner	2
4	24.59	3.61	Female	No	Sun	Dinner	4
..	…	…	…	…	…	…	…
239	29.03	5.92	Male	No	Sat	Dinner	3
240	27.18	2.00	Female	Yes	Sat	Dinner	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

[244 rows x 7 columns]
```

1.1.1 sns.scatterplot(data, x, y, hue, style, size)

[6]:
```
sns.scatterplot(data=tips, x='total_bill', y='tip', hue='sex', style='time',␣
↪size='size')
```

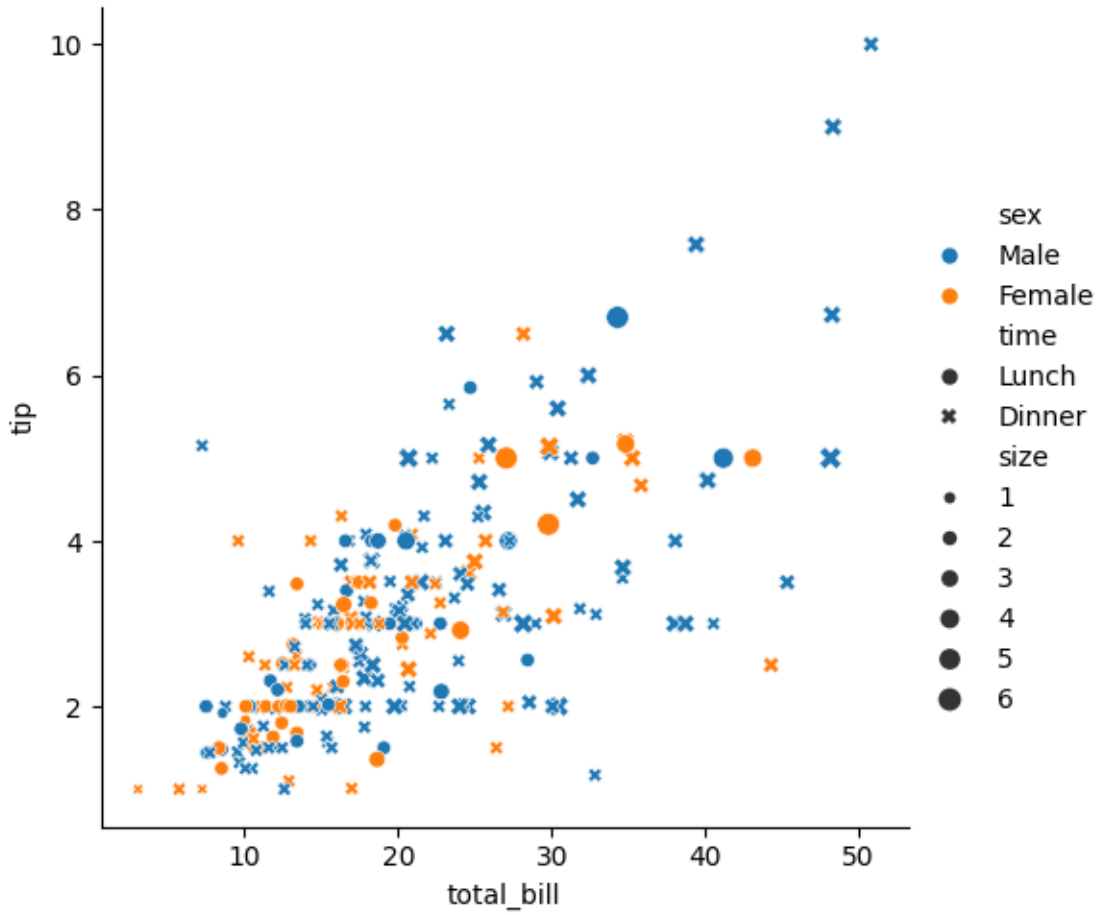
[6]:
```
<Axes: xlabel='total_bill', ylabel='tip'>
```



sns.relplot(data, x, y, kind, hue, style, size)

[8]:
```
sns.relplot(data=tips, x='total_bill', y='tip', kind='scatter', hue='sex',␣
↪style='time', size='size')
```

[8]:
```
<seaborn.axisgrid.FacetGrid at 0x250fe9cc980>
```



1.1.2 sns.lineplot(data, x, y)

[11]:
```
gap = px.data.gapminder()
temp = gap[gap['country'] == 'India']
temp
```

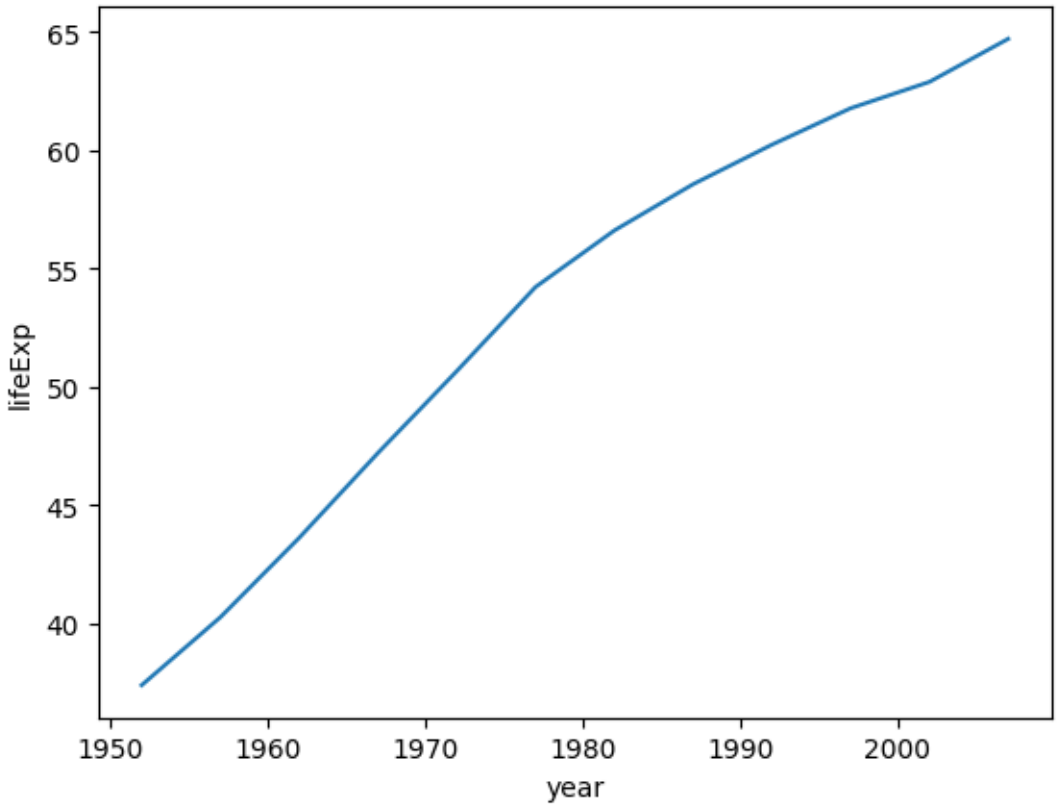
[11]:

	country	continent	year	lifeExp	pop	gdpPercap	iso_alpha	\
696	India	Asia	1952	37.373	372000000	546.565749	IND	
697	India	Asia	1957	40.249	409000000	590.061996	IND	
698	India	Asia	1962	43.605	454000000	658.347151	IND	
699	India	Asia	1967	47.193	506000000	700.770611	IND	
700	India	Asia	1972	50.651	567000000	724.032527	IND	
701	India	Asia	1977	54.208	634000000	813.337323	IND	
702	India	Asia	1982	56.596	708000000	855.723538	IND	
703	India	Asia	1987	58.553	788000000	976.512676	IND	
704	India	Asia	1992	60.223	872000000	1164.406809	IND	
705	India	Asia	1997	61.765	959000000	1458.817442	IND	
706	India	Asia	2002	62.879	1034172547	1746.769454	IND	

```
707   India      Asia  2007   64.698  1110396331  2452.210407       IND

     iso_num
696      356
697      356
698      356
699      356
700      356
701      356
702      356
703      356
704      356
705      356
706      356
707      356
```

[13]:
```
sns.lineplot(data=temp, x='year', y='lifeExp')
```

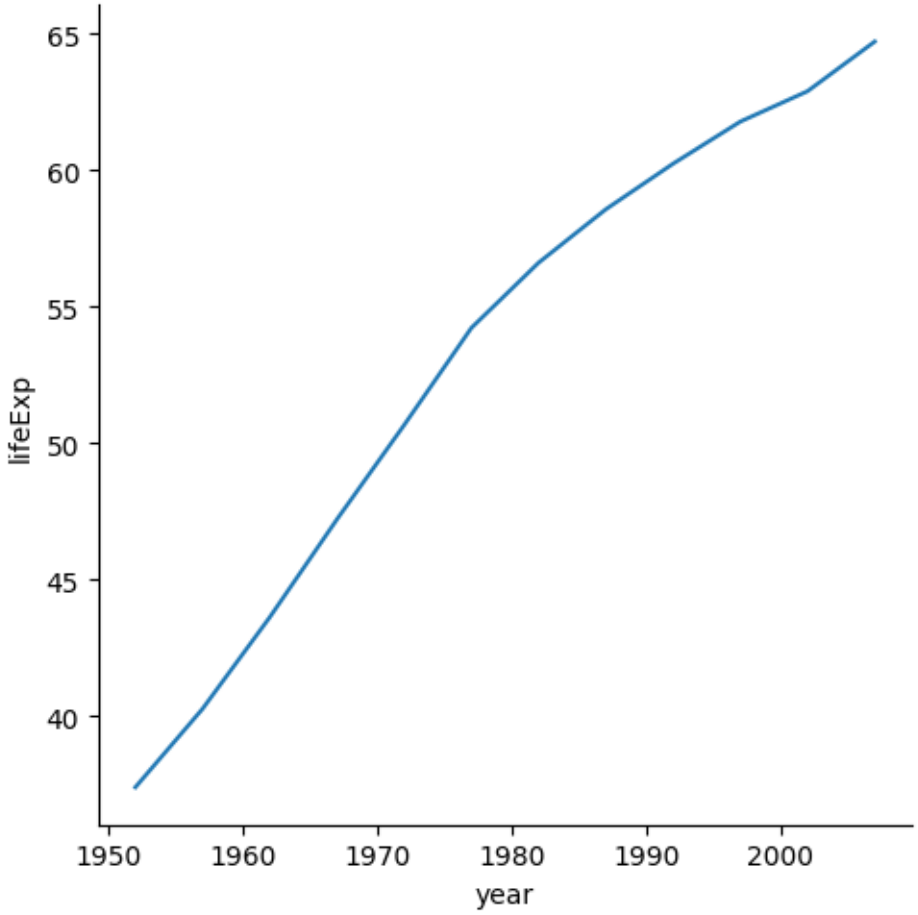
[13]:
```
<Axes: xlabel='year', ylabel='lifeExp'>
```



sns.relplot(data, x, y, kind, hue, style, size)

[14]:
```
sns.relplot(data=temp, x='year', y='lifeExp', kind='line')
```

[14]:
```
<seaborn.axisgrid.FacetGrid at 0x250fe821d90>
```



[17]:
```
temp = gap[gap['country'].isin(['India', 'Brazil', 'Germany'])]
temp
```

[17]:

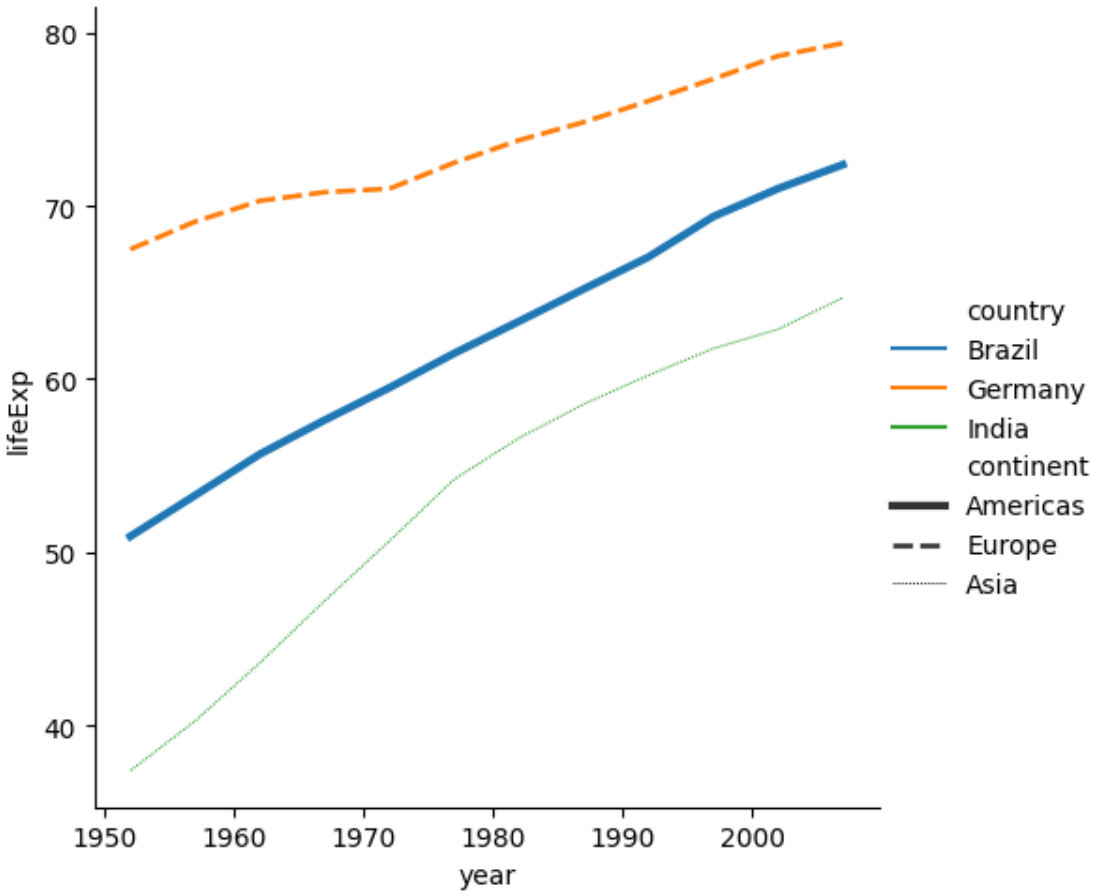
	country	continent	year	lifeExp	pop	gdpPercap	iso_alpha	\
168	Brazil	Americas	1952	50.917	56602560	2108.944355	BRA	
169	Brazil	Americas	1957	53.285	65551171	2487.365989	BRA	
170	Brazil	Americas	1962	55.665	76039390	3336.585802	BRA	
171	Brazil	Americas	1967	57.632	88049823	3429.864357	BRA	
172	Brazil	Americas	1972	59.504	100840058	4985.711467	BRA	
173	Brazil	Americas	1977	61.489	114313951	6660.118654	BRA	
174	Brazil	Americas	1982	63.336	128962939	7030.835878	BRA	
175	Brazil	Americas	1987	65.205	142938076	7807.095818	BRA	
176	Brazil	Americas	1992	67.057	155975974	6950.283021	BRA	
177	Brazil	Americas	1997	69.388	168546719	7957.980824	BRA	

```
178   Brazil  Americas  2002   71.006   179914212   8131.212843       BRA
179   Brazil  Americas  2007   72.390   190010647   9065.800825       BRA
564  Germany    Europe  1952   67.500    69145952   7144.114393       DEU
565  Germany    Europe  1957   69.100    71019069  10187.826650       DEU
566  Germany    Europe  1962   70.300    73739117  12902.462910       DEU
567  Germany    Europe  1967   70.800    76368453  14745.625610       DEU
568  Germany    Europe  1972   71.000    78717088  18016.180270       DEU
569  Germany    Europe  1977   72.500    78160773  20512.921230       DEU
570  Germany    Europe  1982   73.800    78335266  22031.532740       DEU
571  Germany    Europe  1987   74.847    77718298  24639.185660       DEU
572  Germany    Europe  1992   76.070    80597764  26505.303170       DEU
573  Germany    Europe  1997   77.340    82011073  27788.884160       DEU
574  Germany    Europe  2002   78.670    82350671  30035.801980       DEU
575  Germany    Europe  2007   79.406    82400996  32170.374420       DEU
696    India      Asia  1952   37.373   372000000    546.565749       IND
697    India      Asia  1957   40.249   409000000    590.061996       IND
698    India      Asia  1962   43.605   454000000    658.347151       IND
699    India      Asia  1967   47.193   506000000    700.770611       IND
700    India      Asia  1972   50.651   567000000    724.032527       IND
701    India      Asia  1977   54.208   634000000    813.337323       IND
702    India      Asia  1982   56.596   708000000    855.723538       IND
703    India      Asia  1987   58.553   788000000    976.512676       IND
704    India      Asia  1992   60.223   872000000   1164.406809       IND
705    India      Asia  1997   61.765   959000000   1458.817442       IND
706    India      Asia  2002   62.879  1034172547   1746.769454       IND
707    India      Asia  2007   64.698  1110396331   2452.210407       IND

    iso_num
168      76
169      76
170      76
171      76
172      76
173      76
174      76
175      76
176      76
177      76
178      76
179      76
564     276
565     276
566     276
567     276
568     276
569     276
570     276
```

```
571      276
572      276
573      276
574      276
575      276
696      356
697      356
698      356
699      356
700      356
701      356
702      356
703      356
704      356
705      356
706      356
707      356
```

[21]:
```
sns.relplot(data=temp, x='year', y='lifeExp', kind='line', hue='country',␣
↪style='continent', size='continent')
```

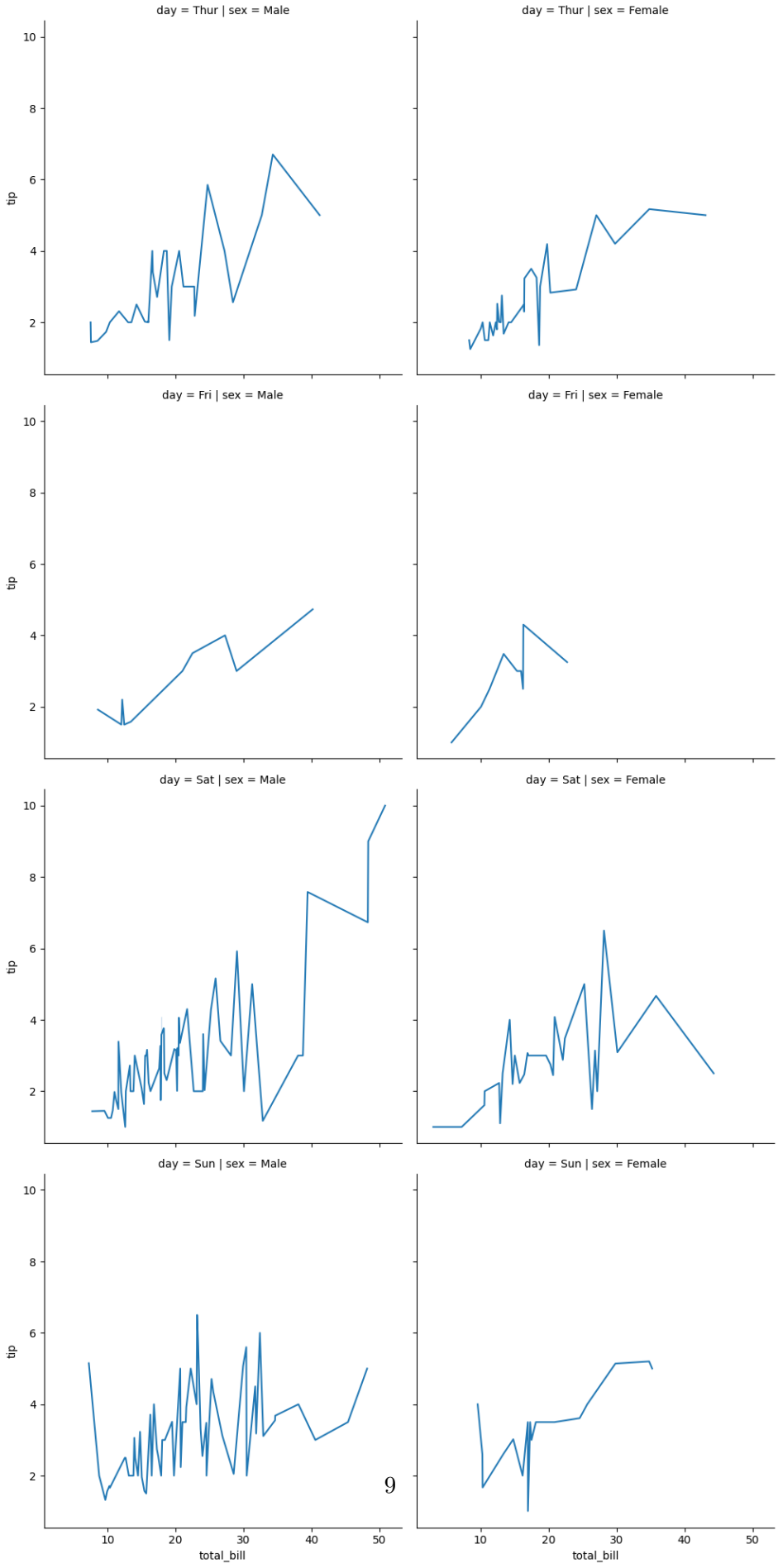
[21]:
```
<seaborn.axisgrid.FacetGrid at 0x250835a25d0>
```



Facet Plot Figure level function, only work with relplot

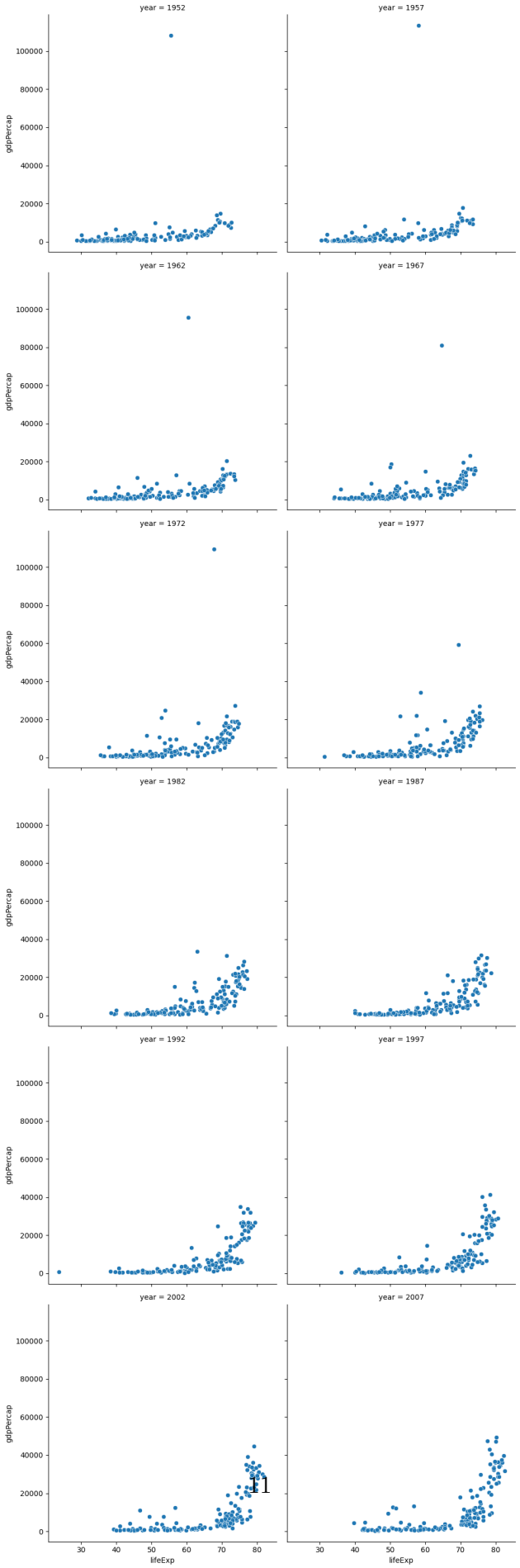
[22]:
```
sns.relplot(data=tips, x='total_bill', y='tip', kind='line', col='sex',␣
↪row='day')
```

[22]:
```
<seaborn.axisgrid.FacetGrid at 0x2508358b770>
```


day = Thur | sex = Male
day = Thur | sex = Female
day = Fri | sex = Male
day = Fri | sex = Female
day = Sat | sex = Male
day = Sat | sex = Female
day = Sun | sex = Male
day = Sun | sex = Female
tip
total_bill
2
4
6
8
10
20
30
40
50

[23]:
```
# Col Wrap
sns.relplot(data=gap, x='lifeExp', y='gdpPercap', kind='scatter', col='year',␣
↪col_wrap=2)
```

[23]:
```
<seaborn.axisgrid.FacetGrid at 0x25082ca3770>
```


year = 1952
year = 1957
year = 1962
year = 1967
year = 1972
year = 1977
year = 1982
year = 1987
year = 1992
year = 1997
year = 2002
year = 2007
gdpPercap
0
20000
40000
60000
80000
100000
30
40
50
60
70
80
lifeExp

1.2 2. Distribution Plots

Generally used for - Univariate Analysis - used to find out the distribution of data - shows the range of the data - central tendency - used to check whether there are any outliers or the data bimodal?

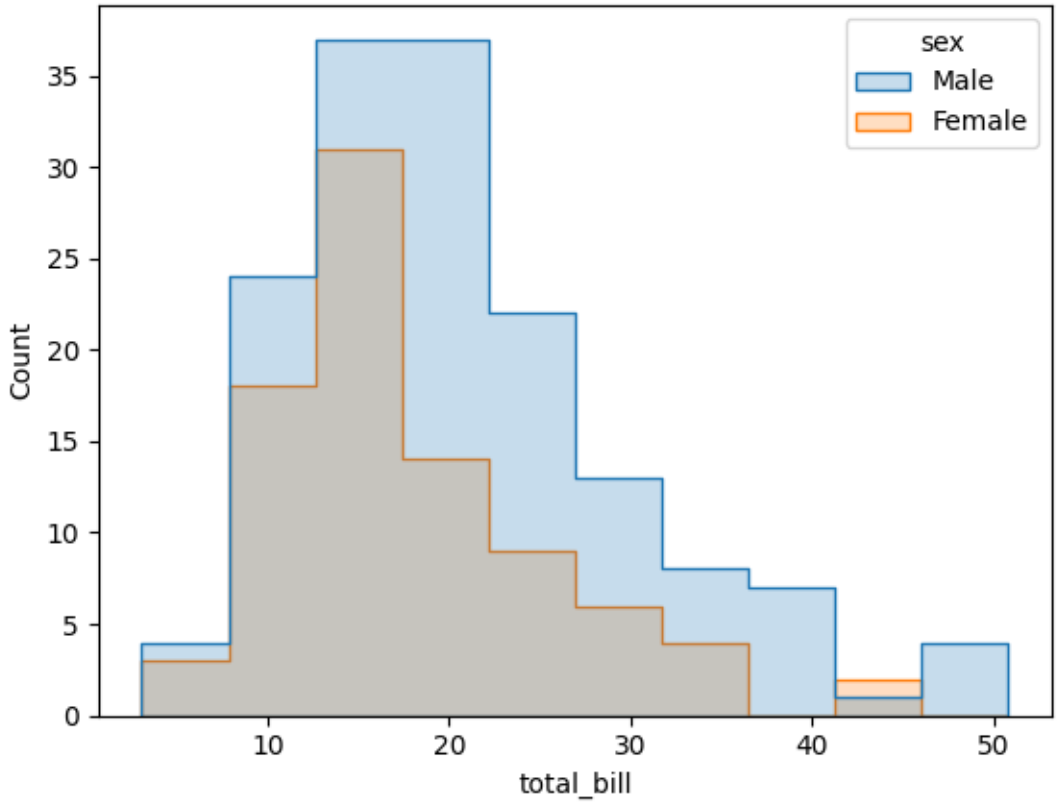
Figure level - displot()
Axis level - 1. histplot() 2. kdeplot() 3. rugplot()

1.2.1 sns.histplot(data, x, bins, hue, element)

element is used to designing

[29]:
```
sns.histplot(data=tips, x='total_bill', bins=10, hue='sex', element='step')
```

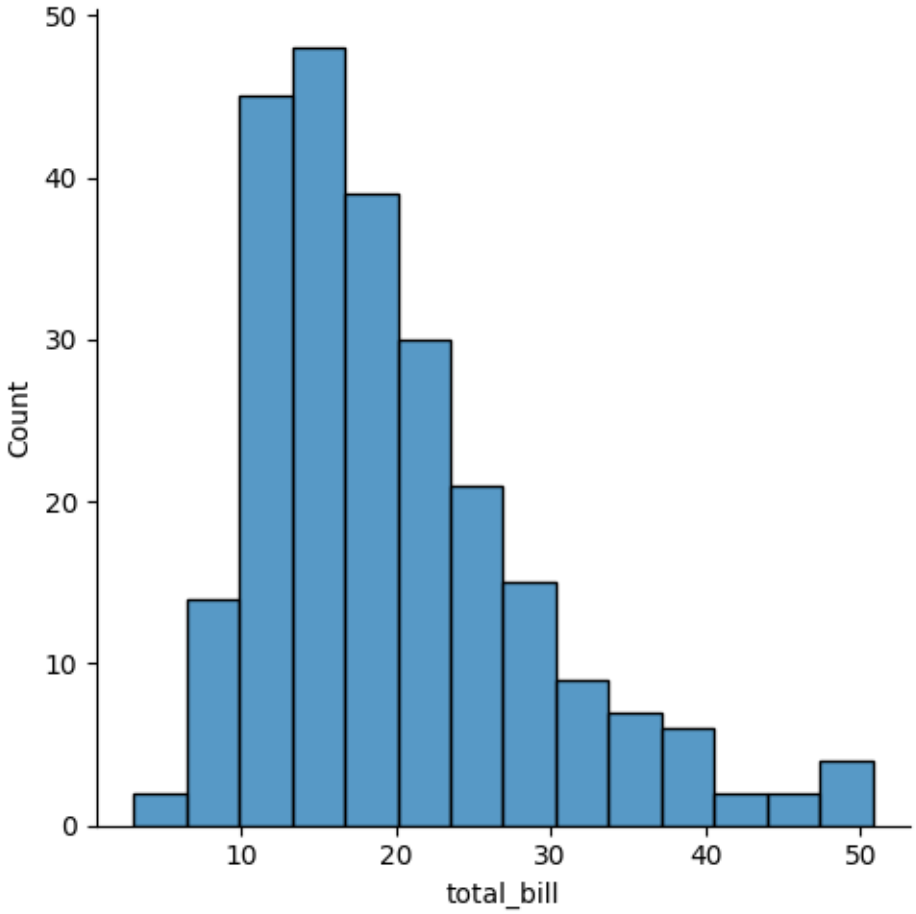
[29]:
```
<Axes: xlabel='total_bill', ylabel='Count'>
```



sns.displot(data, x, kind)

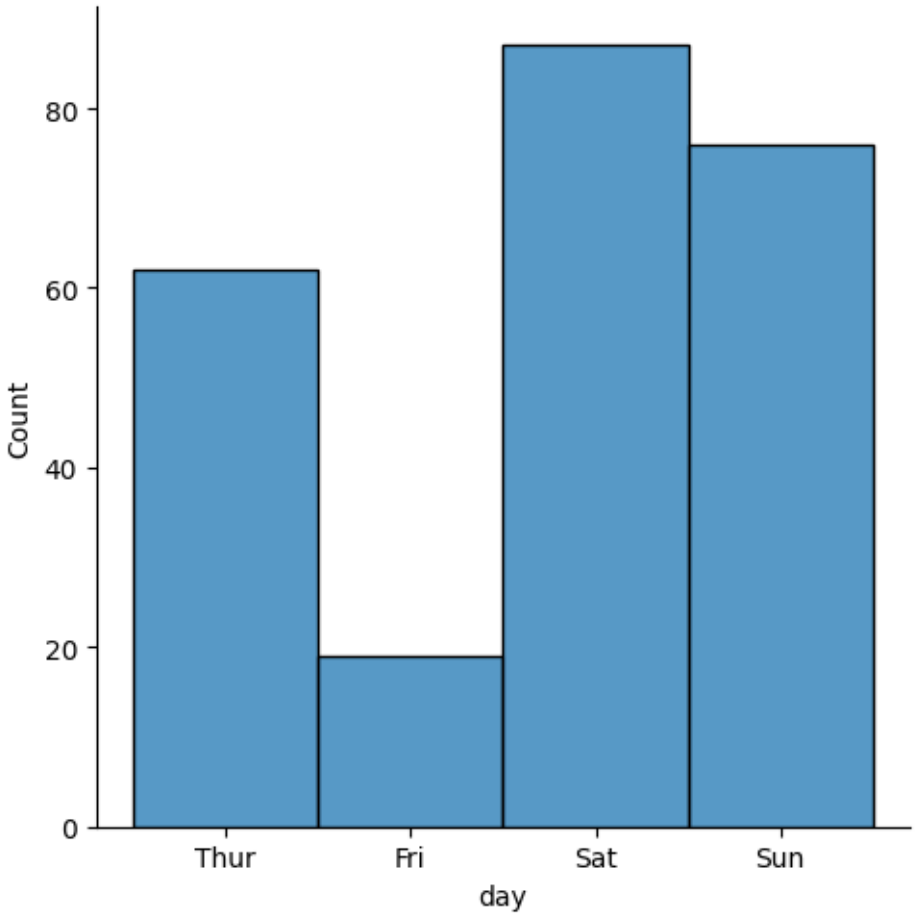
[25]:
```
sns.displot(data=tips, x='total_bill', kind='hist')
```

[25]: <seaborn.axisgrid.FacetGrid at 0x2508390cf50>



[27]:
```
# Categorical variables can also be plotted

sns.displot(data=tips, x='day', kind='hist')
```

[27]: <seaborn.axisgrid.FacetGrid at 0x25085d6e390>



[30]:
```
titanic = sns.load_dataset('titanic')
titanic
```

[30]:

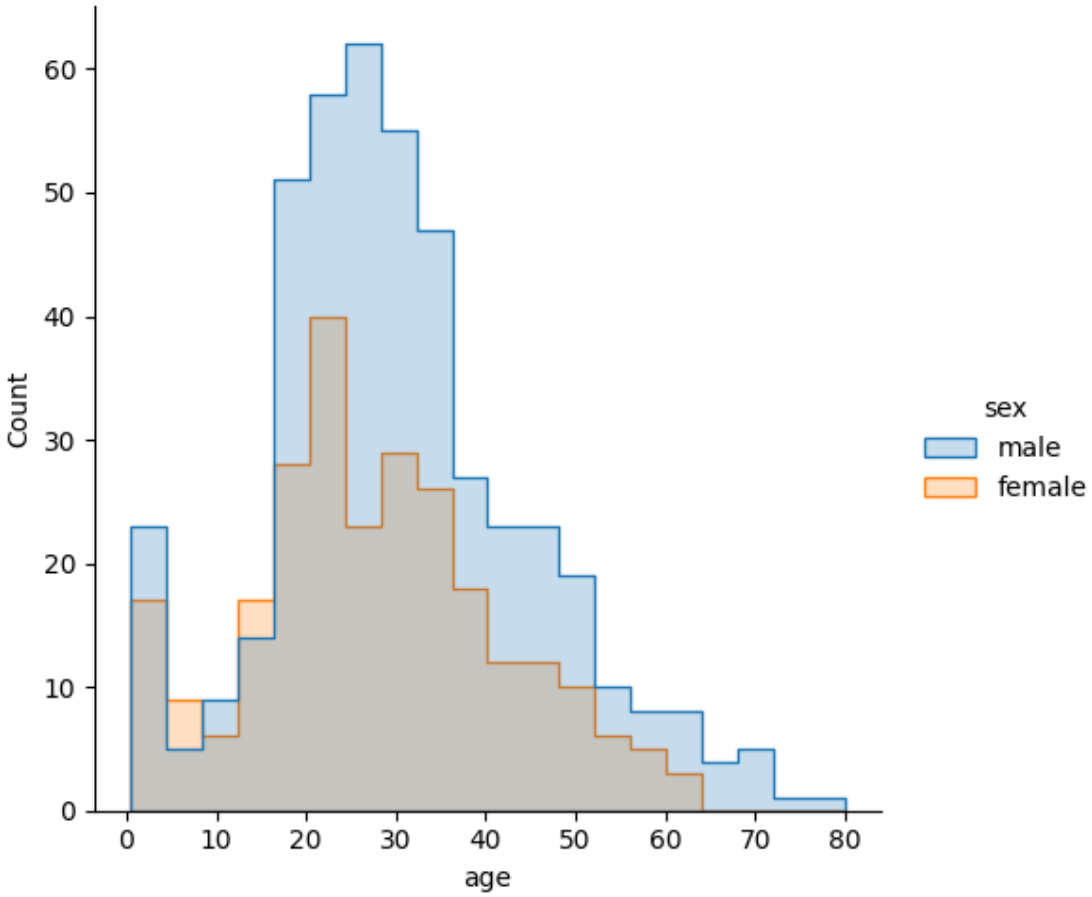
	survived	pclass	sex	age	sibsp	parch	fare	embarked	class	\
0	0	3	male	22.0	1	0	7.2500	S	Third	
1	1	1	female	38.0	1	0	71.2833	C	First	
2	1	3	female	26.0	0	0	7.9250	S	Third	
3	1	1	female	35.0	1	0	53.1000	S	First	
4	0	3	male	35.0	0	0	8.0500	S	Third	
..	…	…	…	…	…	…	…	…	…	
886	0	2	male	27.0	0	0	13.0000	S	Second	
887	1	1	female	19.0	0	0	30.0000	S	First	
888	0	3	female	NaN	1	2	23.4500	S	Third	
889	1	1	male	26.0	0	0	30.0000	C	First	
890	0	3	male	32.0	0	0	7.7500	Q	Third	

	who	adult_male	deck	embark_town	alive	alone
0	man	True	NaN	Southampton	no	False

```
1      woman       False    C    Cherbourg   yes  False
2      woman       False  NaN  Southampton   yes   True
3      woman       False    C  Southampton   yes  False
4        man        True  NaN  Southampton    no   True
..       …          …   …          …    …    …
886      man        True  NaN  Southampton    no   True
887    woman       False    B  Southampton   yes   True
888    woman       False  NaN  Southampton    no  False
889      man        True    C    Cherbourg   yes   True
890      man        True  NaN   Queenstown    no   True

[891 rows x 15 columns]
```

[31]:
```
sns.displot(data=titanic, x='age', kind='hist', element='step', hue='sex')
```

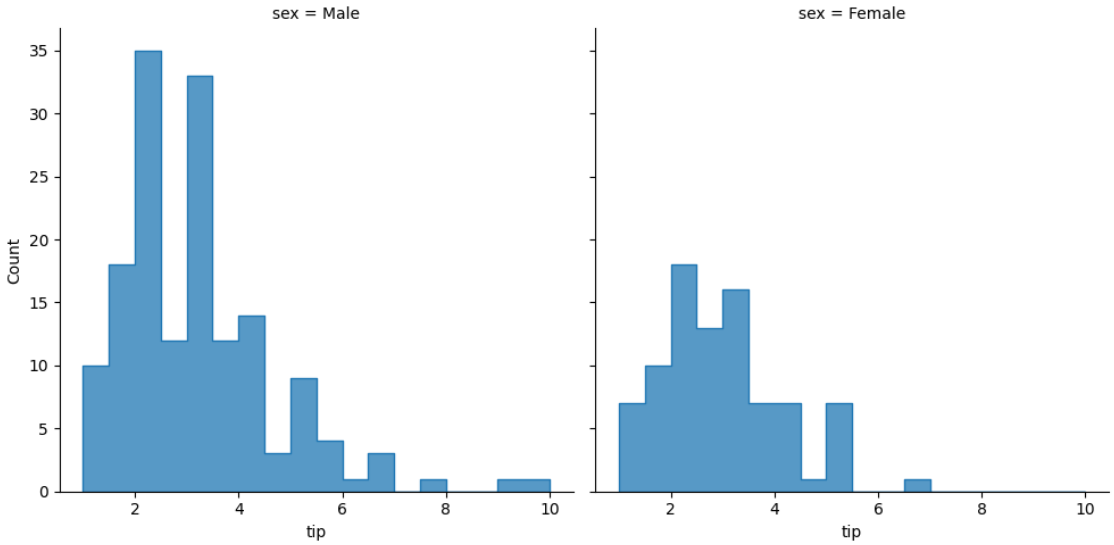
[31]:
```
<seaborn.axisgrid.FacetGrid at 0x25082ca02c0>
```



Facet Plot

[32]:
```
sns.displot(data=tips, x='tip', kind='hist', col='sex', element='step')
```

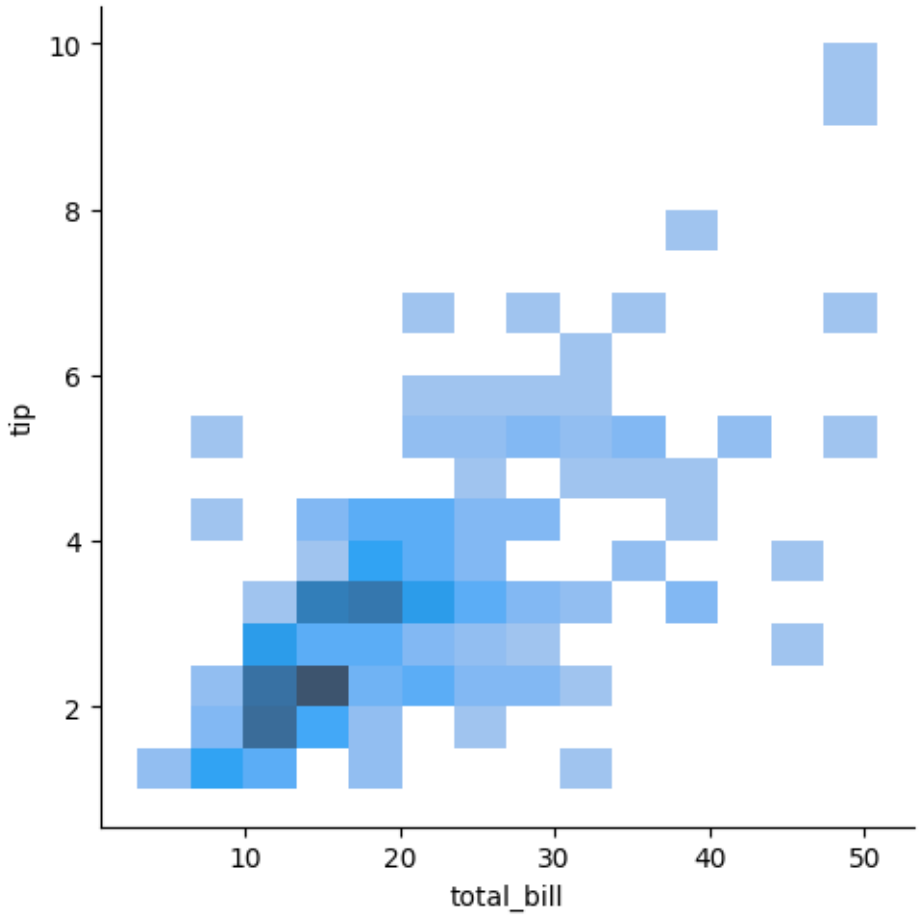
[32]:
```
<seaborn.axisgrid.FacetGrid at 0x25087a84a70>
```



Bivariate Histogram A bivariate histogram bins the data within rectangles that tile the plot and then shows the count of observations within each rectangle with the fill color

[42]:
```
# sns.histplot(data=tips, x='total_bill', y='tip')
sns.displot(data=tips, x='total_bill', y='tip', kind='hist')
```

[42]:
```
<seaborn.axisgrid.FacetGrid at 0x25086a75580>
```

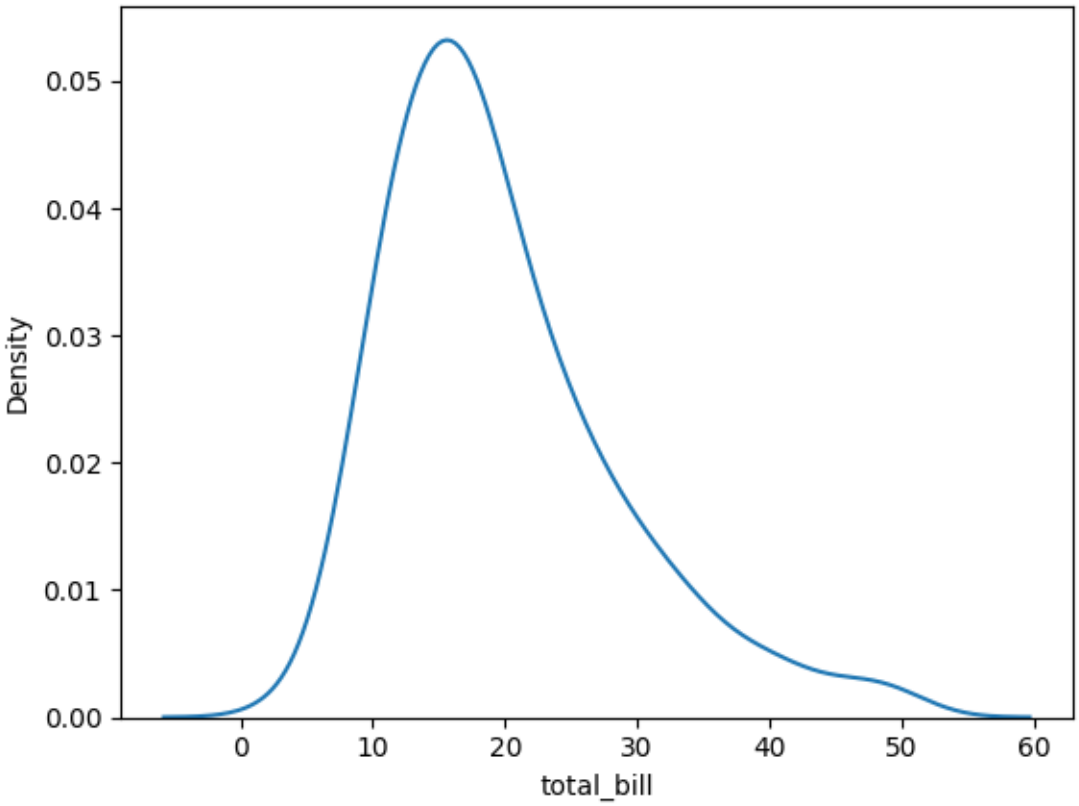


1.2.2 sns.kdeplot(data, x, hue, fill)

Rather than using discrete bins, a KDE plot smooths the observations with a Gaussian kernel, producing a continuous density estimate

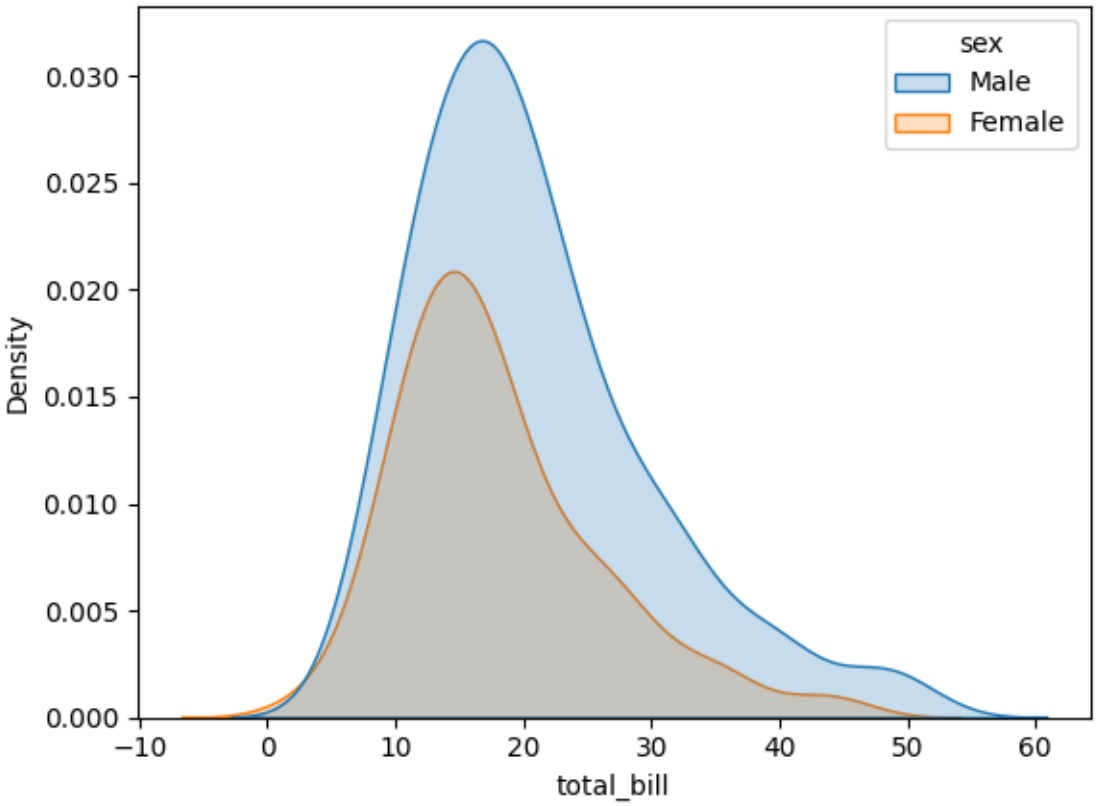
[33]:
```
sns.kdeplot(data=tips, x='total_bill')
```

[33]:
```
<Axes: xlabel='total_bill', ylabel='Density'>
```



[39]:
```
sns.kdeplot(data=tips, x='total_bill', hue='sex', fill=True)
```

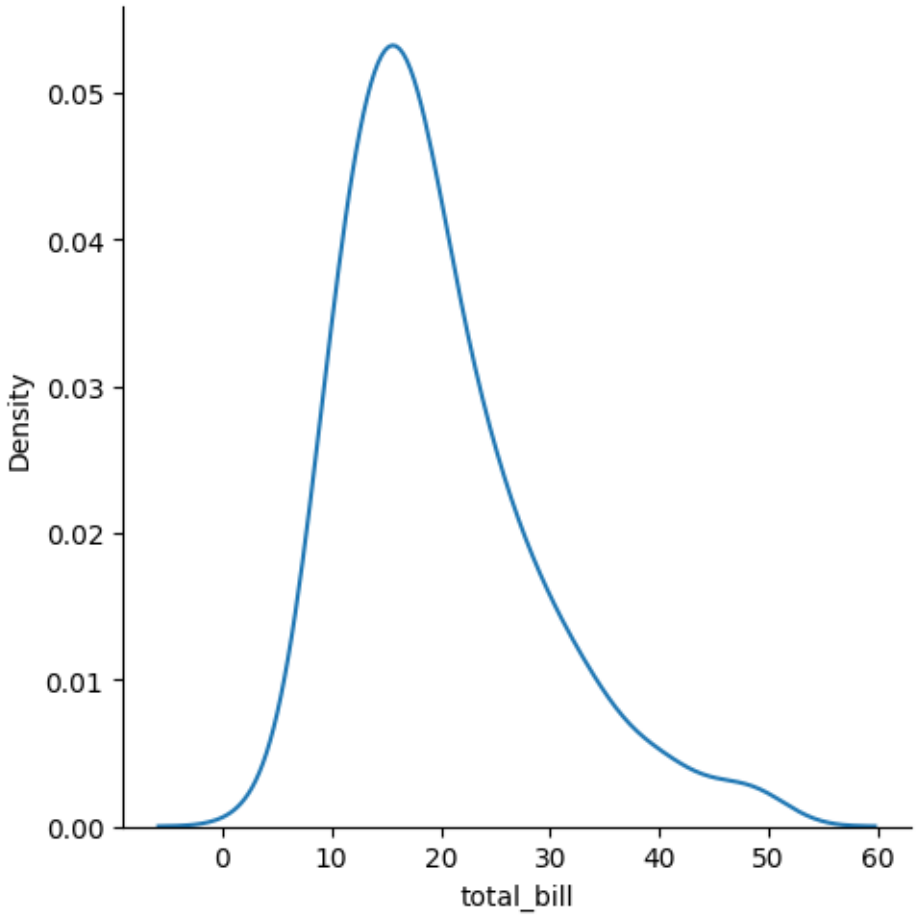
[39]:
```
<Axes: xlabel='total_bill', ylabel='Density'>
```



sns.displot(data, x, kind)

[34]:
```
sns.displot(data=tips, x='total_bill', kind='kde')
```

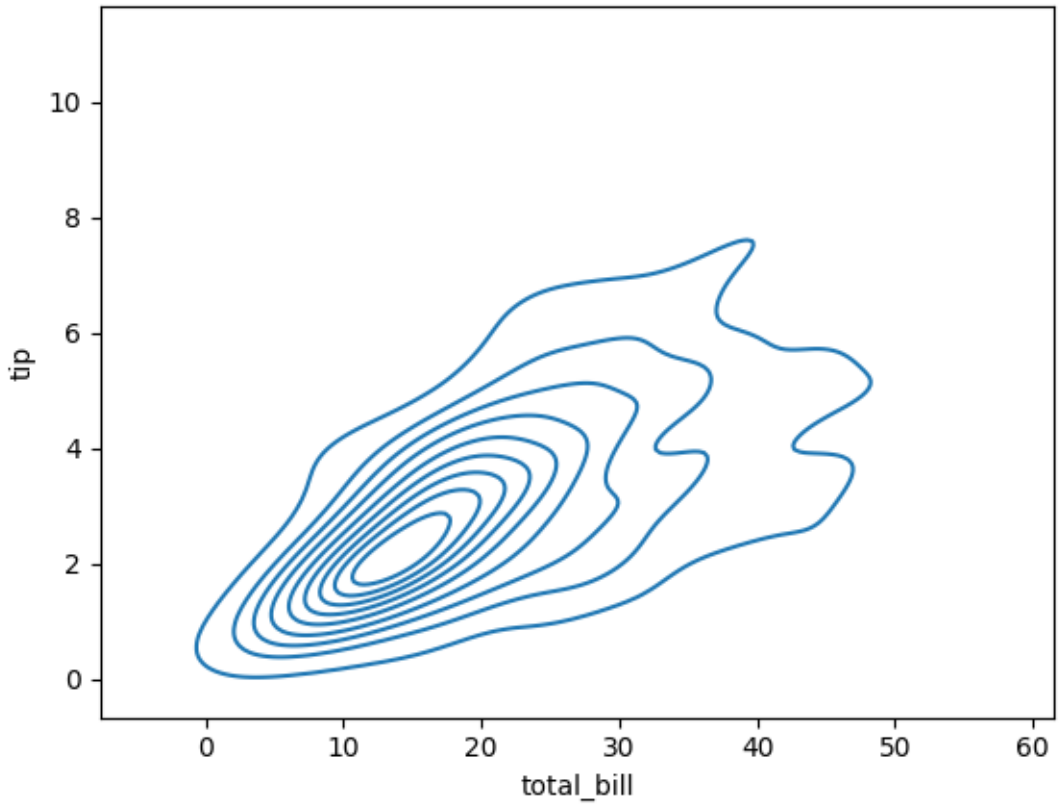
[34]:
```
<seaborn.axisgrid.FacetGrid at 0x25087b63ec0>
```



Bivariate Kdeplot A bivariate kde plot smoothes the (x,y) observations with a 2D Gaussian

[43]:
```
sns.kdeplot(data=tips, x='total_bill', y='tip')
```

[43]:
```
<Axes: xlabel='total_bill', ylabel='tip'>
```

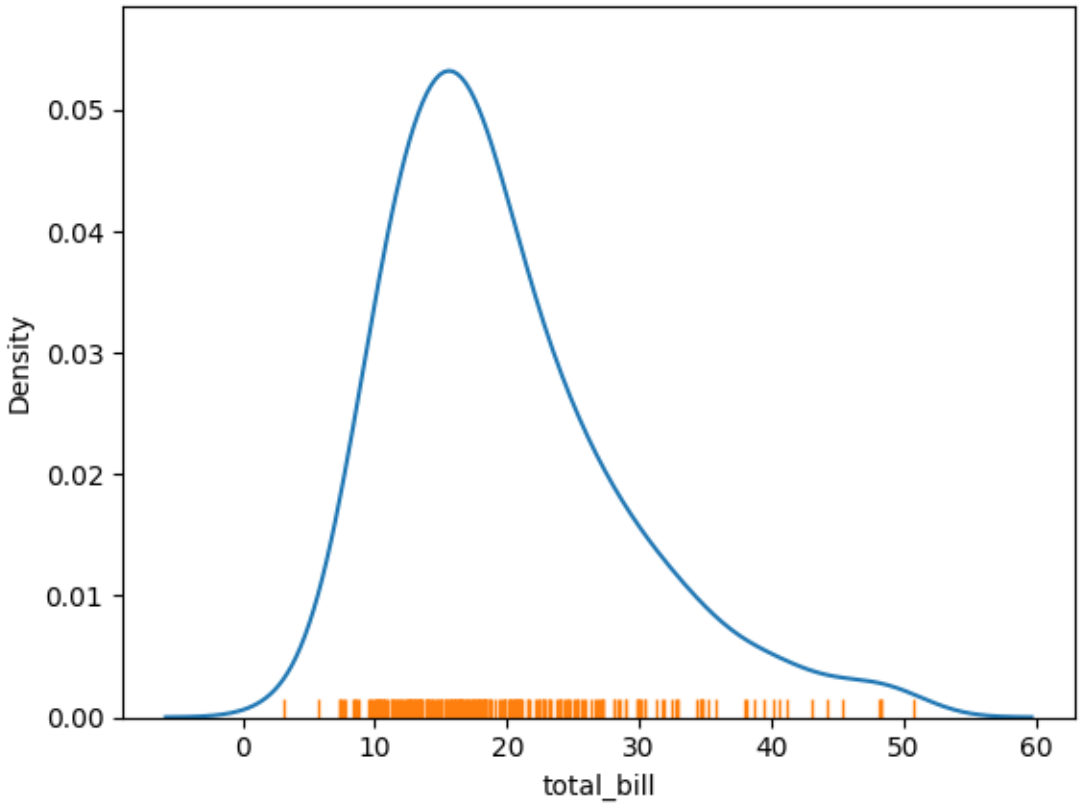


1.2.3 sns.rugplot(data, x)

Plot marginal distributions by drawing ticks along the axes.
This function is intended to complement other plots by showing the location of individual observations in an unobtrusive way

[40]:
```
sns.kdeplot(data=tips, x='total_bill')
sns.rugplot(data=tips, x='total_bill')
```

[40]:
```
<Axes: xlabel='total_bill', ylabel='Density'>
```



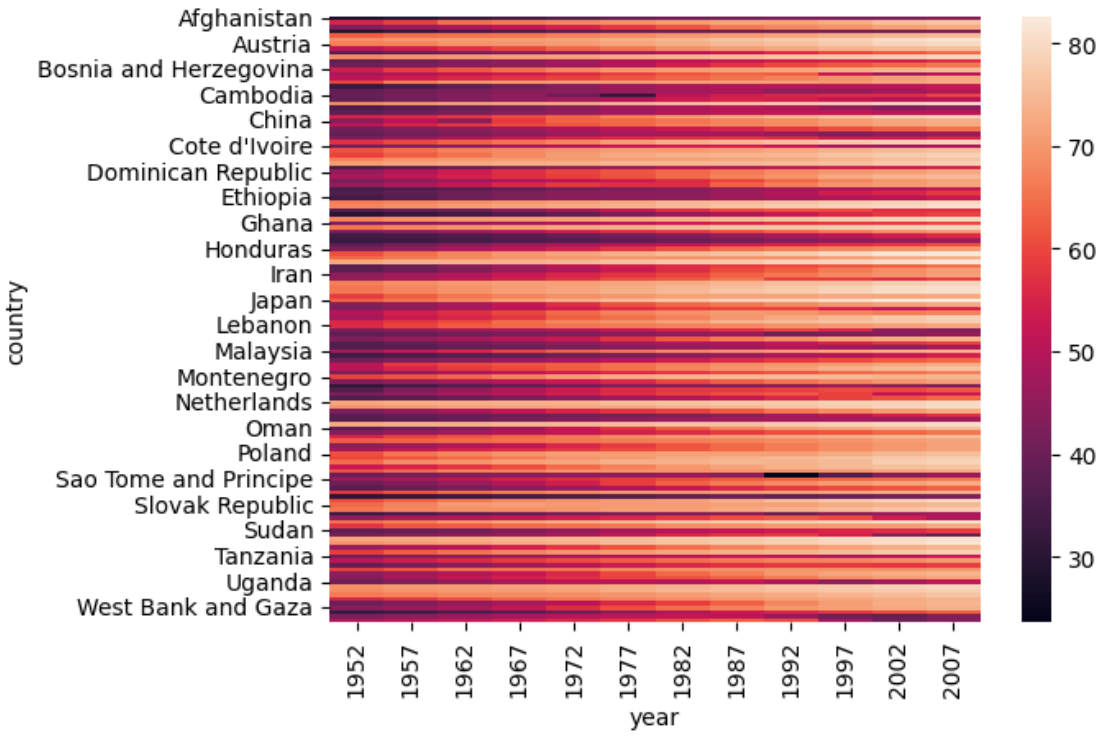
1.3 3. Matrix Plots

Figure level - displot()
Axis level - 1. heatmap() 2. clustermap()

1.3.1 sns.heatmap(data, annot=False, linewidth, cmap)

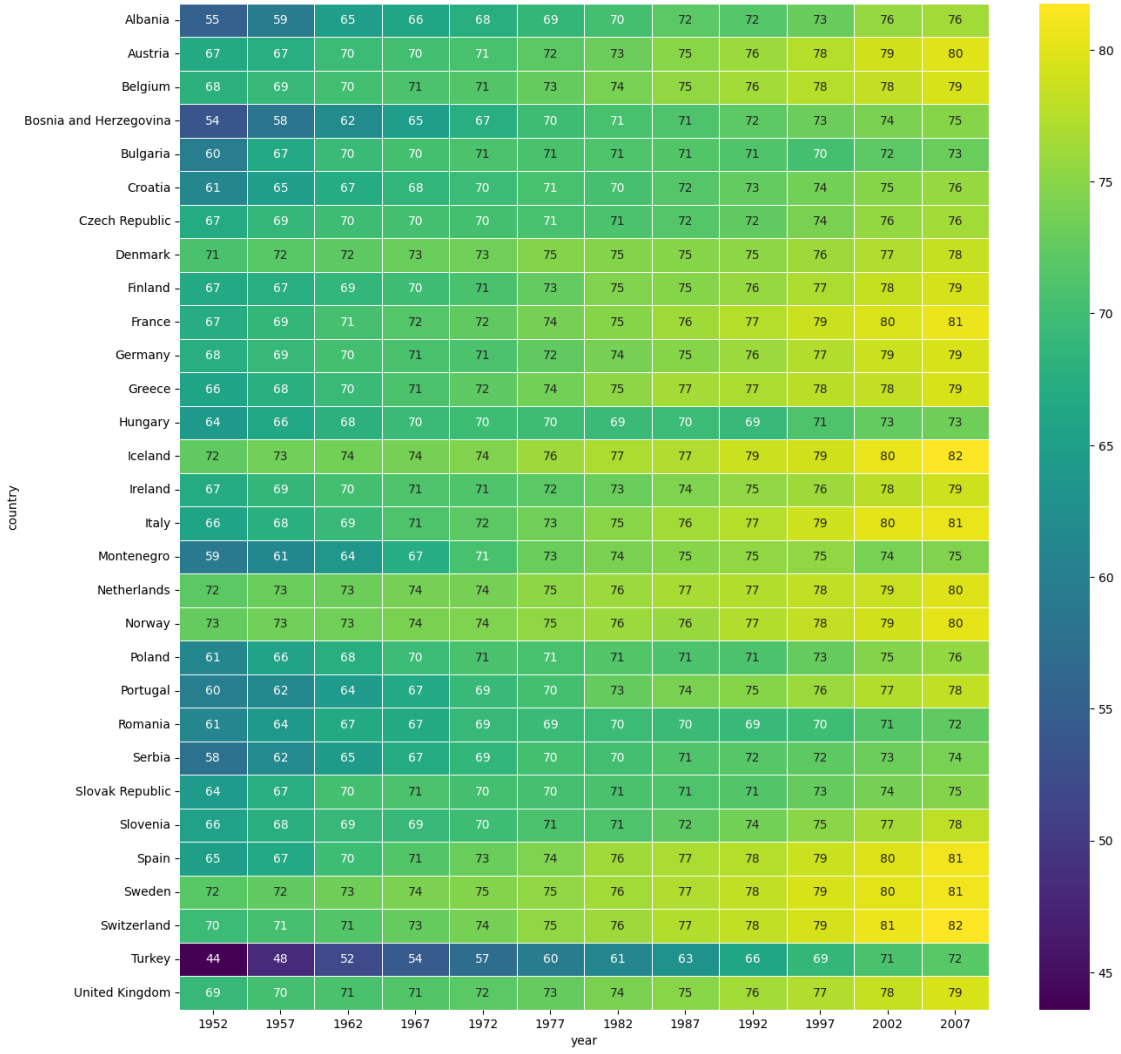
[49]:
```
temp = gap.pivot(index='country', columns='year', values='lifeExp')
sns.heatmap(temp)
```

[49]:
```
<Axes: xlabel='year', ylabel='country'>
```



[56]:
```
temp = gap[gap['continent'] == 'Europe'].pivot(index='country', columns='year',␣
↪values='lifeExp')
import matplotlib.pyplot as plt
plt.figure(figsize=(15,15))
sns.heatmap(temp, annot=True, linewidth=0.5, cmap='viridis')
```

[56]:
```
<Axes: xlabel='year', ylabel='country'>
```



1.3.2 sns.clustermap(data, annot=False, linewidth, cmap)

Plot a matrix dataset as a hierarchically-clustered heatmap.
This function requires scipy to be available.

[58]:
```
import plotly.express as px
iris = px.data.iris()
iris
```

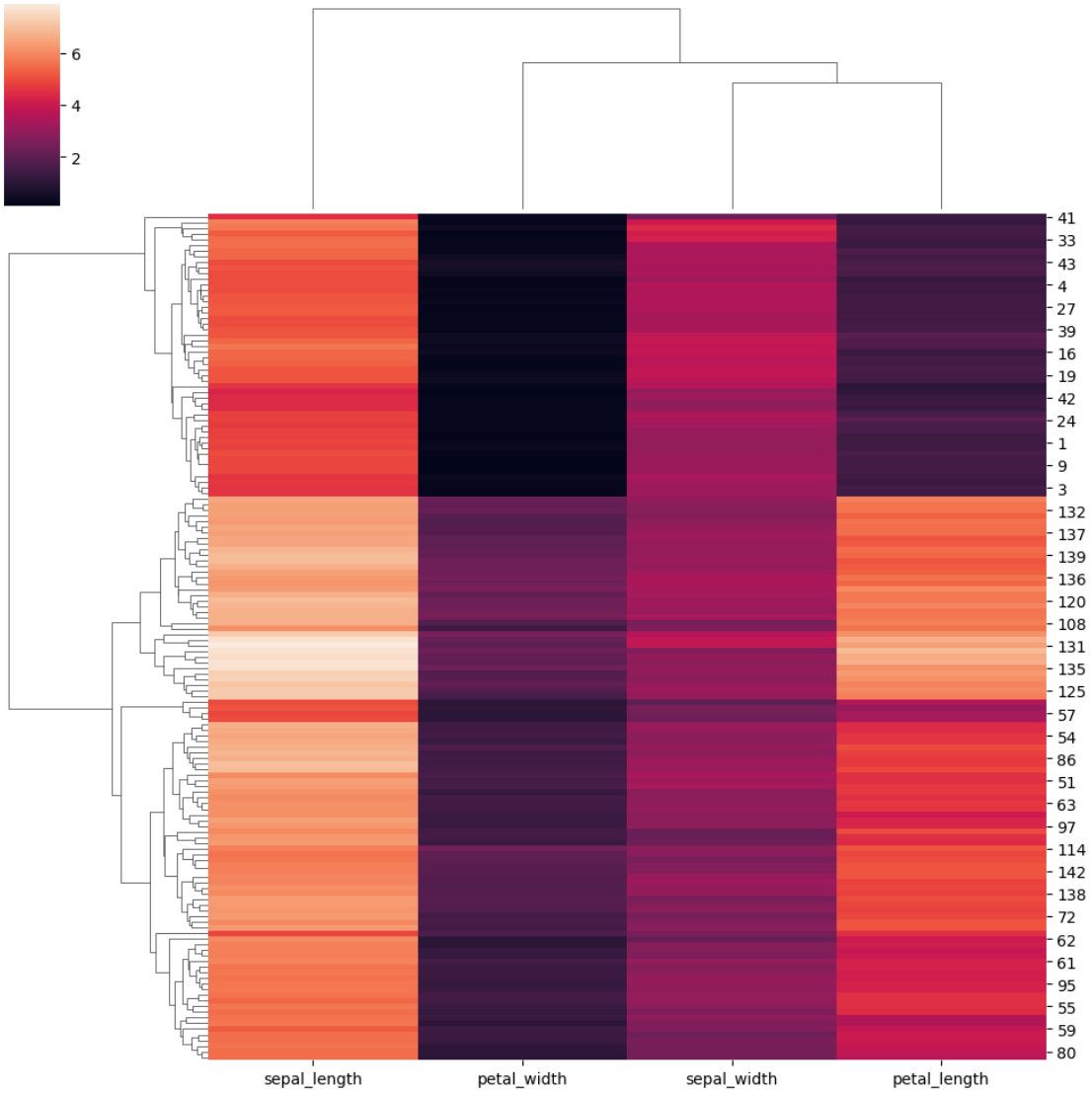
[58]:

	sepal_length	sepal_width	petal_length	petal_width	species	\
0	5.1	3.5	1.4	0.2	setosa	
1	4.9	3.0	1.4	0.2	setosa	
2	4.7	3.2	1.3	0.2	setosa	
3	4.6	3.1	1.5	0.2	setosa	
4	5.0	3.6	1.4	0.2	setosa	

```
..            …          …           …          …        …
145           6.7          3.0           5.2          2.3  virginica
146           6.3          2.5           5.0          1.9  virginica
147           6.5          3.0           5.2          2.0  virginica
148           6.2          3.4           5.4          2.3  virginica
149           5.9          3.0           5.1          1.8  virginica

     species_id
0             1
1             1
2             1
3             1
4             1
..          …
145           3
146           3
147           3
148           3
149           3

[150 rows x 6 columns]
```

[59]:
```
sns.clustermap(iris.iloc[:, [0,1,2,3]])
```

[59]:
```
<seaborn.matrix.ClusterGrid at 0x2508f22d160>
```



1.4 4. Categorical Plots

1.4.1 Categorical Scatter Plot

- Stripplot
- Swarmplot

1.4.2 Categorical Distribution Plots

- Boxplot
- Violinplot

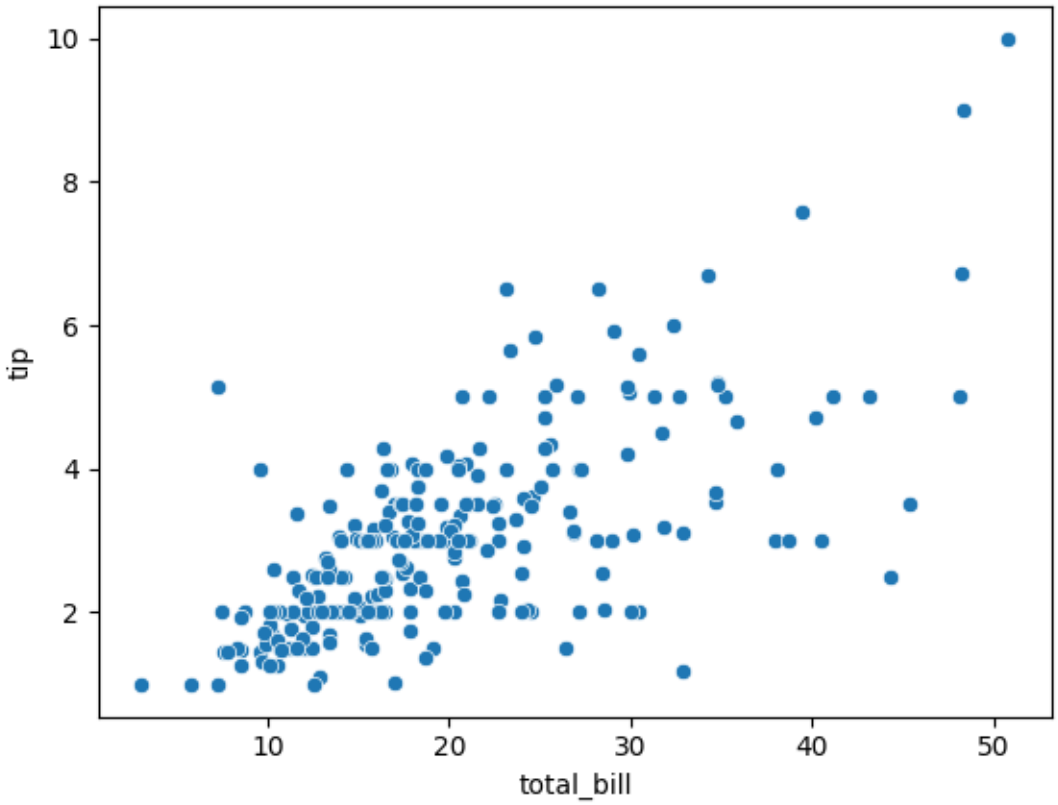
1.4.3 Categorical Estimate Plot -> for central tendency

- Barplot
- Pointplot
- Countplot

1.4.4 Figure level function -> `catplot`

[60]:
```
sns.scatterplot(data=tips, x='total_bill', y='tip')
```

[60]:
```
<Axes: xlabel='total_bill', ylabel='tip'>
```

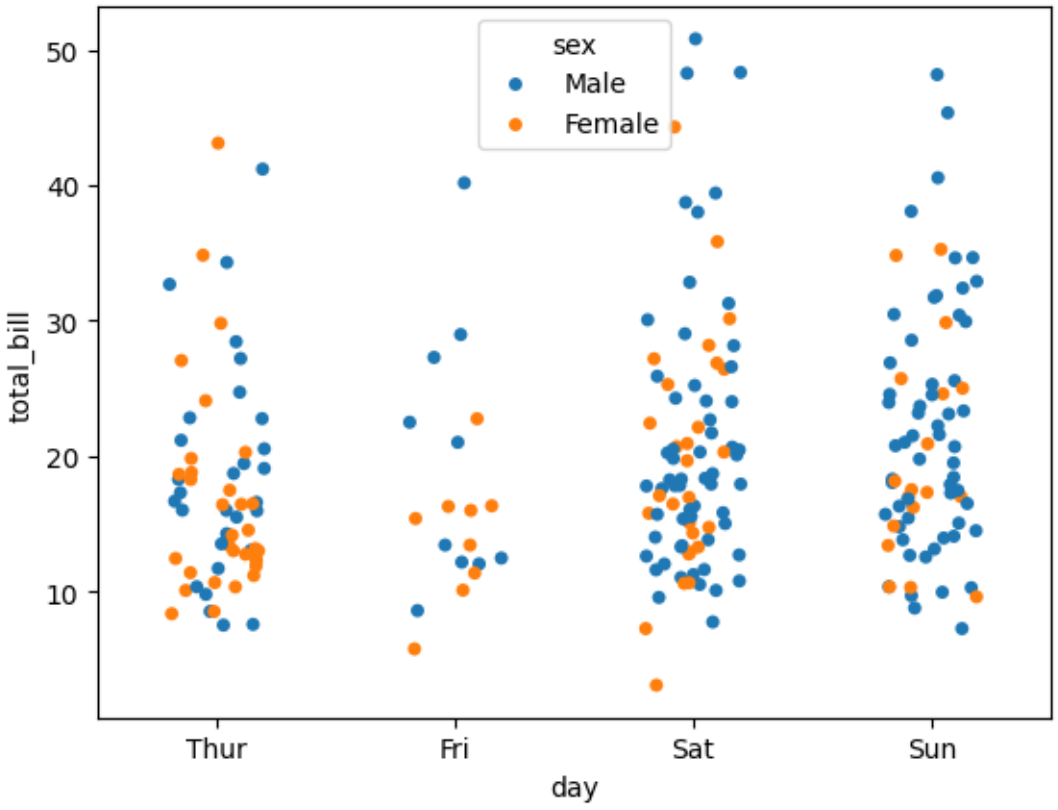


1.4.5 Categorical Scatter Plot

stripplot(data, x, y, jitter, hue) Axes level function

[63]:
```
sns.stripplot(data=tips, x='day', y='total_bill', jitter=0.2, hue='sex')
```

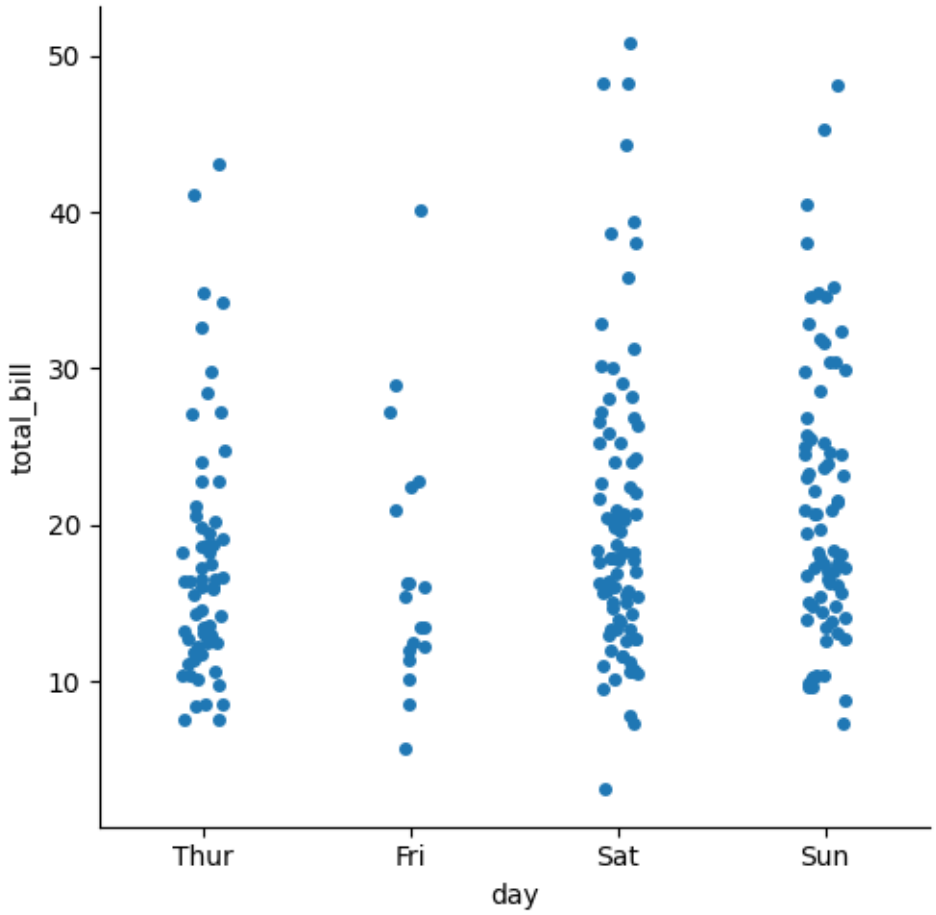
[63]:
```
<Axes: xlabel='day', ylabel='total_bill'>
```



sns.catplot(data, x, y, kind) Figure level function

[62]:
```
sns.catplot(data=tips, x='day', y='total_bill', kind='strip')
```

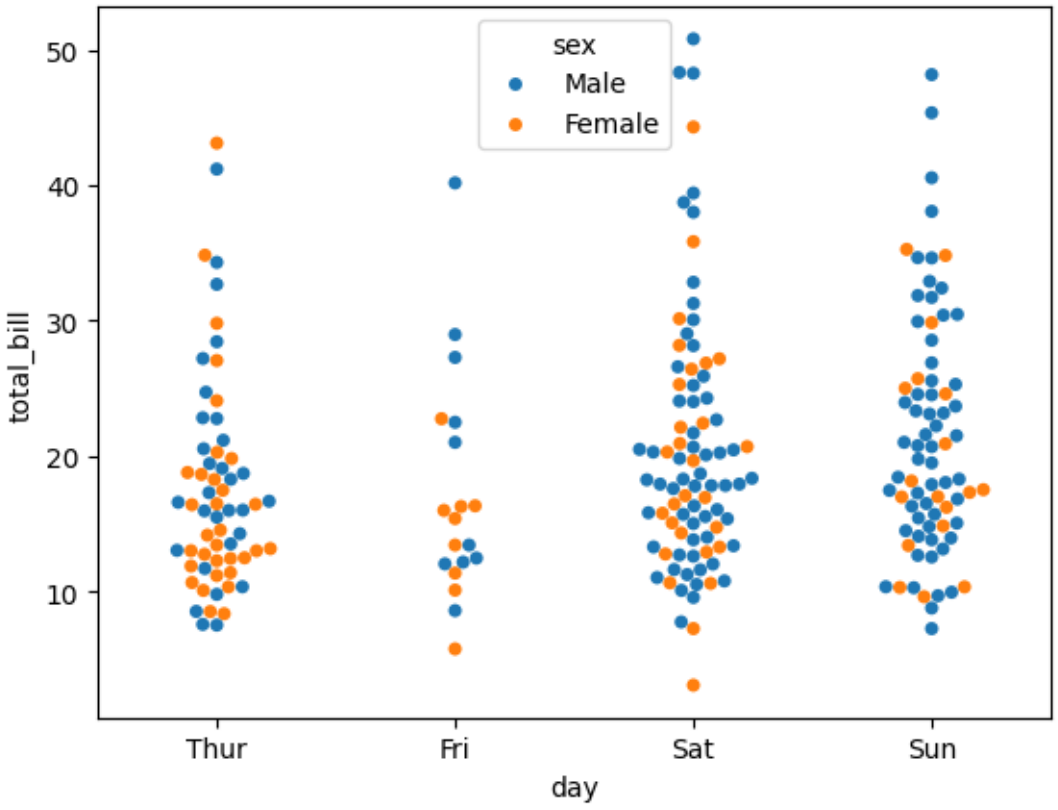
[62]:
```
<seaborn.axisgrid.FacetGrid at 0x2508ea45490>
```



sns.swarmplot(data, x, y, hue)

[65]:
```
sns.swarmplot(data=tips, x='day', y='total_bill', hue='sex')
```

[65]:
```
<Axes: xlabel='day', ylabel='total_bill'>
```



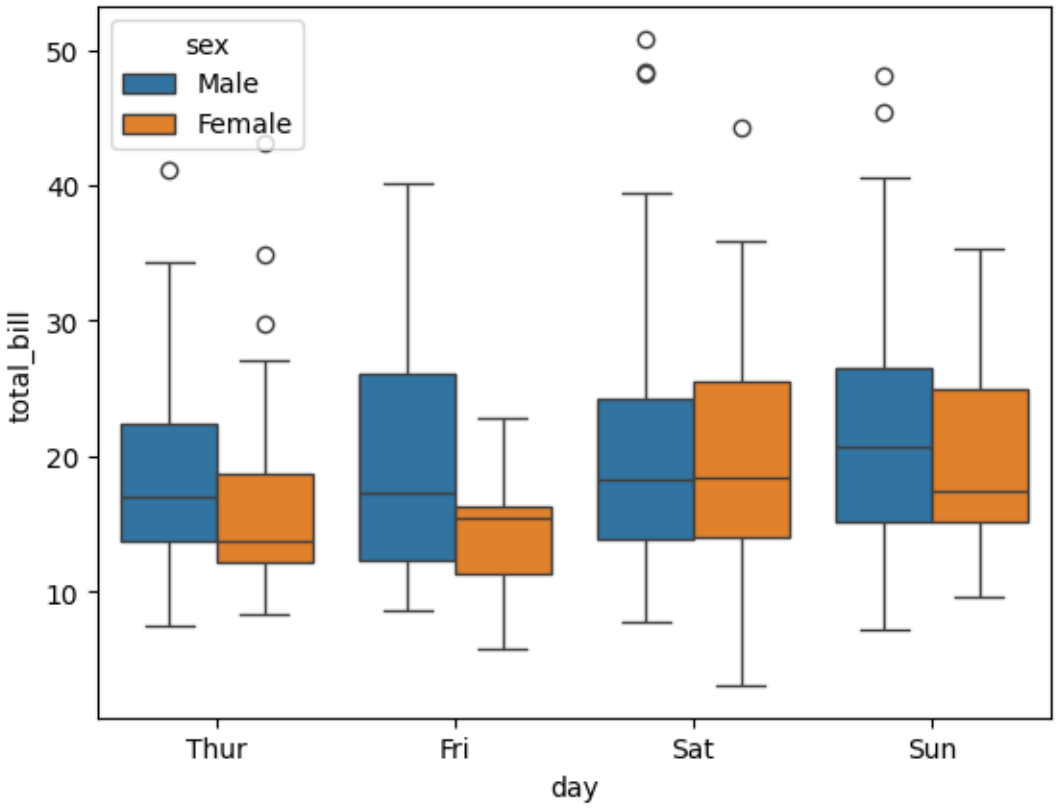
1.4.6 Boxplot

A boxplot is a standardized way of displaying the distribution of data based on a five number summary ("minimum", first quartile [Q1], median, third quartile [Q3] and "maximum"). It can tell you about your outliers and what their values are. Boxplots can also tell you if your data is symmetrical, how tightly your data is grouped and if and how your data is skewed.

1.4.7 sns.boxplot(data, x, y, hue)

[68]:
```
sns.boxplot(data=tips, x='day', y='total_bill', hue='sex')
```

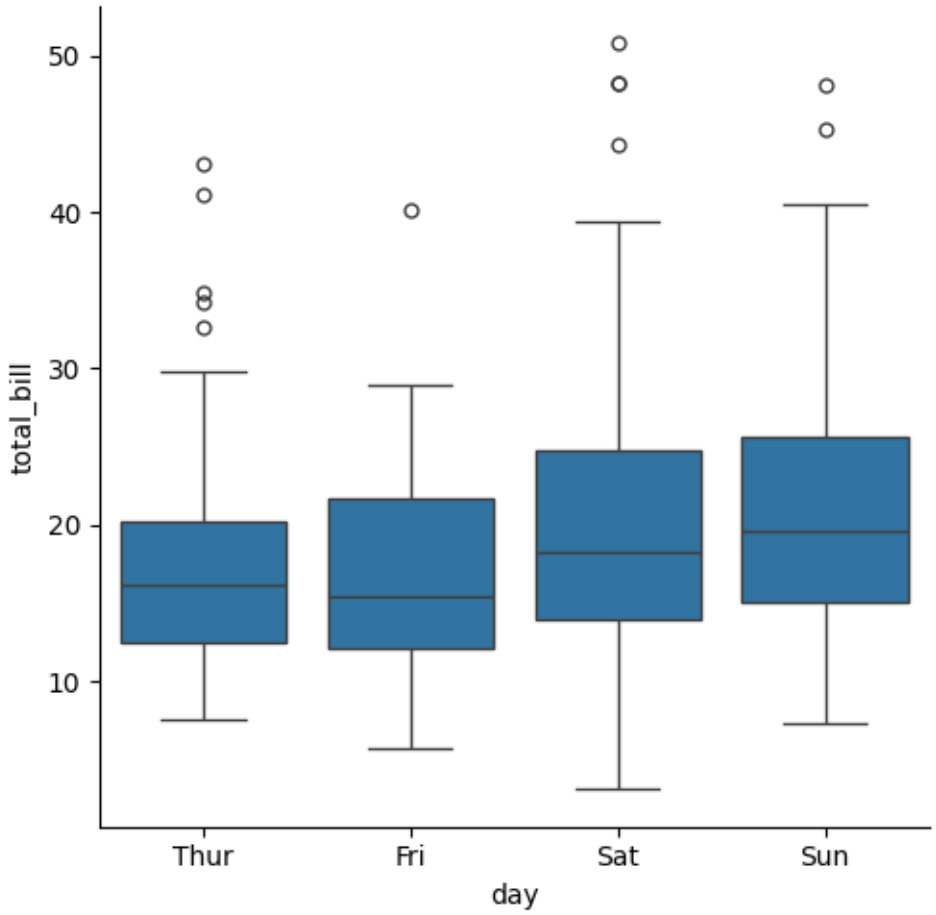
[68]:
```
<Axes: xlabel='day', ylabel='total_bill'>
```



1.4.8 sns.catplot(data, x, y, kind)

[67]:
```
sns.catplot(data=tips, x='day', y='total_bill', kind='box')
```

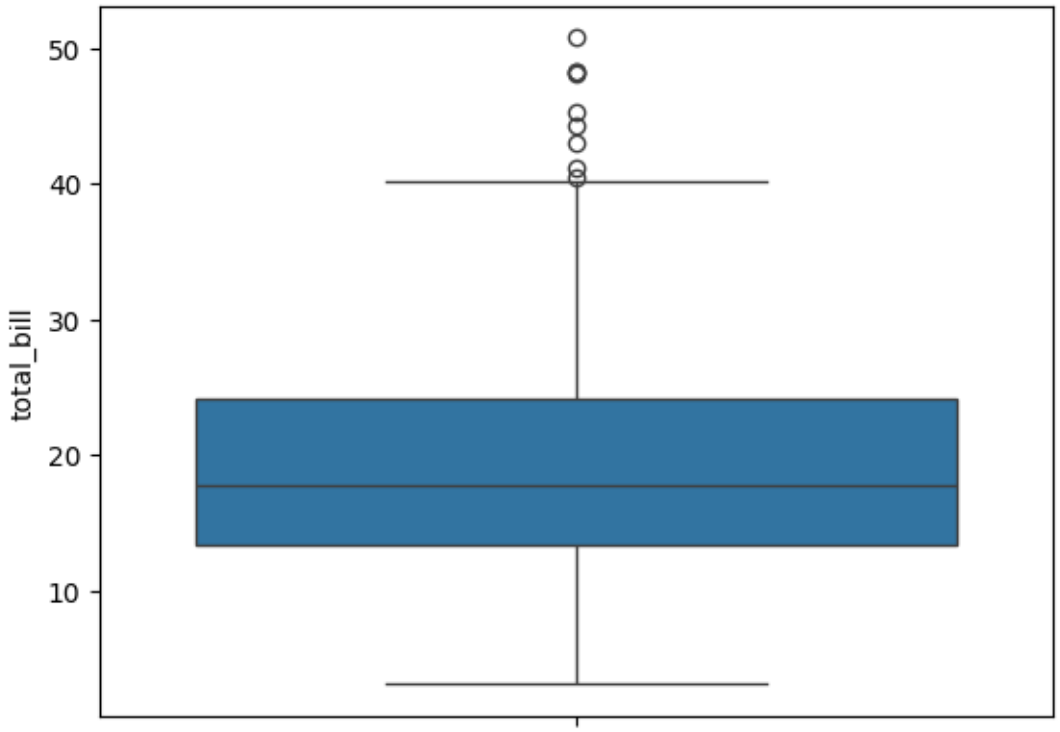
[67]:
```
<seaborn.axisgrid.FacetGrid at 0x2508f8e6870>
```



Single Boxplot -> numerical column

[69]:
```
sns.boxplot(data=tips, y='total_bill')
```

[69]:
```
<Axes: ylabel='total_bill'>
```

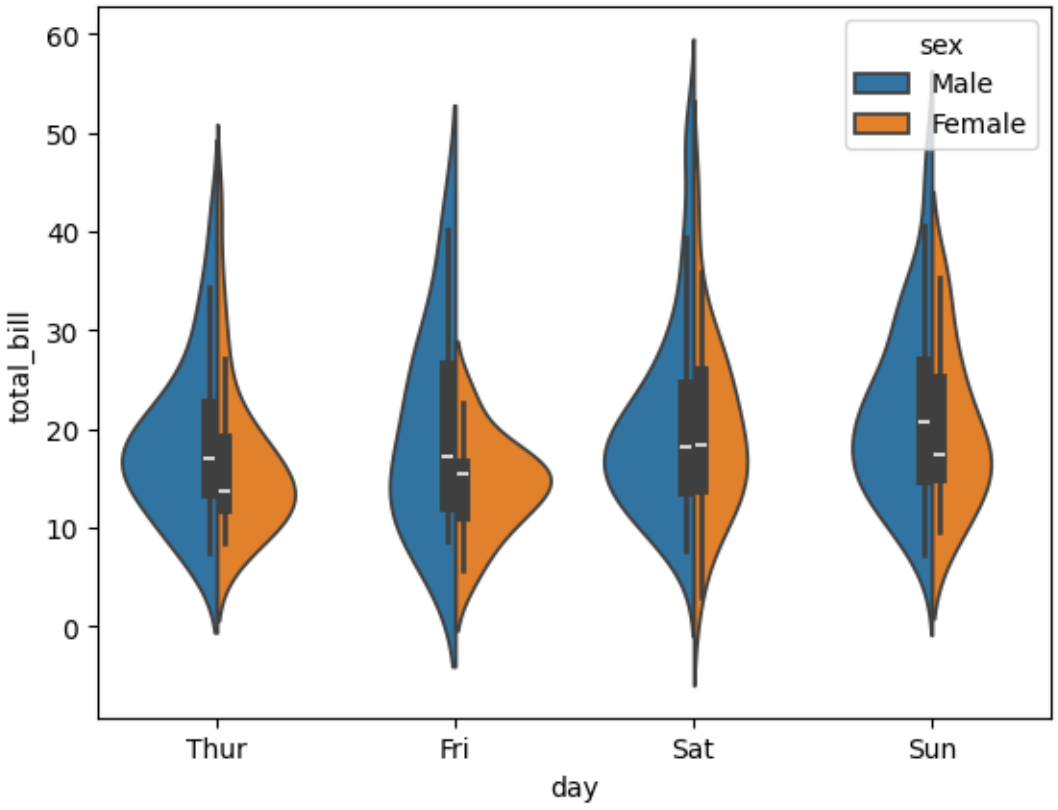


1.4.9 sns.violinplot(data, x, y, hue, split=False)

By default split is False which means for every category in hue there is two violin plots, but if split is True then in single violin plot both category is merged.

[73]:
```
sns.violinplot(data=tips, x='day', y='total_bill', hue='sex', split=True)
```

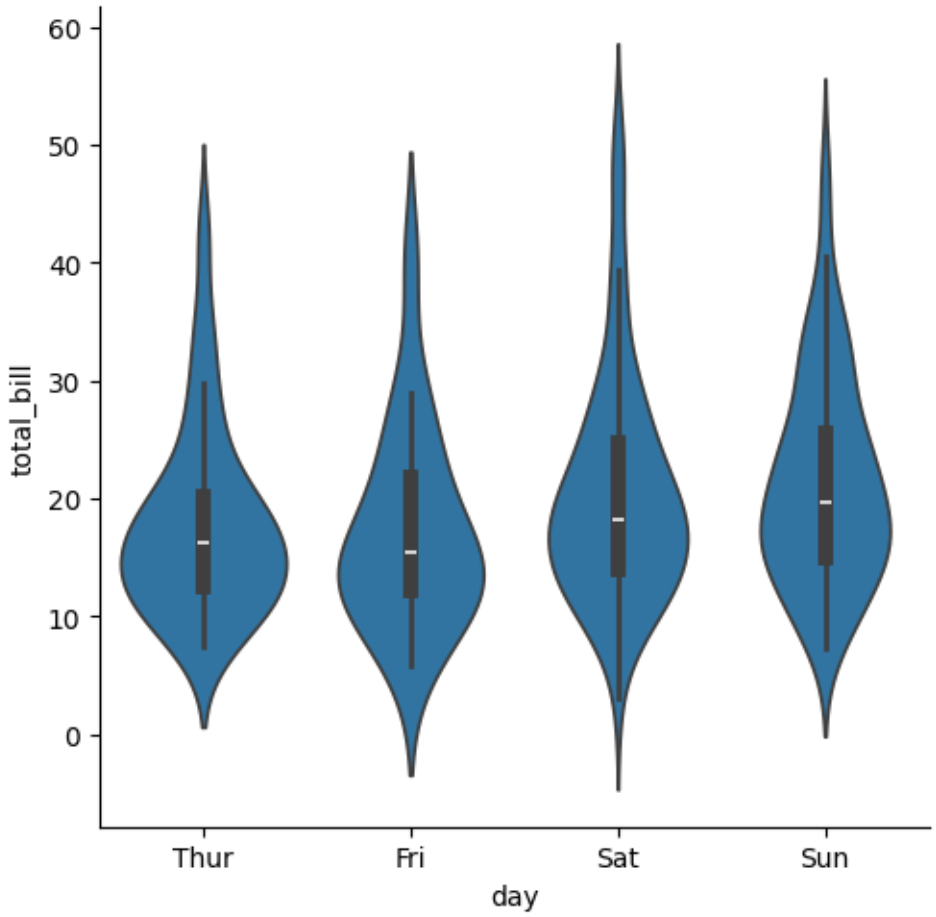
[73]:
```
<Axes: xlabel='day', ylabel='total_bill'>
```



sns.catplot(data, x, y, kind)

[71]:
```
sns.catplot(data=tips, x='day', y='total_bill', kind='violin')
```

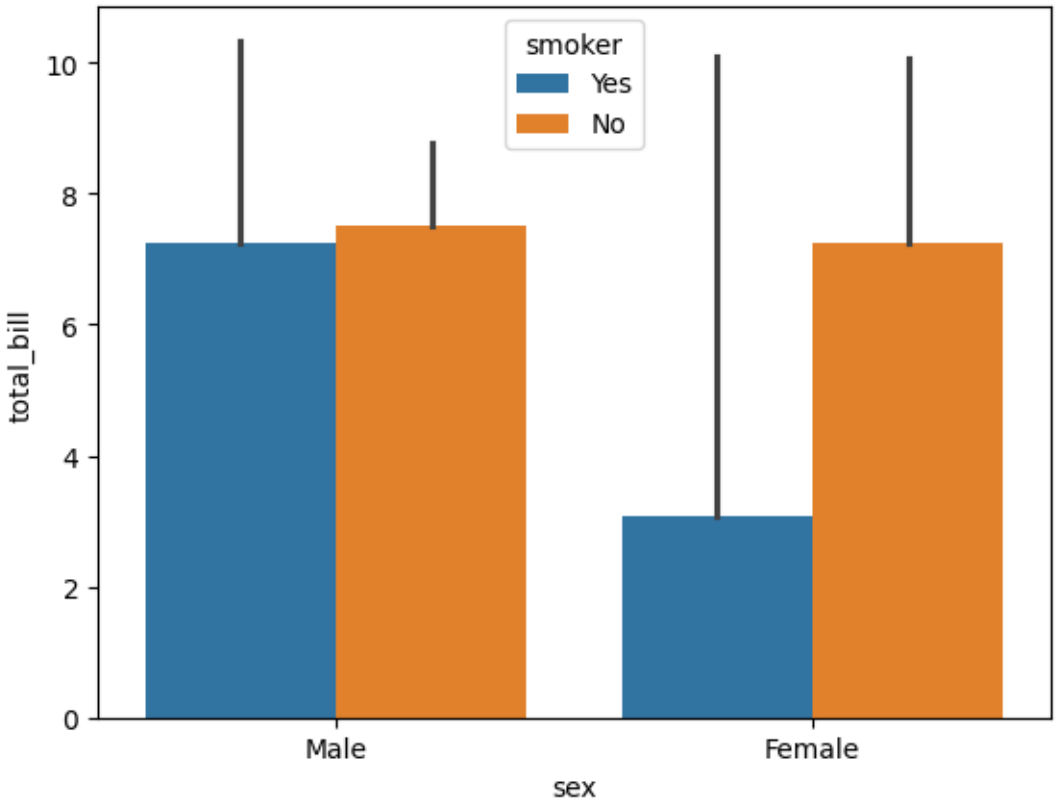
[71]:
```
<seaborn.axisgrid.FacetGrid at 0x25086b73050>
```



1.4.10 sns.barplot(data, x, y, hue, estimator)

[79]:
```
sns.barplot(data=tips, x='sex', y='total_bill', hue='smoker', estimator=np.min)
```

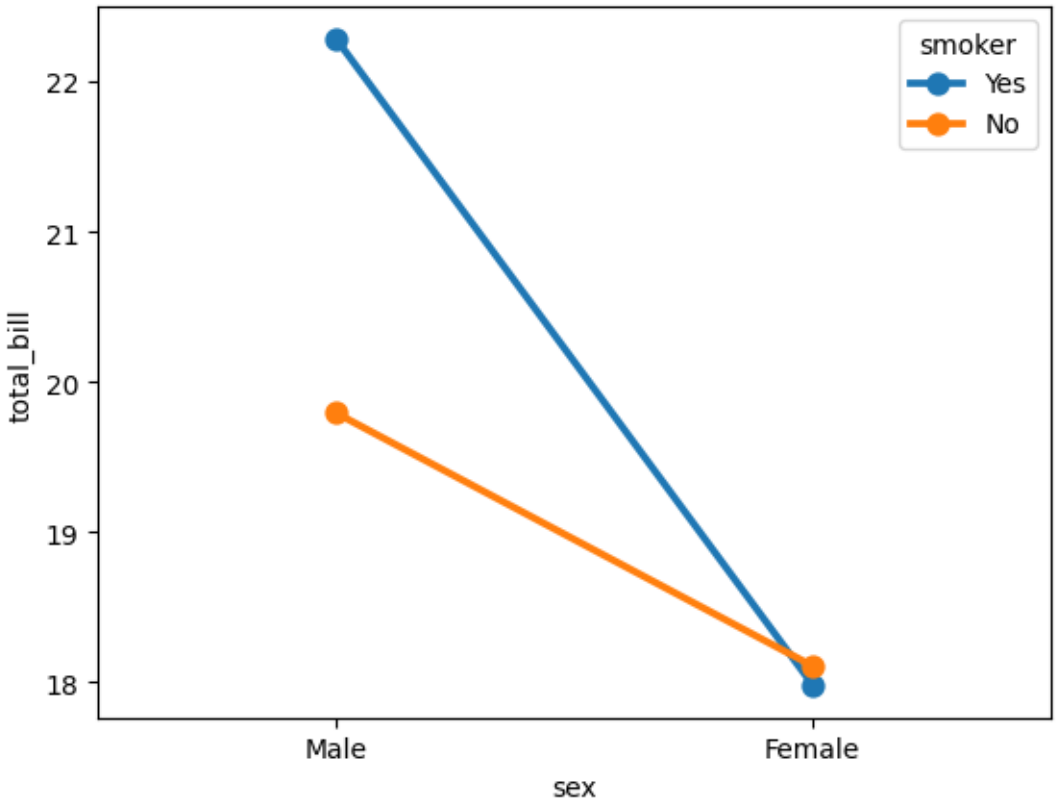
[79]:
```
<Axes: xlabel='sex', ylabel='total_bill'>
```



1.4.11 sns.pointplot(data, x, y, hue, errorbar)

[83]:
```
sns.pointplot(data=tips, x='sex', y='total_bill', hue='smoker', errorbar=None)
```

[83]:
```
<Axes: xlabel='sex', ylabel='total_bill'>
```

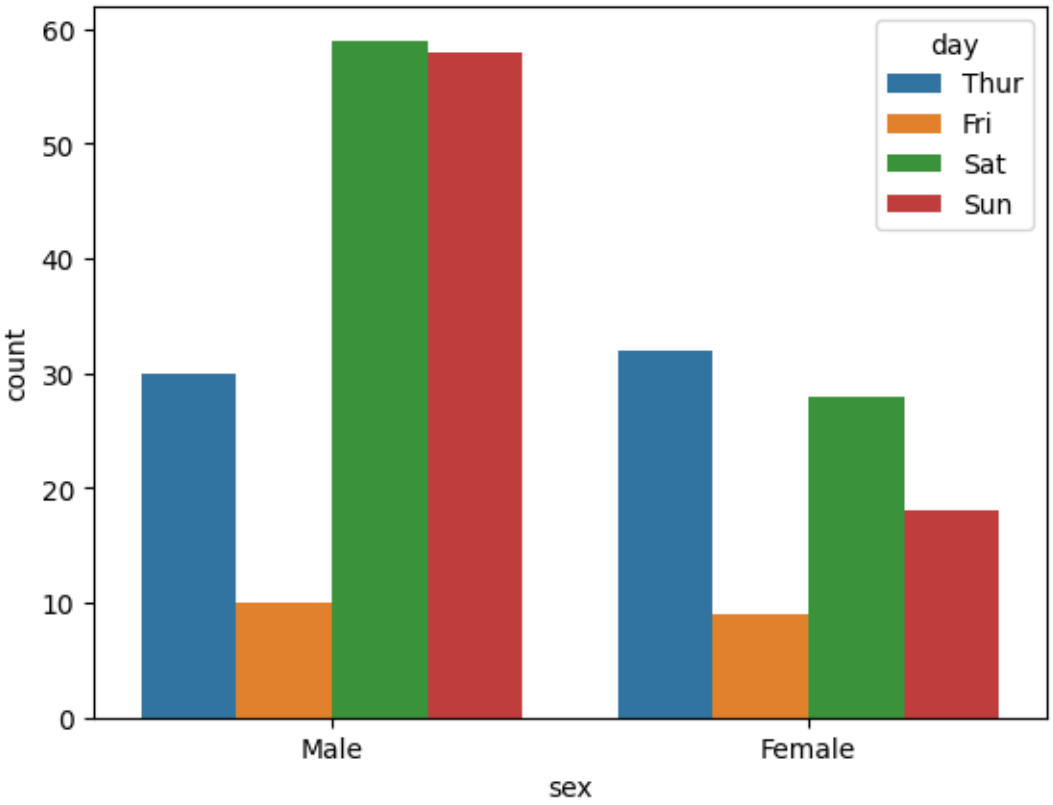


1.4.12 sns.countplot(data, x, hue)

When there are multiple observations in each category, it also uses bootstrapping to compute a cofidence interval around the estimate, which is plotted using error bars.

[84]:
```
sns.countplot(data=tips, x='sex', hue='day')
```

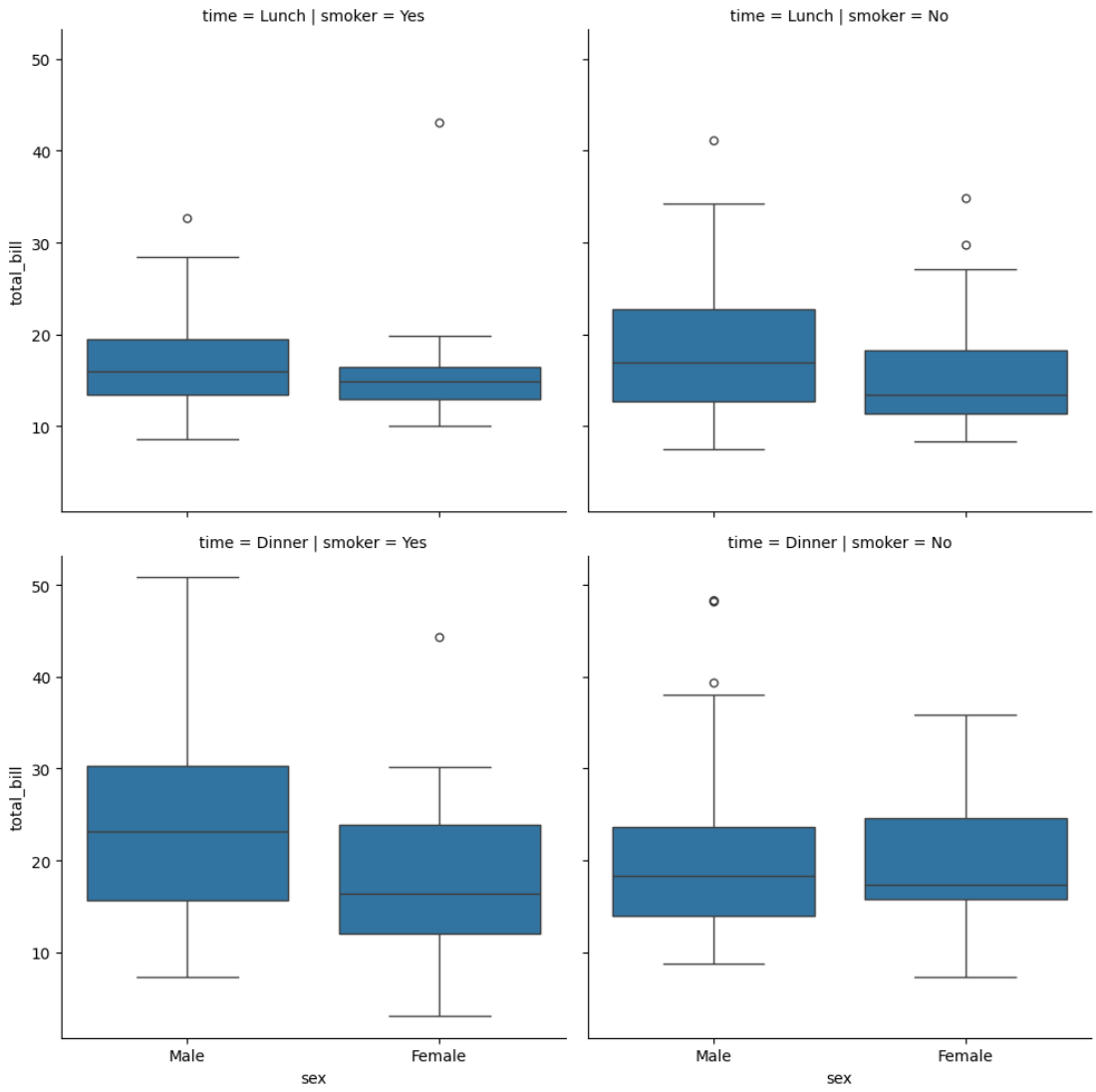
[84]:
```
<Axes: xlabel='sex', ylabel='count'>
```



Facet plots

[85]:
```
sns.catplot(data=tips,␣
↪x='sex',y='total_bill',col='smoker',kind='box',row='time')
```

[85]: <seaborn.axisgrid.FacetGrid at 0x25092bbd520>



1.5 4. Regression Plots

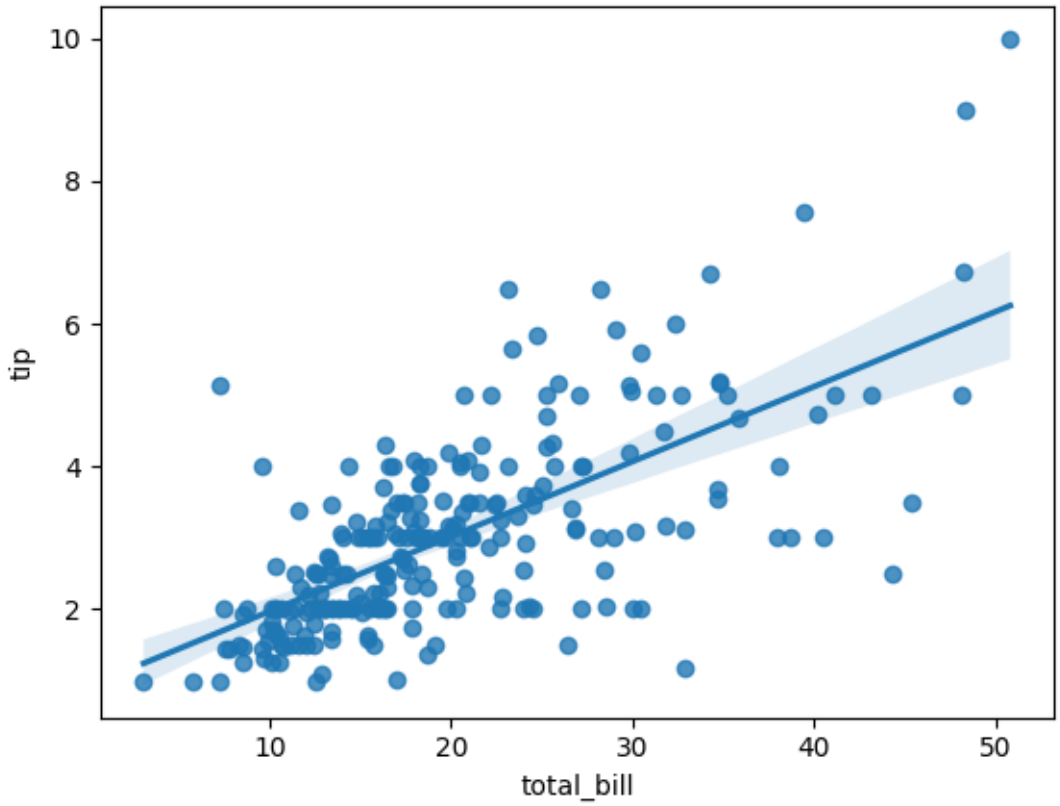
- regplot
- lmplot

In the simplest invocation, both functions draw a scatterplot of two variables, x and y, and then fit the regression model y ~ x and plot the resulting regression line and a 95% confidence interval for that regression.

Hue parameter is not available.

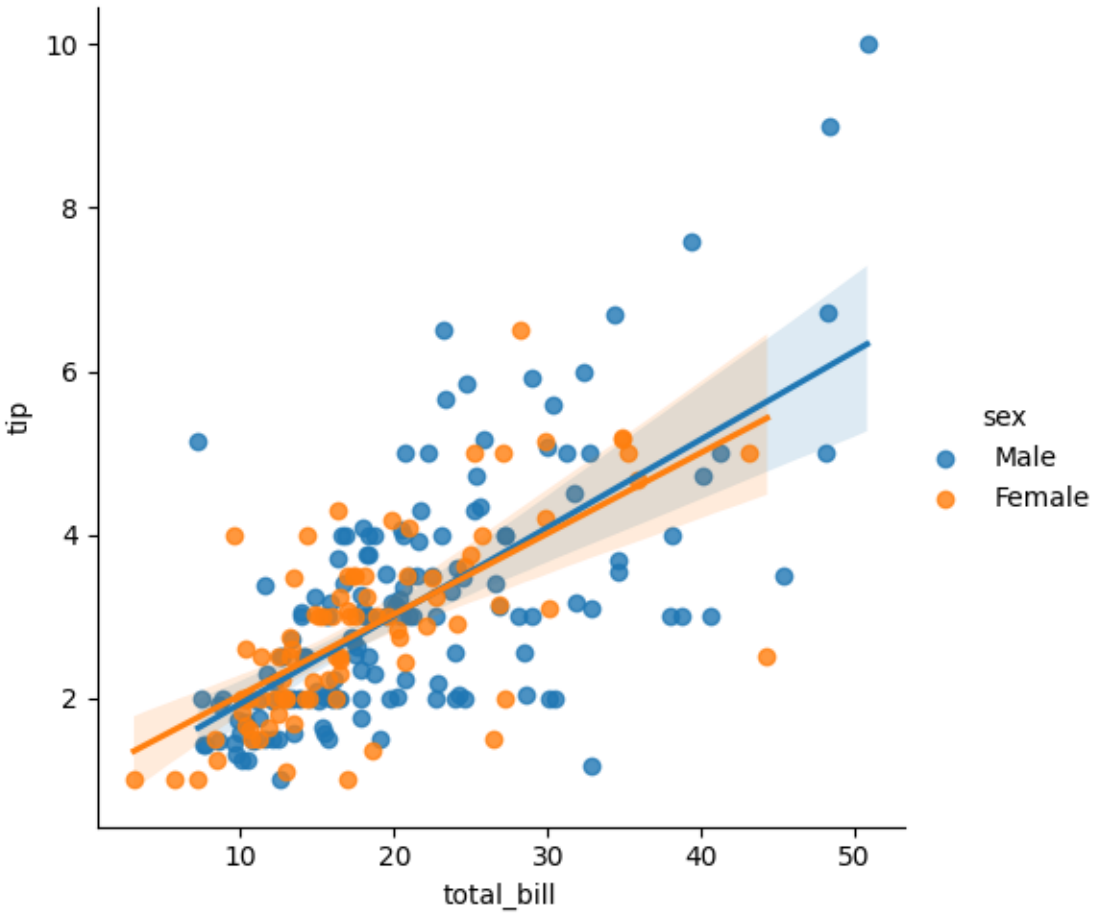
[86]:
```
sns.regplot(data=tips, x='total_bill', y='tip')
```

[86]:
```
<Axes: xlabel='total_bill', ylabel='tip'>
```



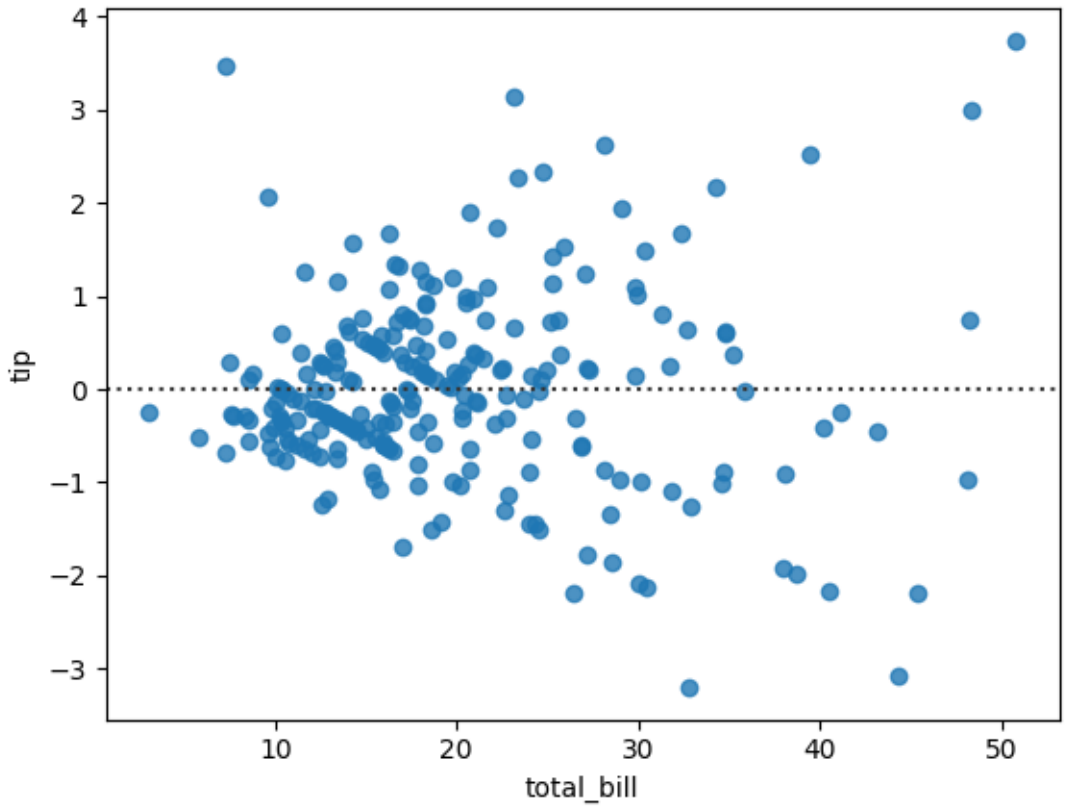
[87]:
```
sns.lmplot(data=tips, x='total_bill', y='tip', hue='sex')
```

[87]: <seaborn.axisgrid.FacetGrid at 0x25092e10bc0>



[88]:
```
sns.residplot(data=tips, x='total_bill', y='tip')
```

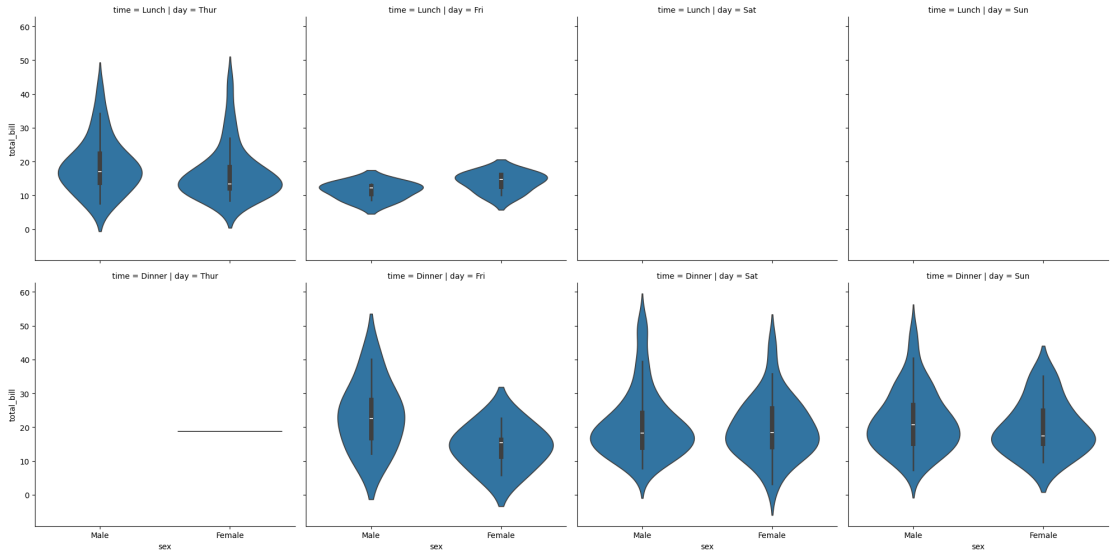
[88]:
```
<Axes: xlabel='total_bill', ylabel='tip'>
```



1.5.1 Facet Grid

[89]:
```
sns.catplot(data=tips, x='sex', y='total_bill', kind='violin', col='day',␣
↪row='time')
```

[89]: <seaborn.axisgrid.FacetGrid at 0x25092e6fd10>

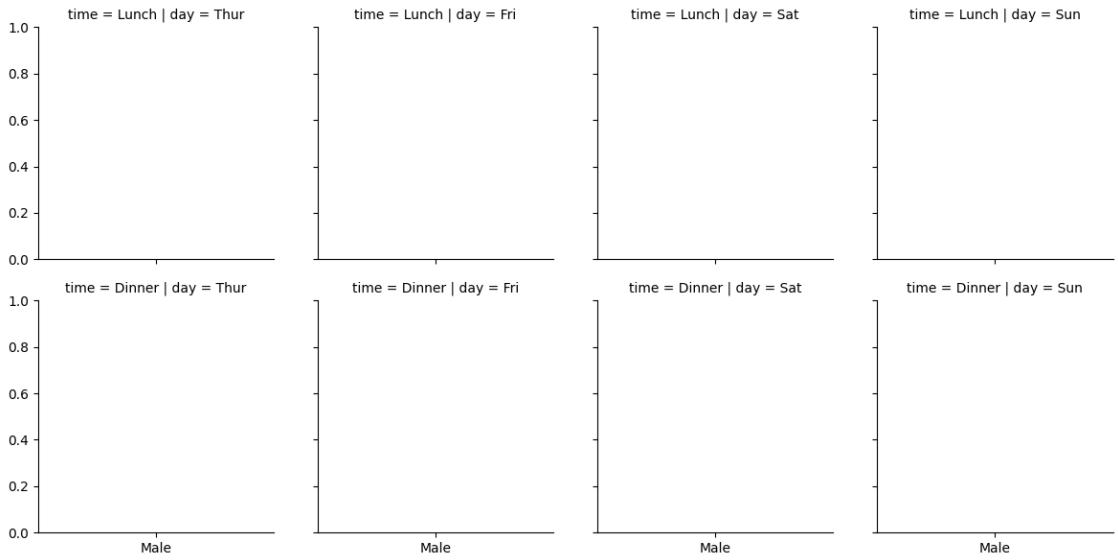


[92]:
```
g = sns.FacetGrid(data=tips, col='day', row='time', hue='smoker')
g.map(sns.boxplot, 'sex', 'total_bill')
g.add_legend()
```

```
c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:718:
UserWarning:

Using the boxplot function without specifying `order` is likely to produce an
incorrect plot.
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
Cell In[92], line 2
      1 g = sns.FacetGrid(data=tips, col='day', row='time', hue='smoker')
----> 2 g.map(sns.boxplot, 'sex', 'total_bill')
      3 g.add_legend()

File c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:758, in␣
 ↪FacetGrid.map(self, func, *args, **kwargs)
    755         plot_args = [v.values for v in plot_args]
    757     # Draw the plot
--> 758     self._facet_plot(func, ax, plot_args, kwargs)
    760 # Finalize the annotations and layout
    761 self._finalize_grid(args[:2])

File c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:854, in␣
 ↪FacetGrid._facet_plot(self, func, ax, plot_args, plot_kwargs)
    852     plot_args = []
```

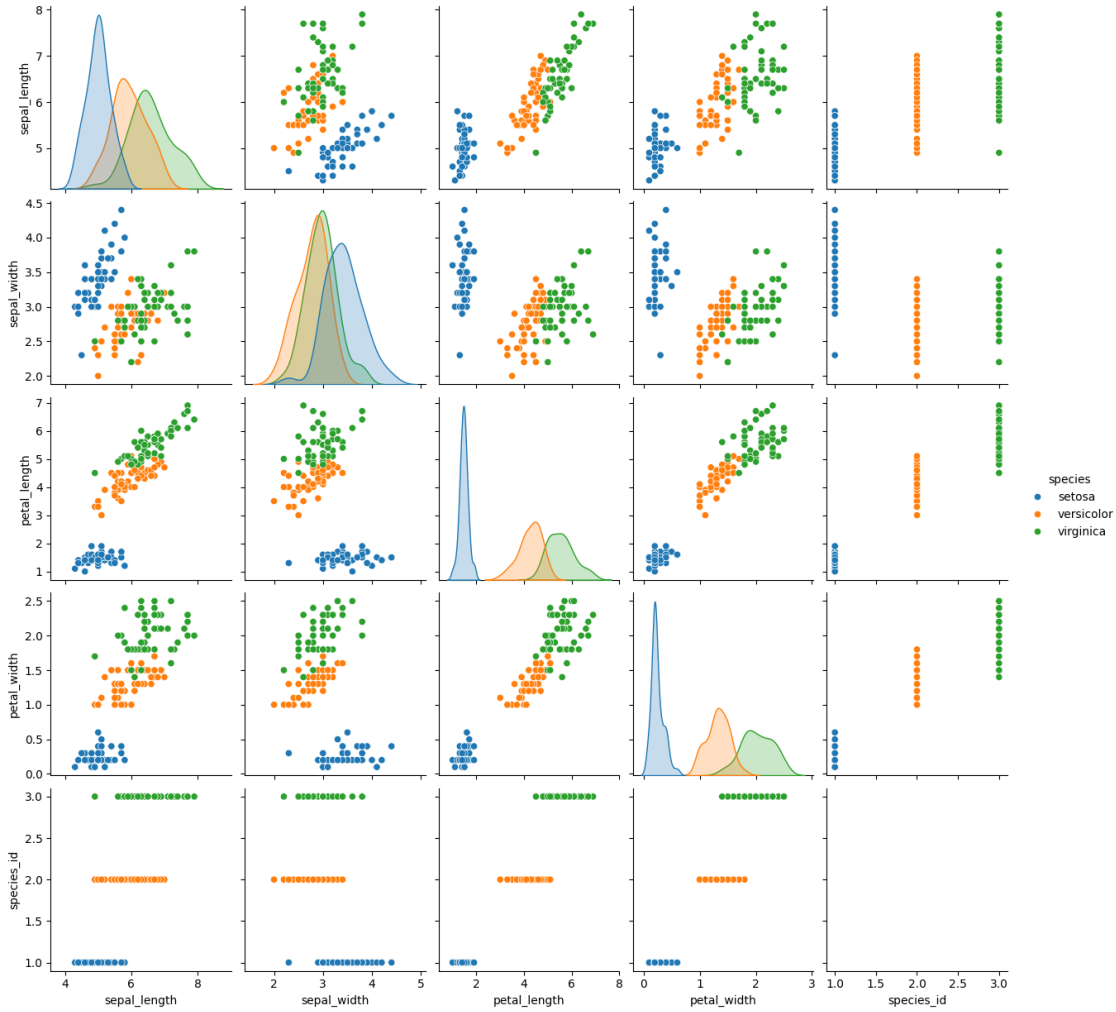
```
    853     plot_kwargs["ax"] = ax
--> 854 func(*plot_args, **plot_kwargs)
    856 # Sort out the supporting information
    857 self._update_legend_data(ax)

File c:\Program Files\Python312\Lib\site-packages\seaborn\categorical.py:1634,␣
 ↪in boxplot(data, x, y, hue, order, hue_order, orient, color, palette,␣
 ↪saturation, fill, dodge, width, gap, whis, linecolor, linewidth, fliersize,␣
 ↪hue_norm, native_scale, log_scale, formatter, legend, ax, **kwargs)
   1627 color = _default_color(
   1628     ax.fill_between, hue, color,
   1629     {k: v for k, v in kwargs.items() if k in ["c", "color", "fc",␣
 ↪"facecolor"]},
   1630     saturation=saturation,
   1631 )
   1632 linecolor = p._complement_color(linecolor, color, p._hue_map)
-> 1634 p.plot_boxes(
   1635     width=width,
   1636     dodge=dodge,
   1637     gap=gap,
   1638     fill=fill,
   1639     whis=whis,
   1640     color=color,
   1641     linecolor=linecolor,
   1642     linewidth=linewidth,
   1643     fliersize=fliersize,
   1644     plot_kws=kwargs,
   1645 )
   1647 p._add_axis_labels(ax)
   1648 p._adjust_cat_axis(ax, axis=p.orient)

File c:\Program Files\Python312\Lib\site-packages\seaborn\categorical.py:700, i␣
 ↪_CategoricalPlotter.plot_boxes(self, width, dodge, gap, fill, whis, color,␣
 ↪linecolor, linewidth, fliersize, plot_kws)
    679 default_kws = dict(
    680     bxpstats=stats.to_dict("records"),
    681     positions=data[self.orient],
   (…)
    697     )
    698 )
    699 boxplot_kws = {**default_kws, **plot_kws}
--> 700 artists = ax.bxp(**boxplot_kws)
    702 # Reset artist widths after adding so everything stays positive
    703 ori_idx = ["x", "y"].index(self.orient)

TypeError: Axes.bxp() got an unexpected keyword argument 'label'
```



1.6 Plotting Pairwise Relationship (PairGrid vs Pairplot)

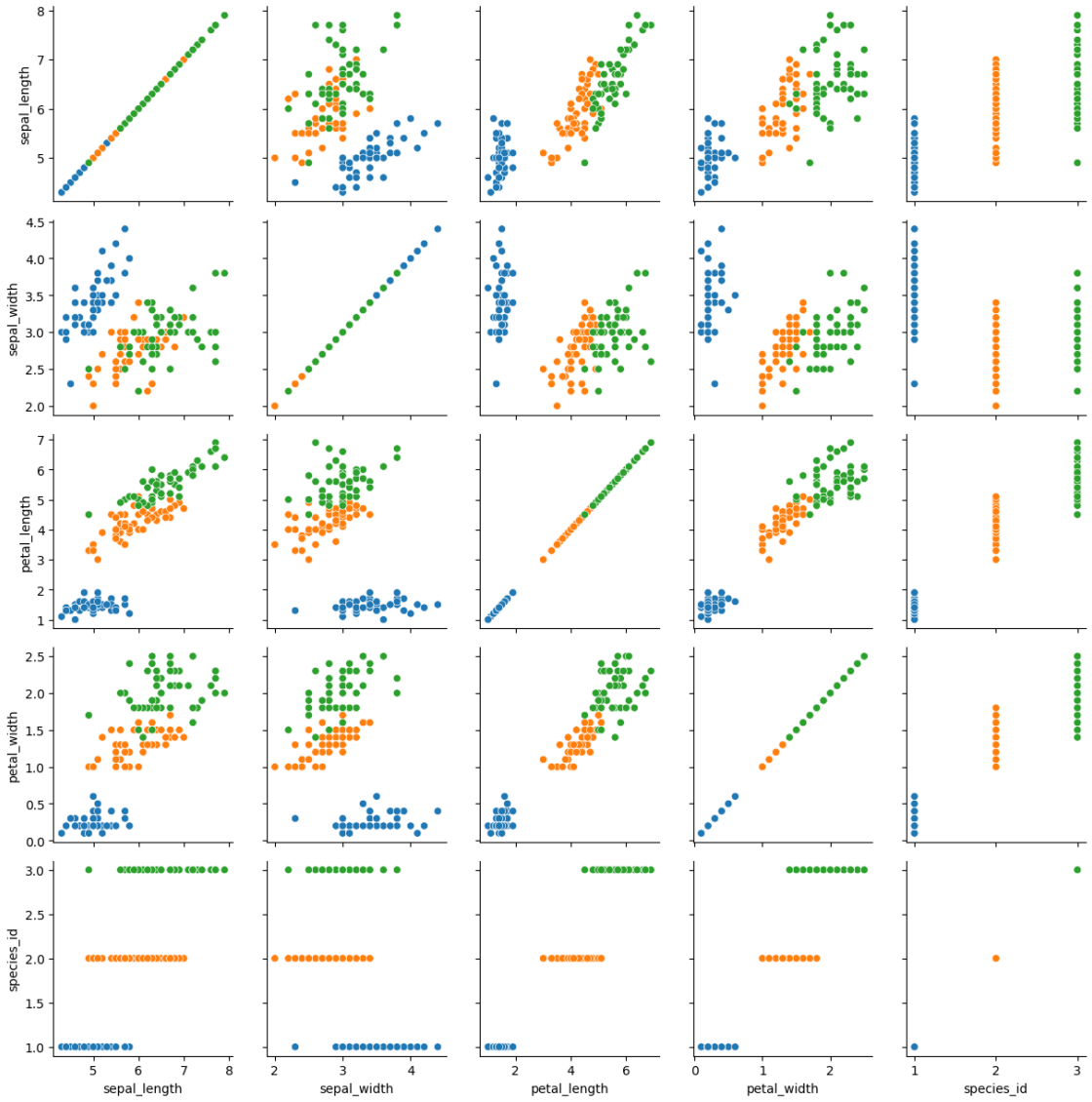
[93]:
```
sns.pairplot(iris, hue='species')
```

[93]:
```
<seaborn.axisgrid.PairGrid at 0x25095b760f0>
```



[95]:
```
# pair grid
g = sns.PairGrid(data=iris, hue='species')
# g.map
g.map(sns.scatterplot)
```

[95]: <seaborn.axisgrid.PairGrid at 0x25099c51f10>



[96]:
```
# map_diag -> map_offdiag

g = sns.PairGrid(data=iris, hue='species')
g.map_diag(sns.boxplot)
g.map_offdiag(sns.kdeplot)
```

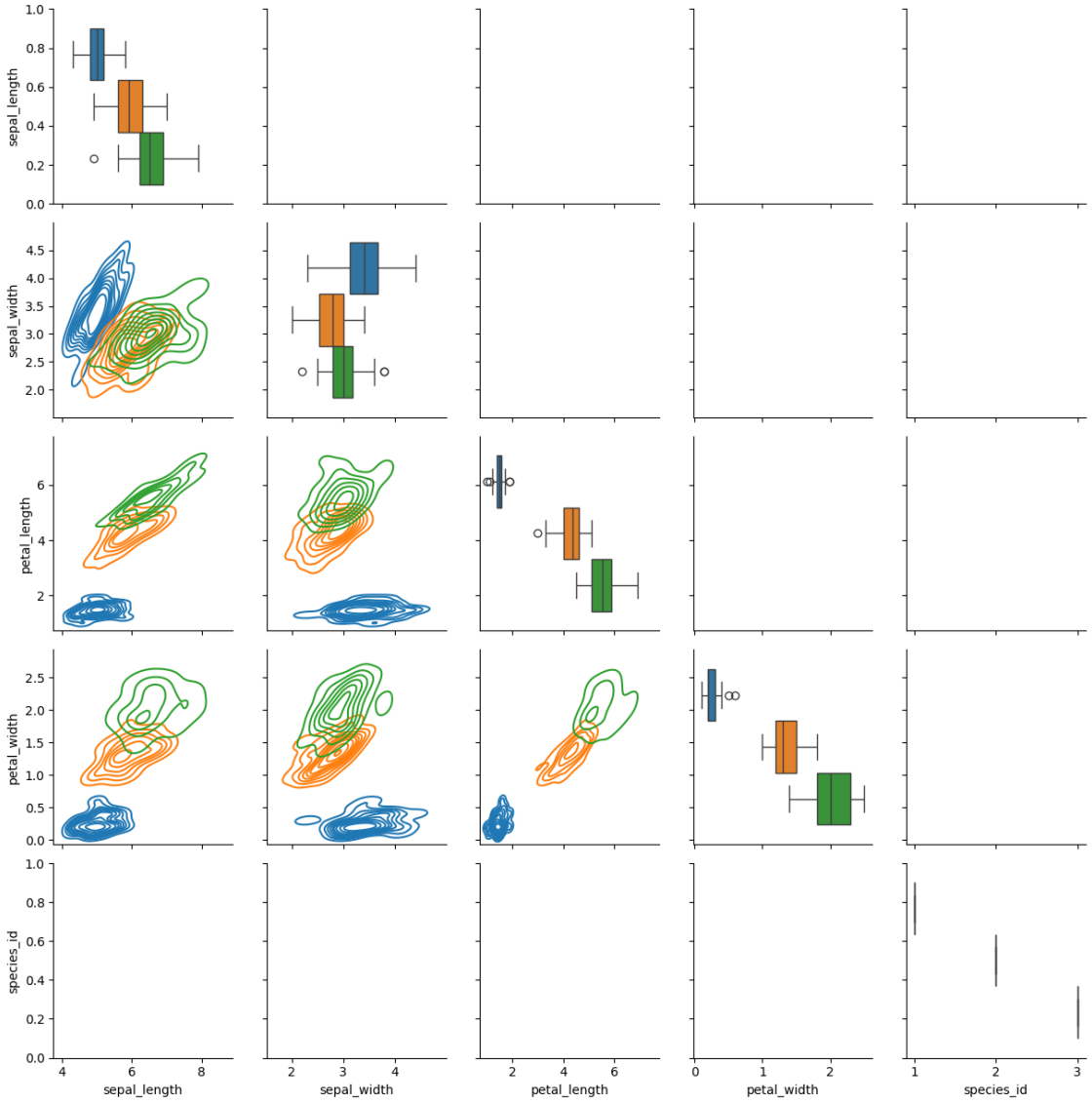
```
c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1615:
UserWarning:

KDE cannot be estimated (0 variance or perfect covariance). Pass
`warn_singular=False` to disable this warning.

c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1615:
```

```
UserWarning:

KDE cannot be estimated (0 variance or perfect covariance). Pass
`warn_singular=False` to disable this warning.

c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1615:
UserWarning:

KDE cannot be estimated (0 variance or perfect covariance). Pass
`warn_singular=False` to disable this warning.
```

```
---------------------------------------------------------------------------
IndexError                                Traceback (most recent call last)
Cell In[96], line 5
      3 g = sns.PairGrid(data=iris, hue='species')
      4 g.map_diag(sns.boxplot)
----> 5 g.map_offdiag(sns.kdeplot)

File c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1425, in␣
 ↪PairGrid.map_offdiag(self, func, **kwargs)
   1414 """Plot with a bivariate function on the off-diagonal subplots.
   1415
   1416 Parameters
   (…)
   1422
   1423 """
   1424 if self.square_grid:
-> 1425     self.map_lower(func, **kwargs)
   1426     if not self._corner:
   1427         self.map_upper(func, **kwargs)

File c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1395, in␣
 ↪PairGrid.map_lower(self, func, **kwargs)
   1384 """Plot with a bivariate function on the lower diagonal subplots.
   1385
   1386 Parameters
   (…)
   1392
   1393 """
   1394 indices = zip(*np.tril_indices_from(self.axes, -1))
-> 1395 self._map_bivariate(func, indices, **kwargs)
   1396 return self

File c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1574, in␣
 ↪PairGrid._map_bivariate(self, func, indices, **kwargs)
   1572     if ax is None:  # i.e. we are in corner mode
```

```
   1573         continue
-> 1574     self._plot_bivariate(x_var, y_var, ax, func, **kws)
   1575 self._add_axis_labels()
   1577 if "hue" in signature(func).parameters:

File c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1615, in␣
 ↪PairGrid._plot_bivariate(self, x_var, y_var, ax, func, **kwargs)
   1611 if "hue" not in kwargs:
   1612     kwargs.update({
   1613         "hue": hue, "hue_order": self._hue_order, "palette": self.
 ↪_orig_palette,
   1614     })
-> 1615 func(x=x, y=y, **kwargs)
   1617 self._update_legend_data(ax)

File c:\Program Files\Python312\Lib\site-packages\seaborn\distributions.py:1715␣
 ↪in kdeplot(data, x, y, hue, weights, palette, hue_order, hue_norm, color,␣
 ↪fill, multiple, common_norm, common_grid, cumulative, bw_method, bw_adjust,␣
 ↪warn_singular, log_scale, levels, thresh, gridsize, cut, clip, legend, cbar,␣
 ↪cbar_ax, cbar_kws, ax, **kwargs)
   1701     p.plot_univariate_density(
   1702         multiple=multiple,
   1703         common_norm=common_norm,
   (…)
   1710         **plot_kws,
   1711     )
   1713 else:
-> 1715     p.plot_bivariate_density(
   1716         common_norm=common_norm,
   1717         fill=fill,
   1718         levels=levels,
   1719         thresh=thresh,
   1720         legend=legend,
   1721         color=color,
   1722         warn_singular=warn_singular,
   1723         cbar=cbar,
   1724         cbar_ax=cbar_ax,
   1725         cbar_kws=cbar_kws,
   1726         estimate_kws=estimate_kws,
   1727         **kwargs,
   1728     )
   1730 return ax

File c:\Program Files\Python312\Lib\site-packages\seaborn\distributions.py:1113␣
 ↪in _DistributionPlotter.plot_bivariate_density(self, common_norm, fill,␣
 ↪levels, thresh, color, legend, cbar, warn_singular, cbar_ax, cbar_kws,␣
 ↪estimate_kws, **contour_kws)
   1111 # Transform from iso-proportions to iso-densities
   1112 if common_norm:
```

```
-> 1113     common_levels = self._quantile_to_level(
   1114         list(densities.values()), levels,
   1115     )
   1116     draw_levels = {k: common_levels for k in densities}
   1117 else:

File c:\Program Files\Python312\Lib\site-packages\seaborn\distributions.py:200,
 ↪in _DistributionPlotter._quantile_to_level(self, data, quantile)
    198 normalized_values = np.cumsum(sorted_values) / values.sum()
    199 idx = np.searchsorted(normalized_values, 1 - isoprop)
--> 200 levels = np.take(sorted_values, idx, mode="clip")
    201 return levels

File c:\Program Files\Python312\Lib\site-packages\numpy\core\fromnumeric.py:192
 ↪in take(a, indices, axis, out, mode)
     95 @array_function_dispatch(_take_dispatcher)
     96 def take(a, indices, axis=None, out=None, mode='raise'):
     97     """
     98     Take elements from an array along an axis.
     99
   (…)
    190            [5, 7]])
    191     """
--> 192     return _wrapfunc(a, 'take', indices, axis=axis, out=out, mode=mode)

File c:\Program Files\Python312\Lib\site-packages\numpy\core\fromnumeric.py:59,
 ↪in _wrapfunc(obj, method, *args, **kwds)
     56     return _wrapit(obj, method, *args, **kwds)
     58 try:
---> 59     return bound(*args, **kwds)
     60 except TypeError:
     61     # A TypeError occurs if the object does have such a method in its
     62     # class, but its signature is not identical to that of NumPy's. Thi
   (…)
     66     # Call _wrapit from within the except clause to ensure a potential
     67     # exception has a traceback chain.
     68     return _wrapit(obj, method, *args, **kwds)

IndexError: cannot do a non-empty take from an empty axes.
```



[97]:
```
# map_diag -> map_upper -> map_lower
g = sns.PairGrid(data=iris, hue='species')
g.map_diag(sns.histplot)
g.map_upper(sns.kdeplot)
g.map_lower(sns.scatterplot)
```

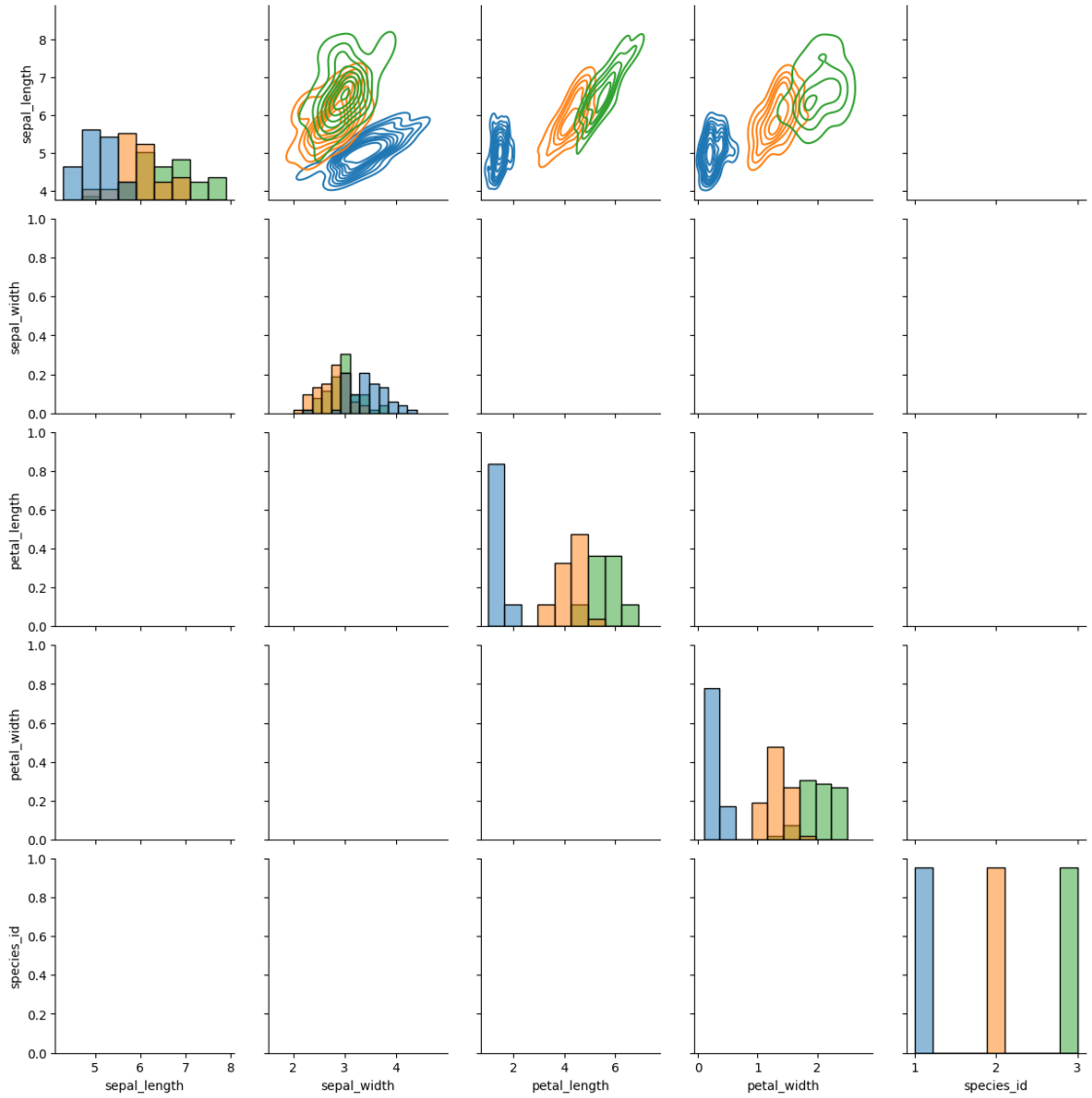
```
c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1615:
UserWarning:

KDE cannot be estimated (0 variance or perfect covariance). Pass
`warn_singular=False` to disable this warning.

c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1615:
```

```
UserWarning:

KDE cannot be estimated (0 variance or perfect covariance). Pass
`warn_singular=False` to disable this warning.

c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1615:
UserWarning:

KDE cannot be estimated (0 variance or perfect covariance). Pass
`warn_singular=False` to disable this warning.
```

```
---------------------------------------------------------------------------
IndexError                                Traceback (most recent call last)
Cell In[97], line 4
      2 g = sns.PairGrid(data=iris, hue='species')
      3 g.map_diag(sns.histplot)
----> 4 g.map_upper(sns.kdeplot)
      5 g.map_lower(sns.scatterplot)

File c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1410, in␣
 ↪PairGrid.map_upper(self, func, **kwargs)
   1399 """Plot with a bivariate function on the upper diagonal subplots.
   1400
   1401 Parameters
   (…)
   1407
   1408 """
   1409 indices = zip(*np.triu_indices_from(self.axes, 1))
-> 1410 self._map_bivariate(func, indices, **kwargs)
   1411 return self

File c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1574, in␣
 ↪PairGrid._map_bivariate(self, func, indices, **kwargs)
   1572     if ax is None:  # i.e. we are in corner mode
   1573         continue
-> 1574     self._plot_bivariate(x_var, y_var, ax, func, **kws)
   1575 self._add_axis_labels()
   1577 if "hue" in signature(func).parameters:

File c:\Program Files\Python312\Lib\site-packages\seaborn\axisgrid.py:1615, in␣
 ↪PairGrid._plot_bivariate(self, x_var, y_var, ax, func, **kwargs)
   1611 if "hue" not in kwargs:
   1612     kwargs.update({
   1613         "hue": hue, "hue_order": self._hue_order, "palette": self.
 ↪_orig_palette,
   1614     })
```

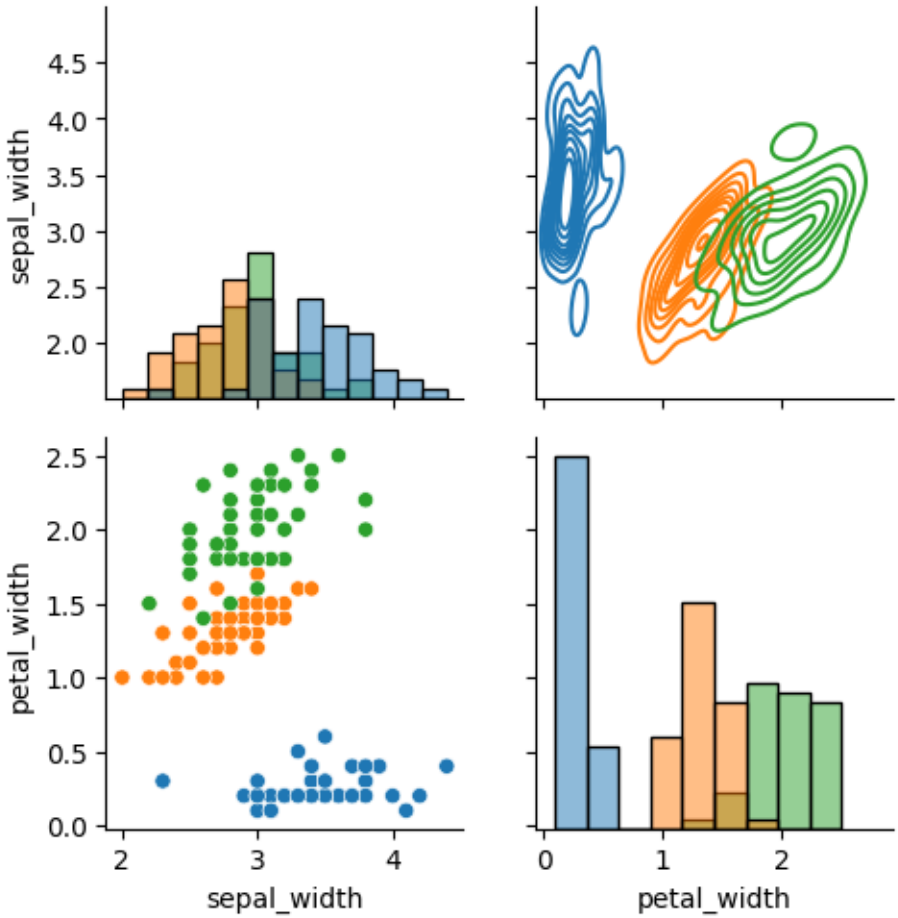
```
-> 1615 func(x=x, y=y, **kwargs)
   1617 self._update_legend_data(ax)

File c:\Program Files\Python312\Lib\site-packages\seaborn\distributions.py:1715
 ↪in kdeplot(data, x, y, hue, weights, palette, hue_order, hue_norm, color,␣
 ↪fill, multiple, common_norm, common_grid, cumulative, bw_method, bw_adjust,␣
 ↪warn_singular, log_scale, levels, thresh, gridsize, cut, clip, legend, cbar,␣
 ↪cbar_ax, cbar_kws, ax, **kwargs)
   1701     p.plot_univariate_density(
   1702         multiple=multiple,
   1703         common_norm=common_norm,
   (…)
   1710         **plot_kws,
   1711     )
   1713 else:
-> 1715     p.plot_bivariate_density(
   1716         common_norm=common_norm,
   1717         fill=fill,
   1718         levels=levels,
   1719         thresh=thresh,
   1720         legend=legend,
   1721         color=color,
   1722         warn_singular=warn_singular,
   1723         cbar=cbar,
   1724         cbar_ax=cbar_ax,
   1725         cbar_kws=cbar_kws,
   1726         estimate_kws=estimate_kws,
   1727         **kwargs,
   1728     )
   1730 return ax

File c:\Program Files\Python312\Lib\site-packages\seaborn\distributions.py:1113
 ↪in _DistributionPlotter.plot_bivariate_density(self, common_norm, fill,␣
 ↪levels, thresh, color, legend, cbar, warn_singular, cbar_ax, cbar_kws,␣
 ↪estimate_kws, **contour_kws)
   1111 # Transform from iso-proportions to iso-densities
   1112 if common_norm:
-> 1113     common_levels = self._quantile_to_level(
   1114         list(densities.values()), levels,
   1115     )
   1116     draw_levels = {k: common_levels for k in densities}
   1117 else:

File c:\Program Files\Python312\Lib\site-packages\seaborn\distributions.py:200,
 ↪in _DistributionPlotter._quantile_to_level(self, data, quantile)
    198 normalized_values = np.cumsum(sorted_values) / values.sum()
    199 idx = np.searchsorted(normalized_values, 1 - isoprop)
--> 200 levels = np.take(sorted_values, idx, mode="clip")
    201 return levels
```

```
File c:\Program Files\Python312\Lib\site-packages\numpy\core\fromnumeric.py:192
 ↪in take(a, indices, axis, out, mode)
     95 @array_function_dispatch(_take_dispatcher)
     96 def take(a, indices, axis=None, out=None, mode='raise'):
     97     """
     98     Take elements from an array along an axis.
     99
   (…)
    190            [5, 7]])
    191     """
--> 192     return _wrapfunc(a, 'take', indices, axis=axis, out=out, mode=mode)

File c:\Program Files\Python312\Lib\site-packages\numpy\core\fromnumeric.py:59,
 ↪in _wrapfunc(obj, method, *args, **kwds)
     56     return _wrapit(obj, method, *args, **kwds)
     58 try:
---> 59     return bound(*args, **kwds)
     60 except TypeError:
     61     # A TypeError occurs if the object does have such a method in its
     62     # class, but its signature is not identical to that of NumPy's. Thi
   (…)
     66     # Call _wrapit from within the except clause to ensure a potential
     67     # exception has a traceback chain.
     68     return _wrapit(obj, method, *args, **kwds)

IndexError: cannot do a non-empty take from an empty axes.
```



[98]:
```
# vars
g = sns.PairGrid(data=iris,hue='species',vars=['sepal_width','petal_width'])
g.map_diag(sns.histplot)
g.map_upper(sns.kdeplot)
g.map_lower(sns.scatterplot)
```

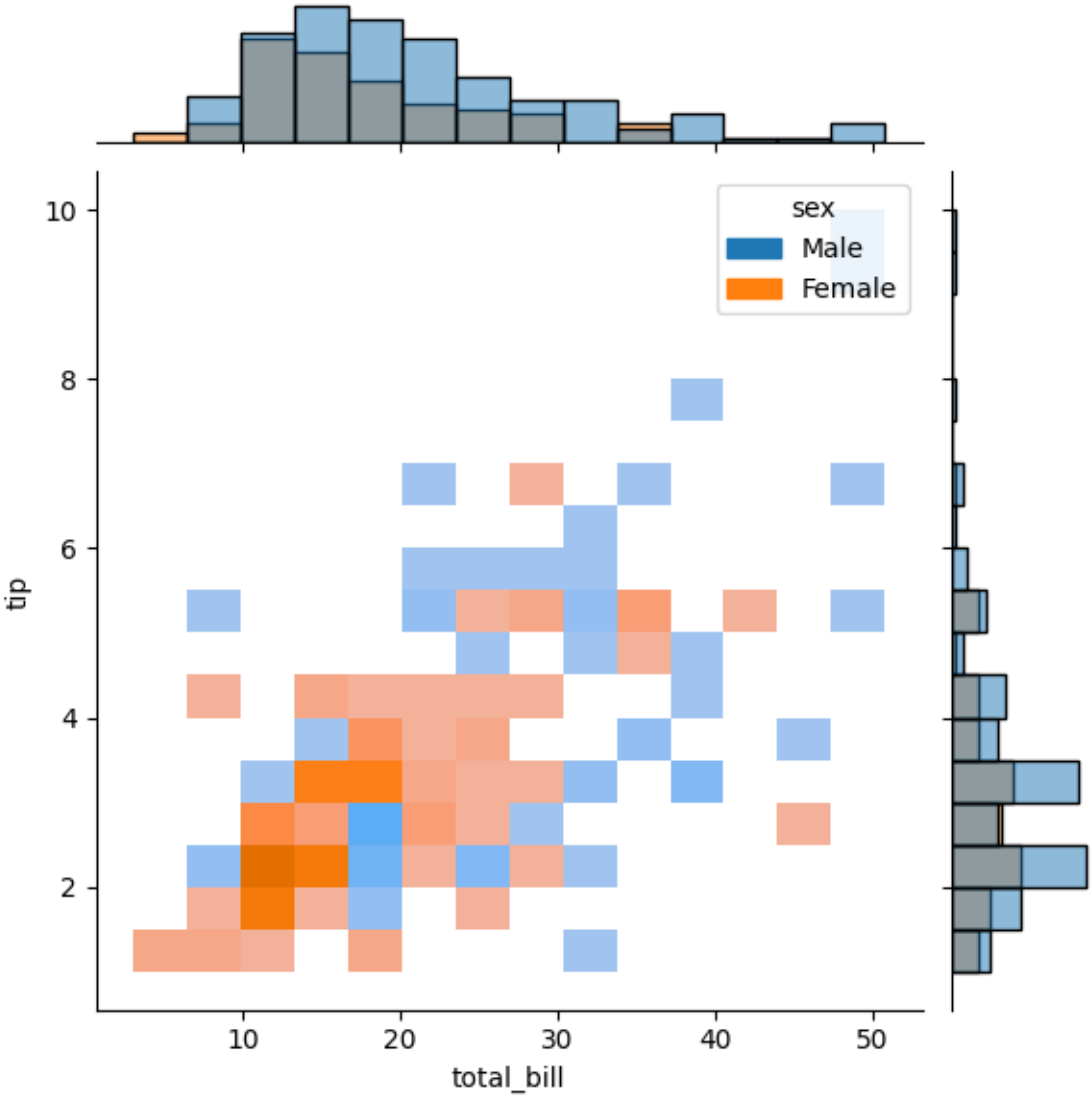
[98]: <seaborn.axisgrid.PairGrid at 0x250a056e690>



1.7 JointGrid Vs Jointplot

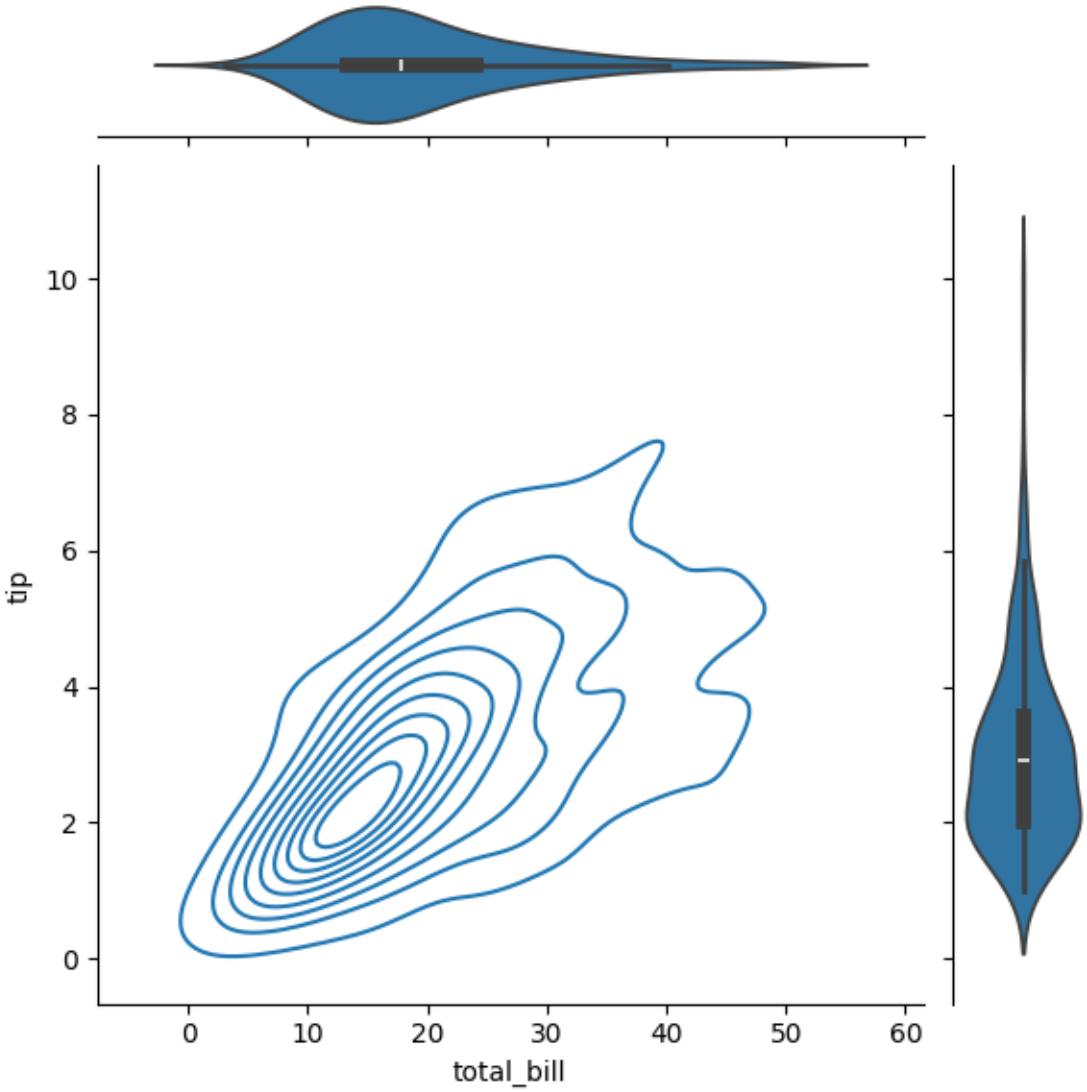
[99]:
```
sns.jointplot(data=tips, x='total_bill', y='tip', kind='hist', hue='sex')
```

[99]:
```
<seaborn.axisgrid.JointGrid at 0x250a0feca70>
```



[101]:
```
g = sns.JointGrid(data=tips, x='total_bill', y='tip')
g.plot(sns.kdeplot, sns.violinplot)
```

[101]: <seaborn.axisgrid.JointGrid at 0x250a2aa20f0>



1.7.1 Utility Functions

[104]:
```
sns.get_dataset_names()
```

```
---------------------------------------------------------------------------
gaierror                                  Traceback (most recent call last)
File c:\Program Files\Python312\Lib\urllib\request.py:1344, in␣
 ↪AbstractHTTPHandler.do_open(self, http_class, req, **http_conn_args)
   1343 try:
-> 1344     h.request(req.get_method(), req.selector, req.data, headers,
   1345               encode_chunked=req.has_header('Transfer-encoding'))
   1346 except OSError as err: # timeout error
```

```
File c:\Program Files\Python312\Lib\http\client.py:1336, in HTTPConnection.
 ↪request(self, method, url, body, headers, encode_chunked)
   1335 """Send a complete request to the server."""
-> 1336 self._send_request(method, url, body, headers, encode_chunked)

File c:\Program Files\Python312\Lib\http\client.py:1382, in HTTPConnection.
 ↪_send_request(self, method, url, body, headers, encode_chunked)
   1381     body = _encode(body, 'body')
-> 1382 self.endheaders(body, encode_chunked=encode_chunked)

File c:\Program Files\Python312\Lib\http\client.py:1331, in HTTPConnection.
 ↪endheaders(self, message_body, encode_chunked)
   1330     raise CannotSendHeader()
-> 1331 self._send_output(message_body, encode_chunked=encode_chunked)

File c:\Program Files\Python312\Lib\http\client.py:1091, in HTTPConnection.
 ↪_send_output(self, message_body, encode_chunked)
   1090 del self._buffer[:]
-> 1091 self.send(msg)
   1093 if message_body is not None:
   1094
   1095     # create a consistent interface to message_body

File c:\Program Files\Python312\Lib\http\client.py:1035, in HTTPConnection.
 ↪send(self, data)
   1034 if self.auto_open:
-> 1035     self.connect()
   1036 else:

File c:\Program Files\Python312\Lib\http\client.py:1470, in HTTPSConnection.
 ↪connect(self)
   1468 "Connect to a host on a given (SSL) port."
-> 1470 super().connect()
   1472 if self._tunnel_host:

File c:\Program Files\Python312\Lib\http\client.py:1001, in HTTPConnection.
 ↪connect(self)
   1000 sys.audit("http.client.connect", self, self.host, self.port)
-> 1001 self.sock = self._create_connection(
   1002     (self.host,self.port), self.timeout, self.source_address)
   1003 # Might fail in OSs that don't implement TCP_NODELAY

File c:\Program Files\Python312\Lib\socket.py:829, in create_connection(address
 ↪timeout, source_address, all_errors)
    828 exceptions = []
--> 829 for res in getaddrinfo(host, port, 0, SOCK_STREAM):
    830     af, socktype, proto, canonname, sa = res
```

```
File c:\Program Files\Python312\Lib\socket.py:964, in getaddrinfo(host, port,␣
 ↪family, type, proto, flags)
    963 addrlist = []
--> 964 for res in _socket.getaddrinfo(host, port, family, type, proto, flags):
    965     af, socktype, proto, canonname, sa = res

gaierror: [Errno 11001] getaddrinfo failed

During handling of the above exception, another exception occurred:

URLError                                  Traceback (most recent call last)
Cell In[104], line 1
----> 1 sns.get_dataset_names()

File c:\Program Files\Python312\Lib\site-packages\seaborn\utils.py:499, in␣
 ↪get_dataset_names()
    493 def get_dataset_names():
    494     """Report available example datasets, useful for reporting issues.
    495
    496     Requires an internet connection.
    497
    498     """
--> 499     with urlopen(DATASET_NAMES_URL) as resp:
    500         txt = resp.read()
    502     dataset_names = [name.strip() for name in txt.decode().split("\n")]

File c:\Program Files\Python312\Lib\urllib\request.py:215, in urlopen(url, data␣
 ↪timeout, cafile, capath, cadefault, context)
    213 else:
    214     opener = _opener
--> 215 return opener.open(url, data, timeout)

File c:\Program Files\Python312\Lib\urllib\request.py:515, in OpenerDirector.
 ↪open(self, fullurl, data, timeout)
    512     req = meth(req)
    514 sys.audit('urllib.Request', req.full_url, req.data, req.headers, req.
 ↪get_method())
--> 515 response = self._open(req, data)
    517 # post-process response
    518 meth_name = protocol+"_response"

File c:\Program Files\Python312\Lib\urllib\request.py:532, in OpenerDirector.
 ↪_open(self, req, data)
    529     return result
    531 protocol = req.type
--> 532 result = self._call_chain(self.handle_open, protocol, protocol +
    533                           '_open', req)
```

```
    534 if result:
    535     return result

File c:\Program Files\Python312\Lib\urllib\request.py:492, in OpenerDirector.
 ↪_call_chain(self, chain, kind, meth_name, *args)
    490 for handler in handlers:
    491     func = getattr(handler, meth_name)
--> 492     result = func(*args)
    493     if result is not None:
    494         return result

File c:\Program Files\Python312\Lib\urllib\request.py:1392, in HTTPSHandler.
 ↪https_open(self, req)
   1391 def https_open(self, req):
-> 1392     return self.do_open(http.client.HTTPSConnection, req,
   1393                         context=self._context)

File c:\Program Files\Python312\Lib\urllib\request.py:1347, in␣
 ↪AbstractHTTPHandler.do_open(self, http_class, req, **http_conn_args)
   1344         h.request(req.get_method(), req.selector, req.data, headers,
   1345                   encode_chunked=req.has_header('Transfer-encoding'))
   1346     except OSError as err: # timeout error
-> 1347         raise URLError(err)
   1348     r = h.getresponse()
   1349 except:

URLError: <urlopen error [Errno 11001] getaddrinfo failed>
```