Practical Application of Statistics Concepts

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Theory

1. stat 1: https://www.linkedin.com/posts/shubham-verma-3968a5119_stats-notes-1-activity-6971835885327716352-739b?utm_source=share&utm_medium=member_desktop
2. stat 2: https://www.linkedin.com/posts/shubham-verma-3968a5119_stats-day-2-activity-6972454558438502400-HFkm?utm_source=share&utm_medium=member_desktop
3. stat 3: https://www.linkedin.com/posts/shubham-verma-3968a5119_stats-3-activity-6974971613096140800-hkHU?utm_source=share&utm_medium=member_desktop
4. stat 4: https://www.linkedin.com/posts/shubham-verma-3968a5119_stats-4-activity-6974983725113630720-G8-U?utm_source=share&utm_medium=member_desktop

Credits Krish Naik Sir for Theory

In [1]:
```
import numpy as np
import seaborn as sns
import statistics as stat
import matplotlib.pyplot as plt
import random
```

0.0 Tips dataset

In [2]:
```
df = sns.load_dataset("tips")
```

In [3]:
```
df.head()
```

Out[3]:

	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

In [4]:
```
df.columns
```

Out[4]:
```
Index(['total_bill', 'tip', 'sex', 'smoker', 'day', 'time', 'size'], dtype='object')
```

In [5]:
```
df_numeric_data = df[df.dtypes[df.dtypes != 'category'].index]
df_numeric_data.head()
```

Out[5]:

	total_bill	tip	size
0	16.99	1.01	2
1	10.34	1.66	3
2	21.01	3.50	3
3	23.68	3.31	2
4	24.59	3.61	4

1.0 Measure of Central Tendency

1.1 mean of all numeric columns

In [6]:
```
np.mean(df_numeric_data,axis=0)
```

Out[6]:
```
total_bill    19.785943
tip            2.998279
size           2.569672
dtype: float64
```

1.2 median of all numeric columns

In [7]:
```
np.median(df_numeric_data, axis=0)
```

Out[7]:
```
array([17.795,  2.9  ,  2.   ])
```

1.3 mode of all columns

In [8]:
```
stat.mode(df['total_bill'])
```

Out[8]:
```
13.42
```

In [9]:
```
stat.mode(df['tip'])
```

Out[9]:
```
2.0
```

In [10]:
```
stat.mode(df['sex'])
```

Out[10]:
```
'Male'
```

In [11]:
```
stat.mode(df['smoker'])
```

Out[11]:
```
'No'
```

In [12]:
```
stat.mode(df['day'])
```

Out[12]:
```
'Sat'
```

In [13]:
```
stat.mode(df['time'])
```

Out[13]:
```
'Dinner'
```

In [14]:
```
stat.mode(df['size'])
```

Out[14]:
```
2
```

2.0 Measure of Dispersion

2.1 Variance

In [15]:
```
stat.variance(df_numeric_data['total_bill'])
```

Out[15]:
```
79.25293861397827
```

In [16]:
```
stat.variance(df_numeric_data['tip'])
```

Out[16]:
```
1.9144546380624705
```

In [17]:
```
stat.variance(df_numeric_data['size'])
```

Out[17]:
```
0.9045908385616946
```

2.2 Standard Deviation

In [18]:
```
stat.stdev(df_numeric_data['total_bill'])
```

Out[18]:
```
8.902411954856856
```

In [19]:
```
stat.stdev(df_numeric_data['tip'])
```

Out[19]:
```
1.383638189001182
```

In [20]:
```
stat.stdev(df_numeric_data['size'])
```

Out[20]: 0.9510998047322345

3.0 Five point summary

3.1 For total_bill Column

In [21]:
```
df_numeric_data['total_bill'].min()  # zeroth Percentile or minimum value
```
Out[21]: 3.07

In [22]:
```
np.percentile(df_numeric_data['total_bill'], 25) # 1st quartile
```
Out[22]: 13.3475

In [23]:
```
np.percentile(df_numeric_data['total_bill'], 50) # 2nd quartile or median
```
Out[23]: 17.795

In [24]:
```
np.percentile(df_numeric_data['total_bill'], 75) # 3rd quartile
```
Out[24]: 24.127499999999998

In [25]:
```
df_numeric_data['total_bill'].max()  # 100th Percentile or maximum value
```
Out[25]: 50.81

3.2 For tip Column

In [26]:
```
df_numeric_data['tip'].min()  # zeroth Percentile or minimum value
```
Out[26]: 1.0

In [27]:
```
np.percentile(df_numeric_data['tip'], 25) # 1st quartile
```
Out[27]: 2.0

In [28]:
```
np.percentile(df_numeric_data['tip'], 50) # 2nd quartile or median
```
Out[28]: 2.9

In [29]:
```
np.percentile(df_numeric_data['tip'], 75) # 3rd quartile
```
Out[29]: 3.5625

In [30]:
```
df_numeric_data['tip'].max()  # 100th Percentile or maximum value
```
Out[30]: 10.0

3.3 For size Column

In [31]:
```
df_numeric_data['size'].min()  # zeroth Percentile or minimum value
```
Out[31]: 1

In [32]:
```
np.percentile(df_numeric_data['size'], 25) # 1st quartile
```
Out[32]: 2.0

In [33]:
```
np.percentile(df_numeric_data['size'], 50) # 2nd quartile or median
```
Out[33]: 2.0

In [34]:
```
np.percentile(df_numeric_data['size'], 75) # 3rd quartile
```
Out[34]: 3.0

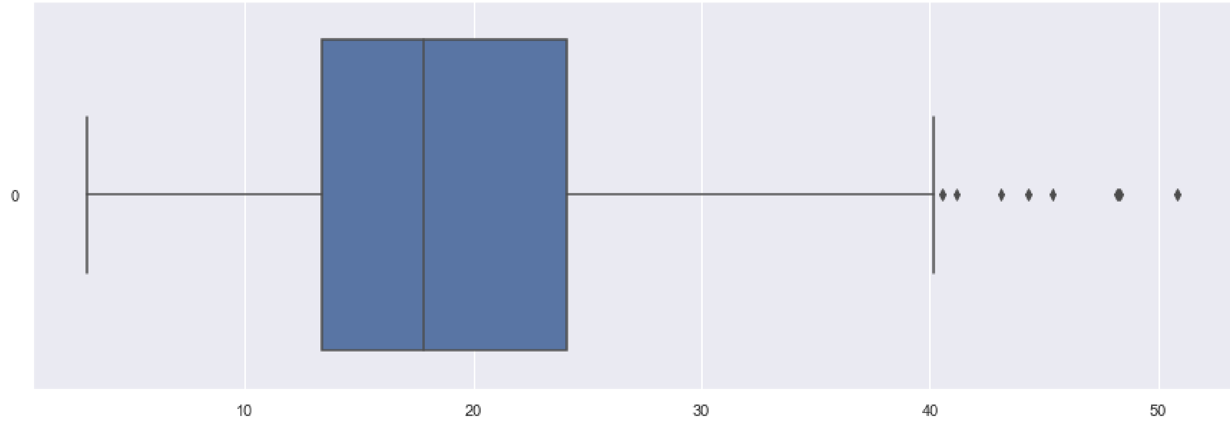
In [35]:
```
df_numeric_data['size'].max()  # 100th Percentile or maximum value
```
Out[35]: 6

4.0 Box Plot

4.1 Box plot for total_bill

In [36]:
```
sns.set(rc={'figure.figsize':(15,5)})
sns.boxplot(data = df_numeric_data['total_bill'], orient="h")
```

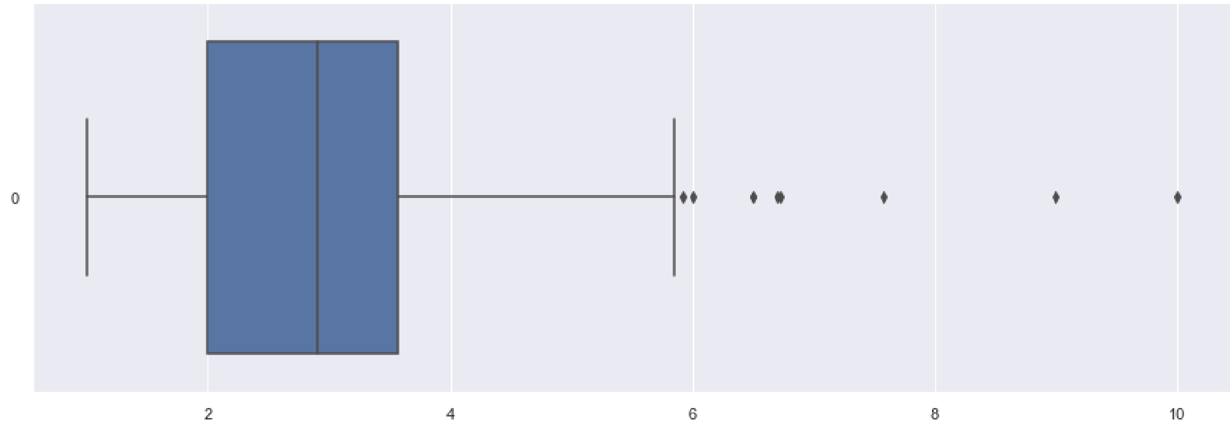
Out[36]: <AxesSubplot:>



4.2 Box plot for tip

In [37]:
```
sns.set(rc={'figure.figsize':(15,5)})
sns.boxplot(data = df_numeric_data['tip'], orient="h")
```

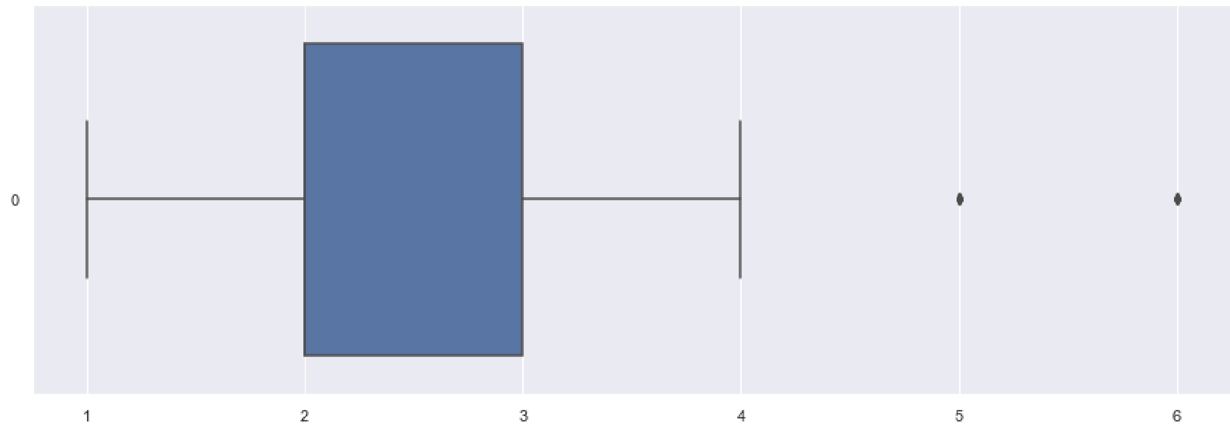
Out[37]: <AxesSubplot:>



4.3 Box plot for size

In [38]:
```
sns.set(rc={'figure.figsize':(15,5)})
sns.boxplot(data = df_numeric_data['size'], orient="h")
```

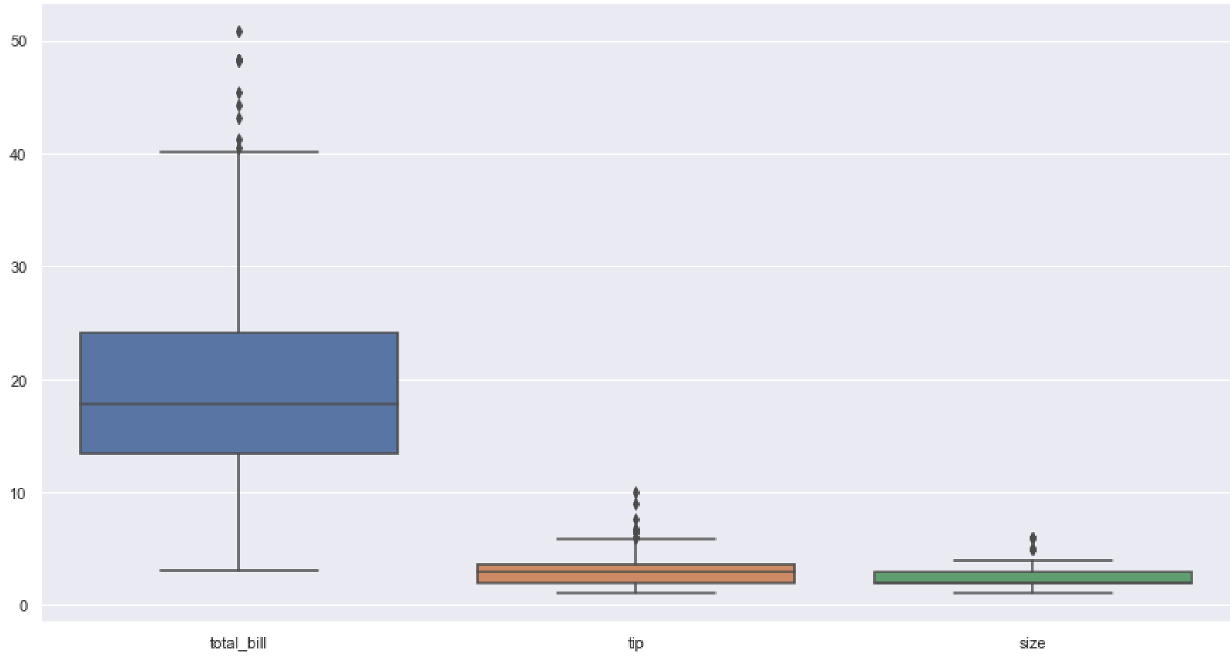
Out[38]: <AxesSubplot:>



4.4 Box plot combined

In [39]:
```
sns.set(rc={'figure.figsize':(15,8)})
sns.boxplot(data = df_numeric_data, orient="v")
```

Out[39]:
```
<AxesSubplot:>
```

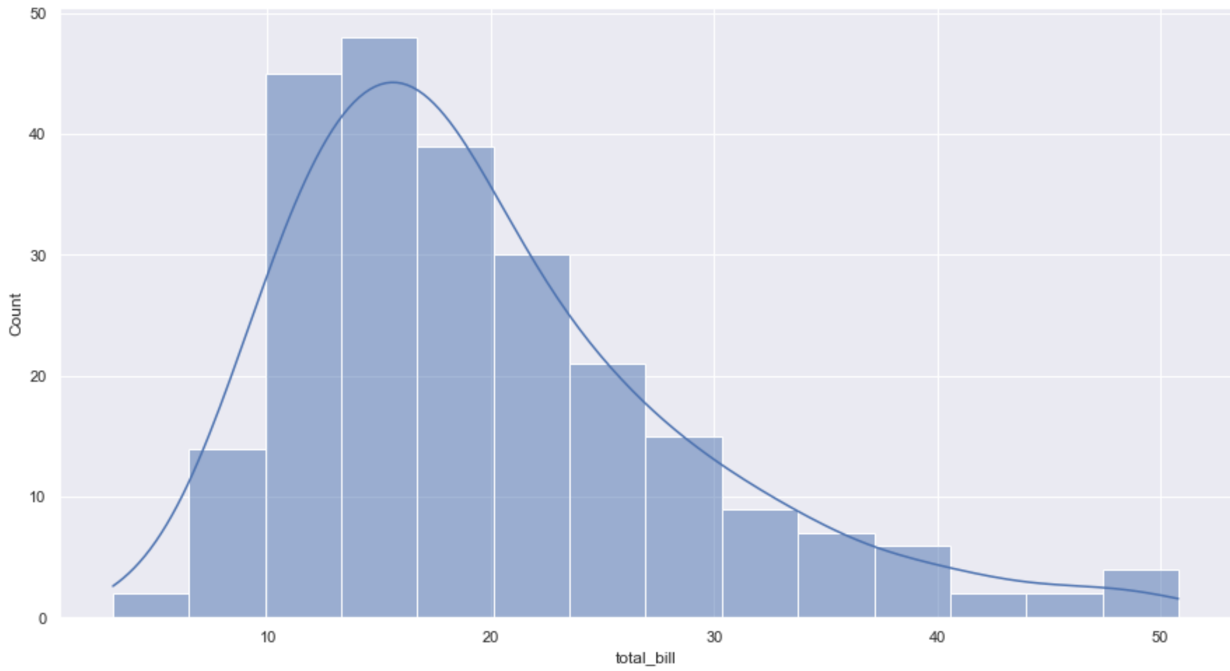


5.0 Histogram and Distribution

5.1 Histogram and distribution for total_bill

In [40]:
```
sns.histplot(df_numeric_data['total_bill'], kde=True)
```

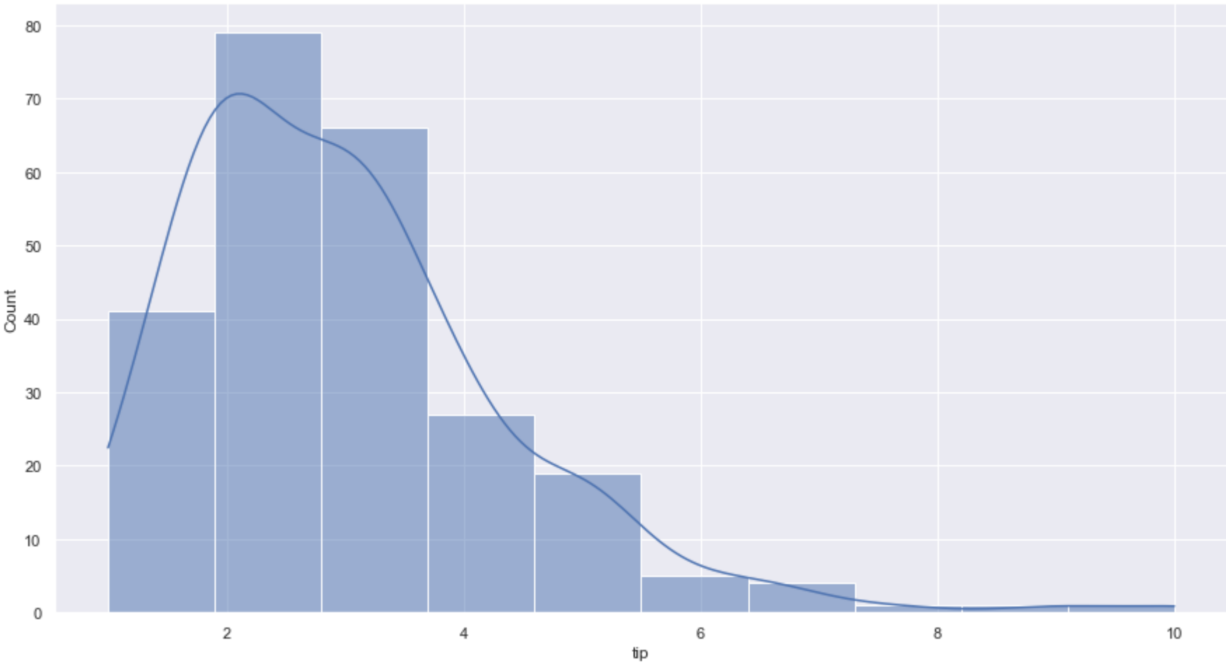
Out[40]:
```
<AxesSubplot:xlabel='total_bill', ylabel='Count'>
```



5.2 Histogram and distribution for tip

In [41]:
```
sns.histplot(df_numeric_data['tip'], kde=True, bins=10)
```

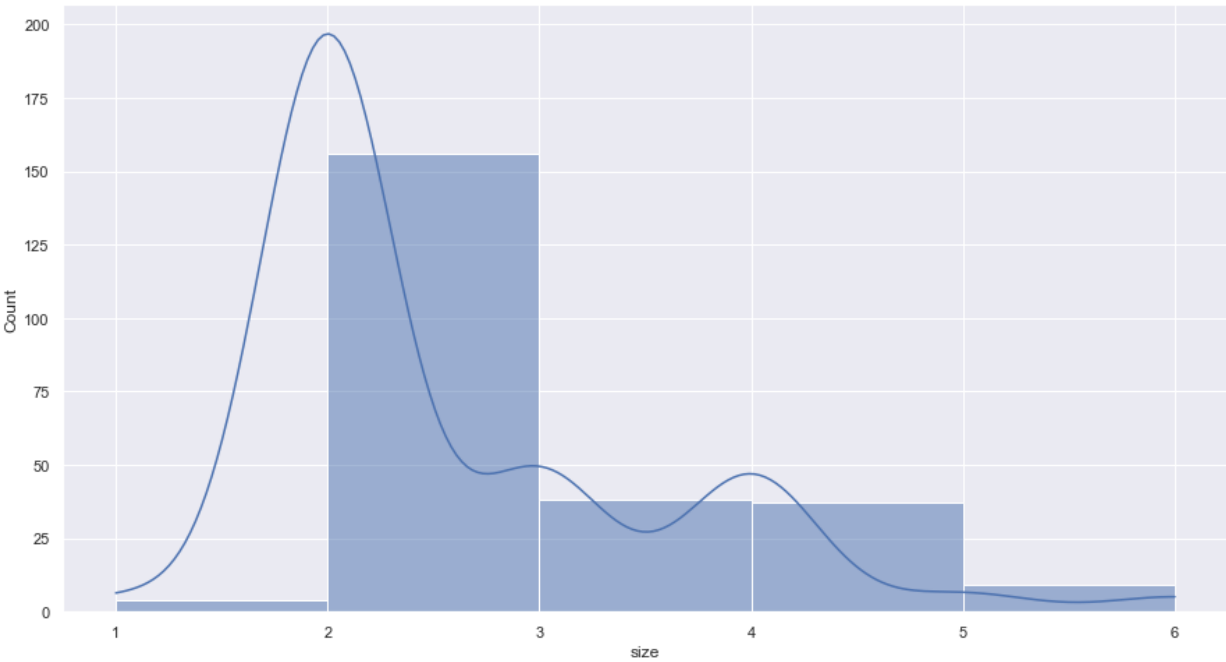
Out[41]:
```
<AxesSubplot:xlabel='tip', ylabel='Count'>
```



5.3 Histogram and distribution for size

In [42]:
```
sns.histplot(df_numeric_data['size'], kde=True, bins=5)
```

Out[42]: <AxesSubplot:xlabel='size', ylabel='Count'>



6.0 Standardization

In [43]:
```
df_numeric_data.head()
```

Out[43]:

	total_bill	tip	size
0	16.99	1.01	2
1	10.34	1.66	3
2	21.01	3.50	3
3	23.68	3.31	2
4	24.59	3.61	4

6.1 standardization of dataset

In [44]:
```
df_numeric_data_std = (df_numeric_data - df_numeric_data.mean())/df_numeric_data.std()
```

In [45]:
```
df_numeric_data_std.head()
```

Out[45]:

	total_bill	tip	size
0	-0.314066	-1.436993	-0.598961
1	-1.061054	-0.967217	0.452453
2	0.137497	0.362610	0.452453
3	0.437416	0.225291	-0.598961
4	0.539635	0.442111	1.503867

6.2 mean and standard deviation of standardized dataset

In [46]:
```
round(df_numeric_data_std.mean(), 2)
```

Out[46]:
```
total_bill   -0.0
tip          -0.0
size         -0.0
dtype: float64
```

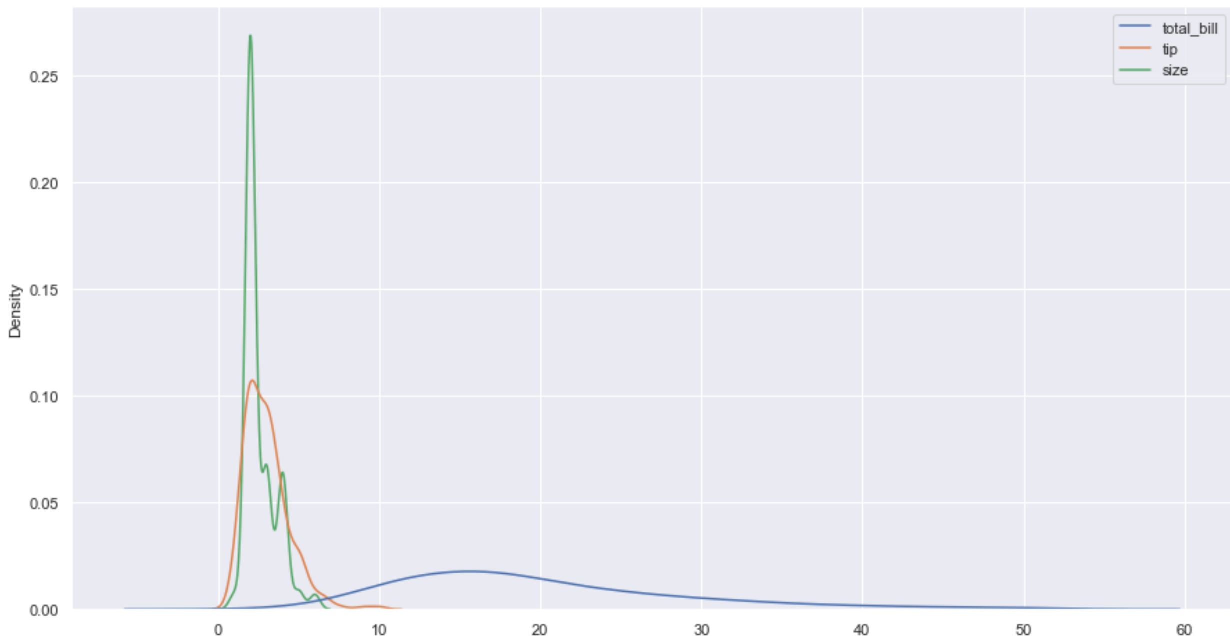
In [47]:
```
df_numeric_data_std.std()
```

Out[47]:
```
total_bill    1.0
tip           1.0
size          1.0
dtype: float64
```

6.3 kde plot of original dataset

In [48]:
```
sns.kdeplot(data = df_numeric_data) # kde plot for numeric data
```

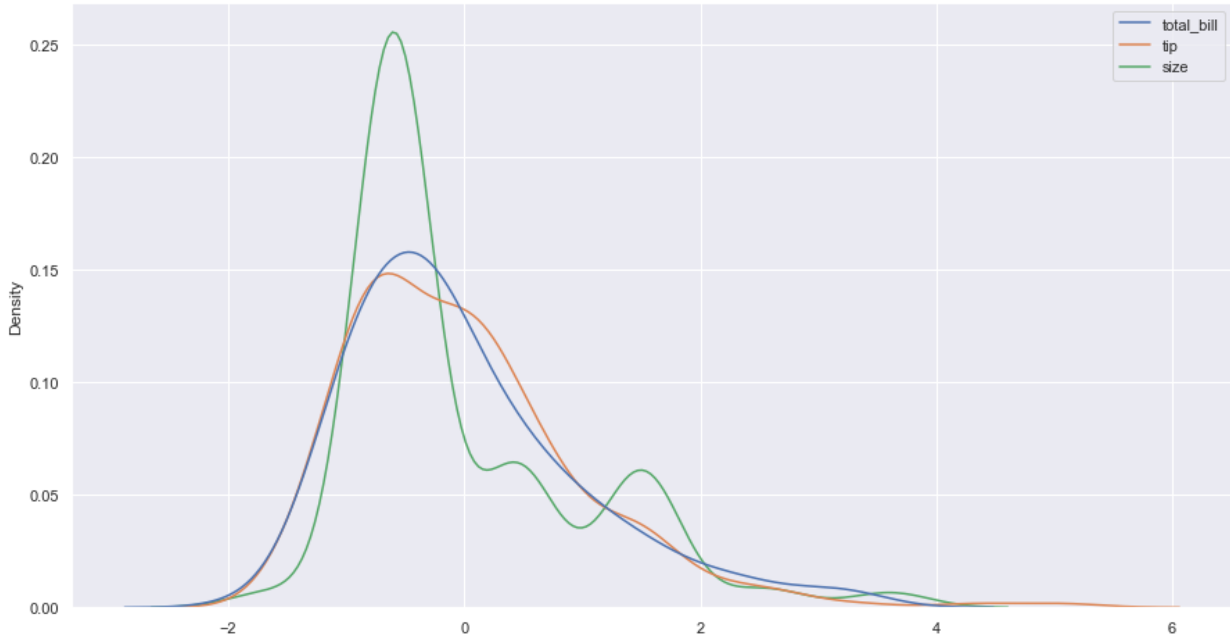
Out[48]:
```
&lt;AxesSubplot:ylabel='Density'&gt;
```



6.4 kde plot of standardized dataset

In [49]:
```
sns.kdeplot(data = df_numeric_data_std) # kde plot for numeric data in tips data set after standardization
```

Out[49]:
```
&lt;AxesSubplot:ylabel='Density'&gt;
```



7.0 Normalization

Using MinMax Scalar

Note: using MinMax Scalar the data range will be 0 to 1.

In [50]:
```
df_numeric_data.head()
```

Out[50]:

	total_bill	tip	size
0	16.99	1.01	2
1	10.34	1.66	3
2	21.01	3.50	3
3	23.68	3.31	2
4	24.59	3.61	4

7.1 normalization of dataset

In [51]:
```
df_numeric_data_normal = (df_numeric_data - df_numeric_data.min()) / (df_numeric_data.max() - df_numeric_data
```

In [52]:
```
df_numeric_data_normal.head()
```

Out[52]:

	total_bill	tip	size
0	0.291579	0.001111	0.2
1	0.152283	0.073333	0.4
2	0.375786	0.277778	0.4
3	0.431713	0.256667	0.2
4	0.450775	0.290000	0.6

7.2 min, max, mean and standard deviation of normalized dataset

In [53]:
```
df_numeric_data_normal.min() # minimum value of data
```

Out[53]:
```
total_bill    0.0
tip           0.0
size          0.0
dtype: float64
```

In [54]:
```
df_numeric_data_normal.max() # maximum value of data
```

Out[54]:
```
total_bill    1.0
tip           1.0
size          1.0
dtype: float64
```

In [55]:
```
df_numeric_data_normal.mean()
```

Out[55]:
```
total_bill    0.350145
tip           0.222031
size          0.313934
dtype: float64
```

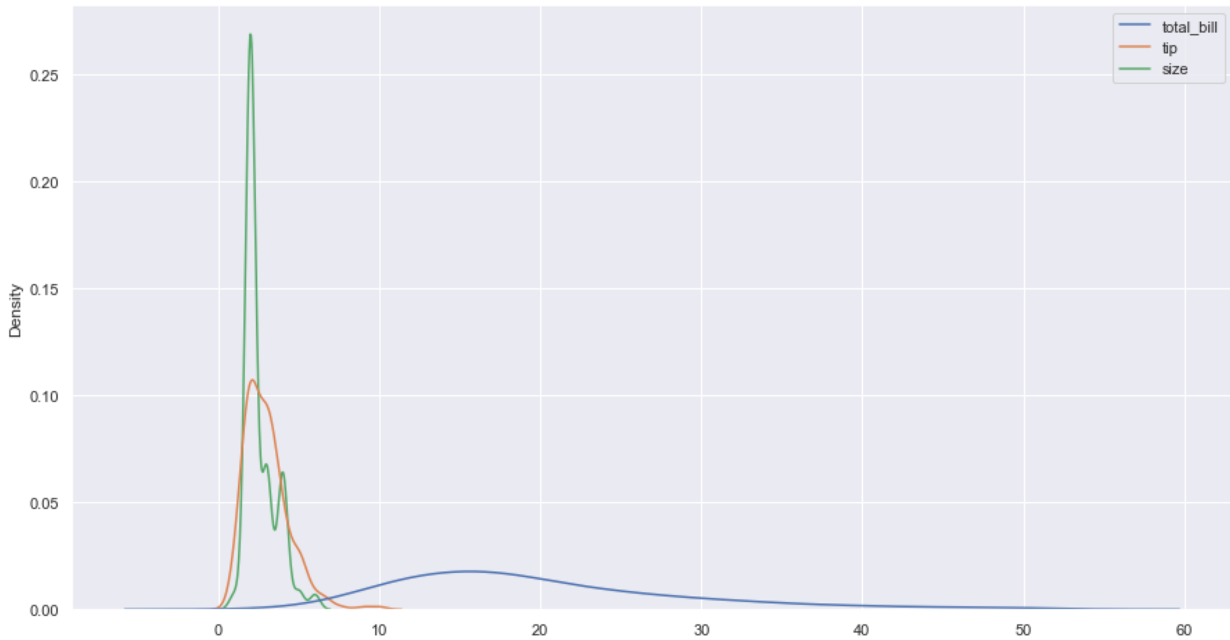
In [56]:
```
df_numeric_data_normal.std()
```

Out[56]:
```
total_bill    0.186477
tip           0.153738
size          0.190220
dtype: float64
```

7.3 kde plot of original dataset

In [57]:
```
sns.kdeplot(data = df_numeric_data) # kde plot for numeric data
```

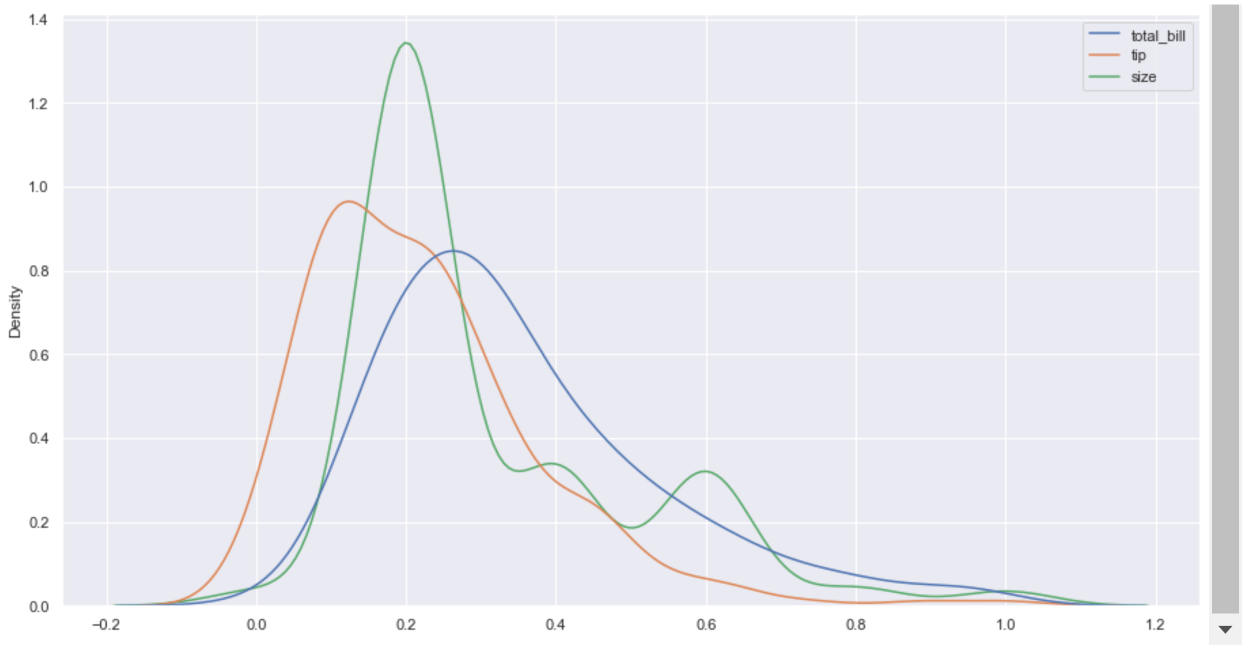
Out[57]: <AxesSubplot:ylabel='Density'>



7.4 kde plot of normalized dataset

In [58]:
```
sns.kdeplot(data = df_numeric_data_normal)  # kde plot for numeric data in tips data set after normalization
```

Out[58]: <AxesSubplot:ylabel='Density'>



8.0 Central Limit Theorem

In [59]:
```
df_numeric_data.head()
```

Out[59]:

	total_bill	tip	size
0	16.99	1.01	2
1	10.34	1.66	3
2	21.01	3.50	3
3	23.68	3.31	2
4	24.59	3.61	4

8.1 for total_bill

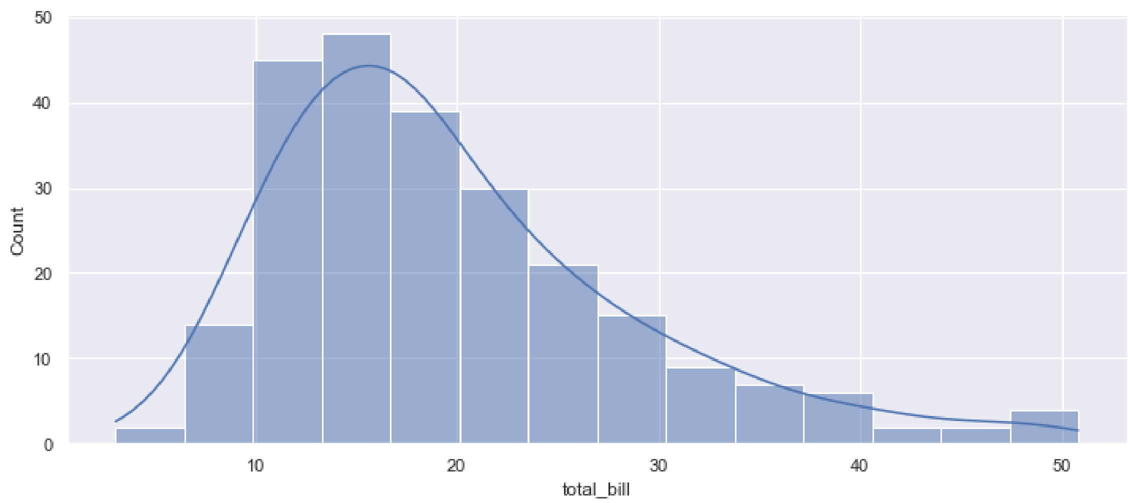
In [60]:
```
mean_pop_total_bill = df_numeric_data['total_bill'].mean()
std_pop_total_bill = df_numeric_data['total_bill'].std()

print("population mean (μ): {}\npopulation standard deviation (σ): {}".format(mean_pop_total_bill,std_pop_tot
```

```
population mean (μ): 19.785942622950824
population standard deviation (σ): 8.902411954856856
```

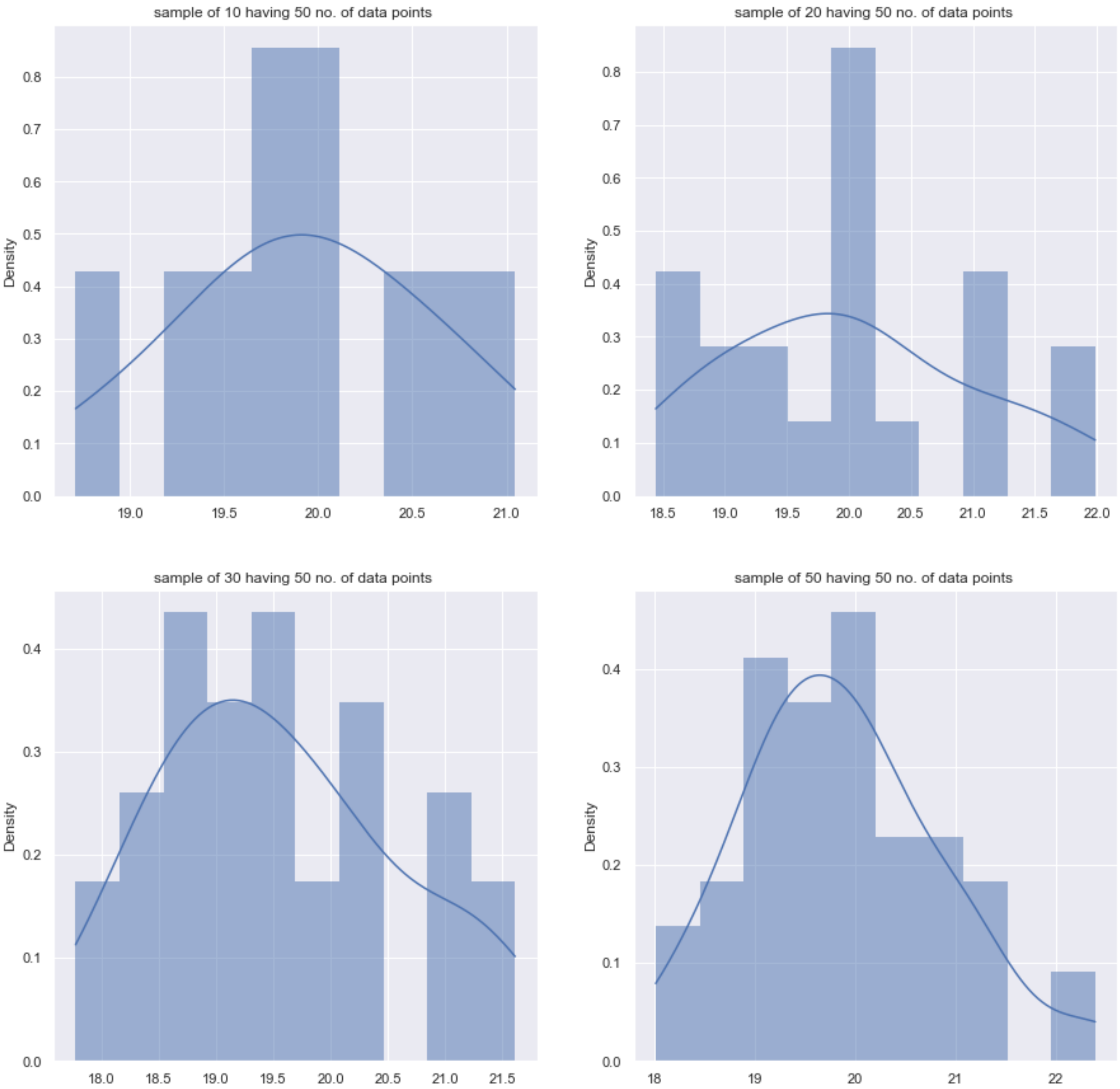
In [61]:
```
sns.set(rc={'figure.figsize':(12,5)})
sns.histplot(df_numeric_data['total_bill'], kde=True)
```

Out[61]: <AxesSubplot:xlabel='total_bill', ylabel='Count'>



In [62]:
```
def mean_distribution(data, samples_count, data_points_count):
```

```
    list_sample = list()
    data = np.array(data.values)
    for i in range(0, samples_count):
        samples = random.sample(range(0, data.shape[0]), data_points_count)
        list_sample.append(data[samples].mean())
    return np.array(list_sample)
count = 0
mean_list = list()
fg, ax = plt.subplots(nrows=2, ncols=2, figsize=(15, 15))
lst = [(10,50),(20,50),(30,50),(50,50)]
for i in (0,1):
    for j in (0,1):
        ax[i,j].set_title("sample of " + str(lst[count][0]) + " having " + str(lst[count][1])+" no. of data p
        sns.histplot(mean_distribution(df_numeric_data['total_bill'], lst[count][0],lst[count][1]),ax = ax[i,
        mean_list.append(mean_distribution(df_numeric_data['total_bill'], lst[count][0],lst[count][1]))
        count +=1
```



8.2 for tip

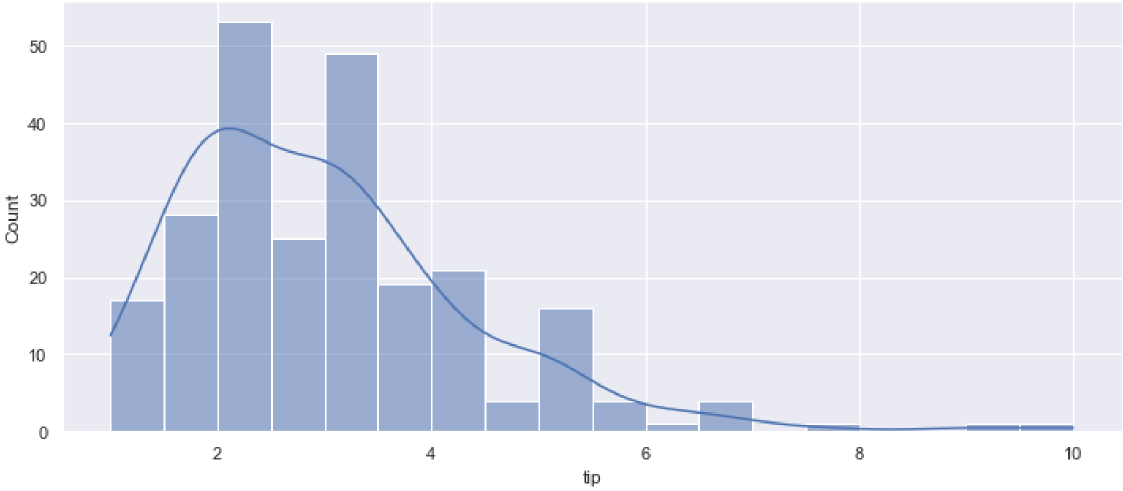
In [63]:
```
mean_pop_tip = df_numeric_data['tip'].mean()
std_pop_tip= df_numeric_data['tip'].std()

print("population mean (μ): {}\npopulation standard deviation (σ): {}".format(mean_pop_tip,std_pop_tip))
```

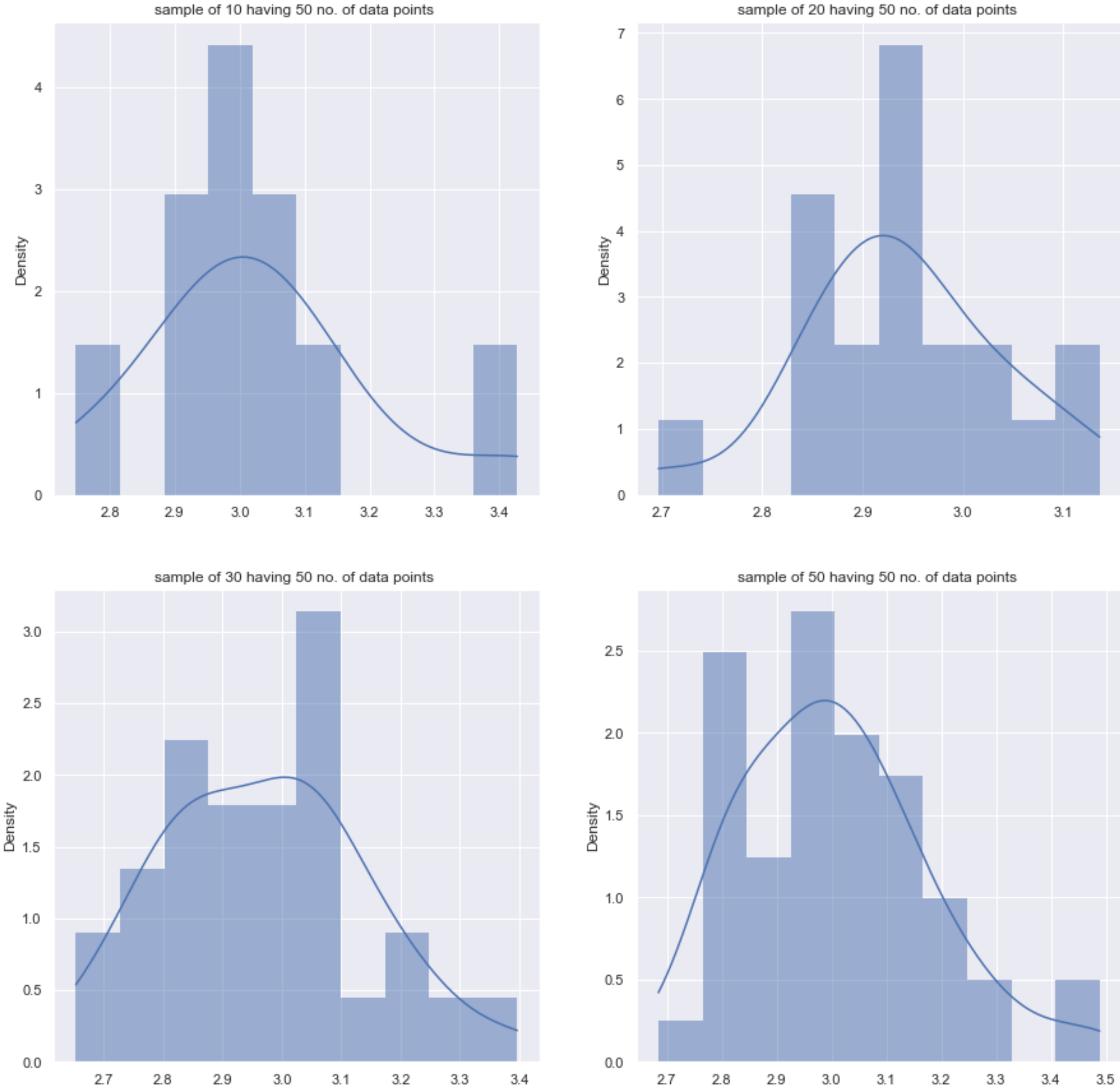
```
population mean (μ): 2.9982786885245902
population standard deviation (σ): 1.3836381890011826
```

In [64]:
```
sns.set(rc={'figure.figsize':(12,5)})
sns.histplot(df_numeric_data['tip'], kde=True)
```

Out[64]:
```
<AxesSubplot:xlabel='tip', ylabel='Count'>
```



In [65]:
```
def mean_distribution(data, samples_count, data_points_count):
    list_sample = list()
    data = np.array(data.values)
    for i in range(0, samples_count):
        samples = random.sample(range(0, data.shape[0]), data_points_count)
        list_sample.append(data[samples].mean())
    return np.array(list_sample)
count = 0
mean_list = list()
fg, ax = plt.subplots(nrows=2, ncols=2, figsize=(15, 15))
lst = [(10,50),(20,50),(30,50),(50,50)]
for i in (0,1):
    for j in (0,1):
        ax[i,j].set_title("sample of " + str(lst[count][0]) + " having " + str(lst[count][1])+" no. of data p
        sns.histplot(mean_distribution(df_numeric_data['tip'], lst[count][0],lst[count][1]),ax = ax[i,j],bins
        mean_list.append(mean_distribution(df_numeric_data['tip'], lst[count][0],lst[count][1]))
        count +=1
```



8.3 for size

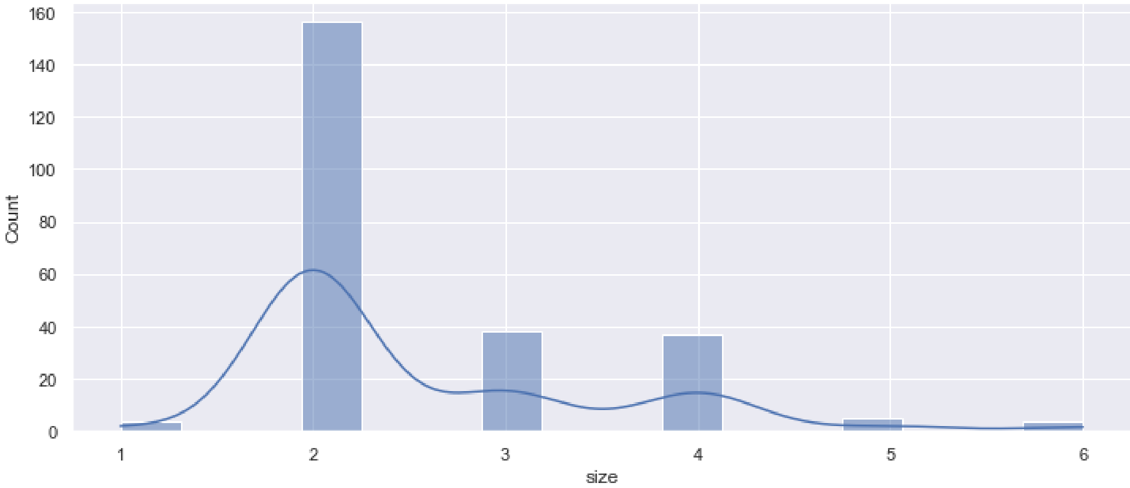
In [66]:
```
mean_pop_size = df_numeric_data['size'].mean()
std_pop_size = df_numeric_data['size'].std()

print("population mean (μ): {}\npopulation standard deviation (σ): {}".format(mean_pop_size,std_pop_size))
```

```
population mean (μ): 2.569672131147541
population standard deviation (σ): 0.9510998047322332
```

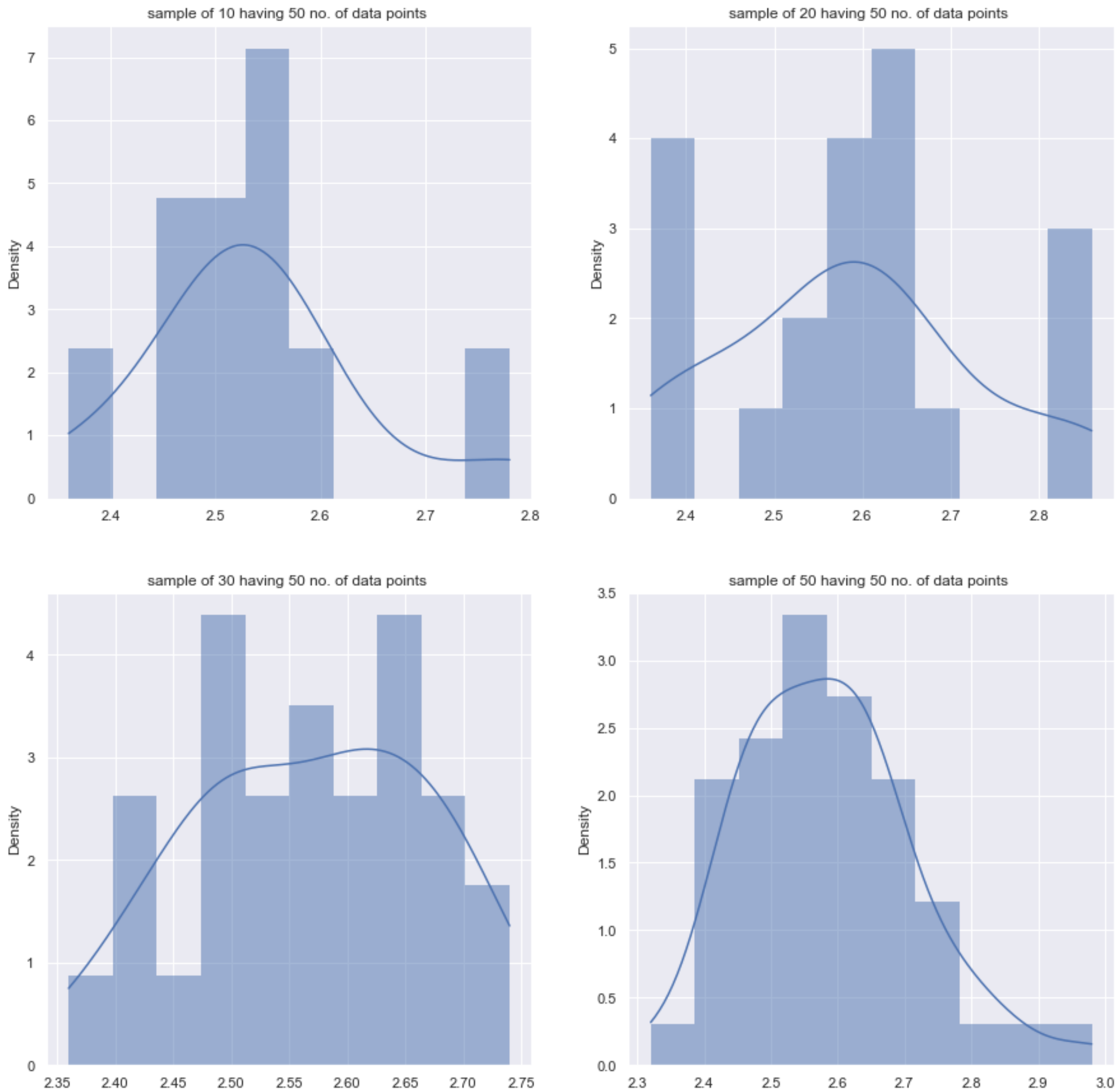
In [67]:
```
sns.set(rc={'figure.figsize':(12,5)})
sns.histplot(df_numeric_data['size'], kde=True)
```

Out[67]:
```
<AxesSubplot:xlabel='size', ylabel='Count'>
```



In [68]:

```
def mean_distribution(data, samples_count, data_points_count):
    list_sample = list()
    data = np.array(data.values)
    for i in range(0, samples_count):
        samples = random.sample(range(0, data.shape[0]), data_points_count)
        list_sample.append(data[samples].mean())
    return np.array(list_sample)
count = 0
mean_list = list()
fg, ax = plt.subplots(nrows=2, ncols=2, figsize=(15, 15))
lst = [(10,50),(20,50),(30,50),(50,50)]
for i in (0,1):
    for j in (0,1):
        ax[i,j].set_title("sample of " + str(lst[count][0]) + " having " + str(lst[count][1])+" no. of data p
        sns.histplot(mean_distribution(df_numeric_data['size'], lst[count][0],lst[count][1]),ax = ax[i,j],bin
        mean_list.append(mean_distribution(df_numeric_data['size'], lst[count][0],lst[count][1]))
        count +=1
```



9.0 Covariance, Pearson correlation coefficient, Spearman's rank correlation coefficient

9.1 Covarience

In [69]:
```
df_numeric_data.cov()
```

Out[69]:

	total_bill	tip	size
total_bill	79.252939	8.323502	5.065983
tip	8.323502	1.914455	0.643906
size	5.065983	0.643906	0.904591

9.2 Pearson correlation coefficient

In [70]:
```
df_numeric_data.corr("pearson")
```

Out[70]:

	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

9.3 Spearman's rank correlation coefficient

In [75]:
```
df_numeric_data.corr("spearman")
```

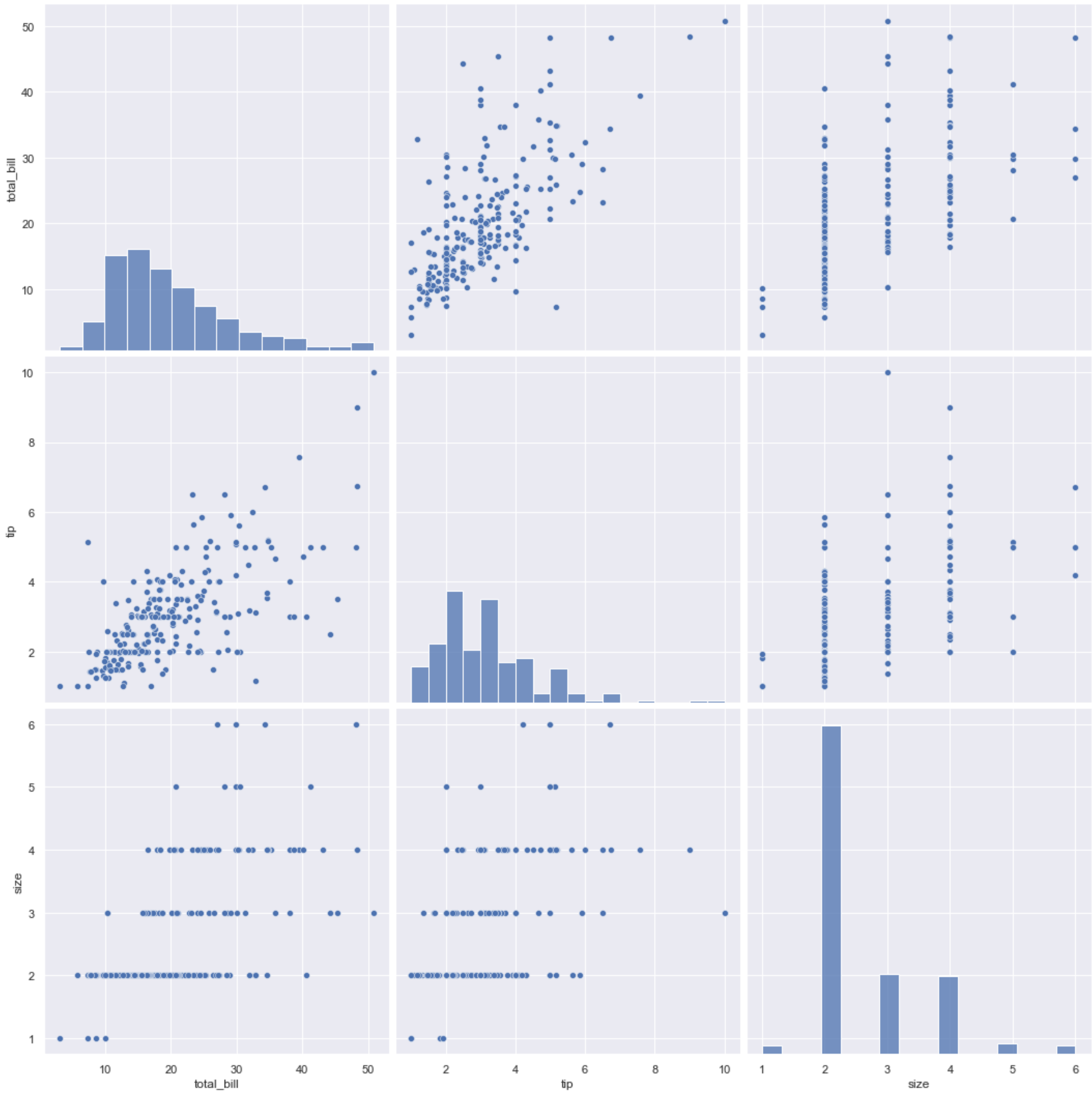
Out[75]:

	total_bill	tip	size
total_bill	1.000000	0.678968	0.604791
tip	0.678968	1.000000	0.468268
size	0.604791	0.468268	1.000000

9.4 Pairplot for tips dataset

In [87]:
```
sns.set(rc={'figure.figsize':(15,15)})
sns.pairplot(df_numeric_data, height=5)
```

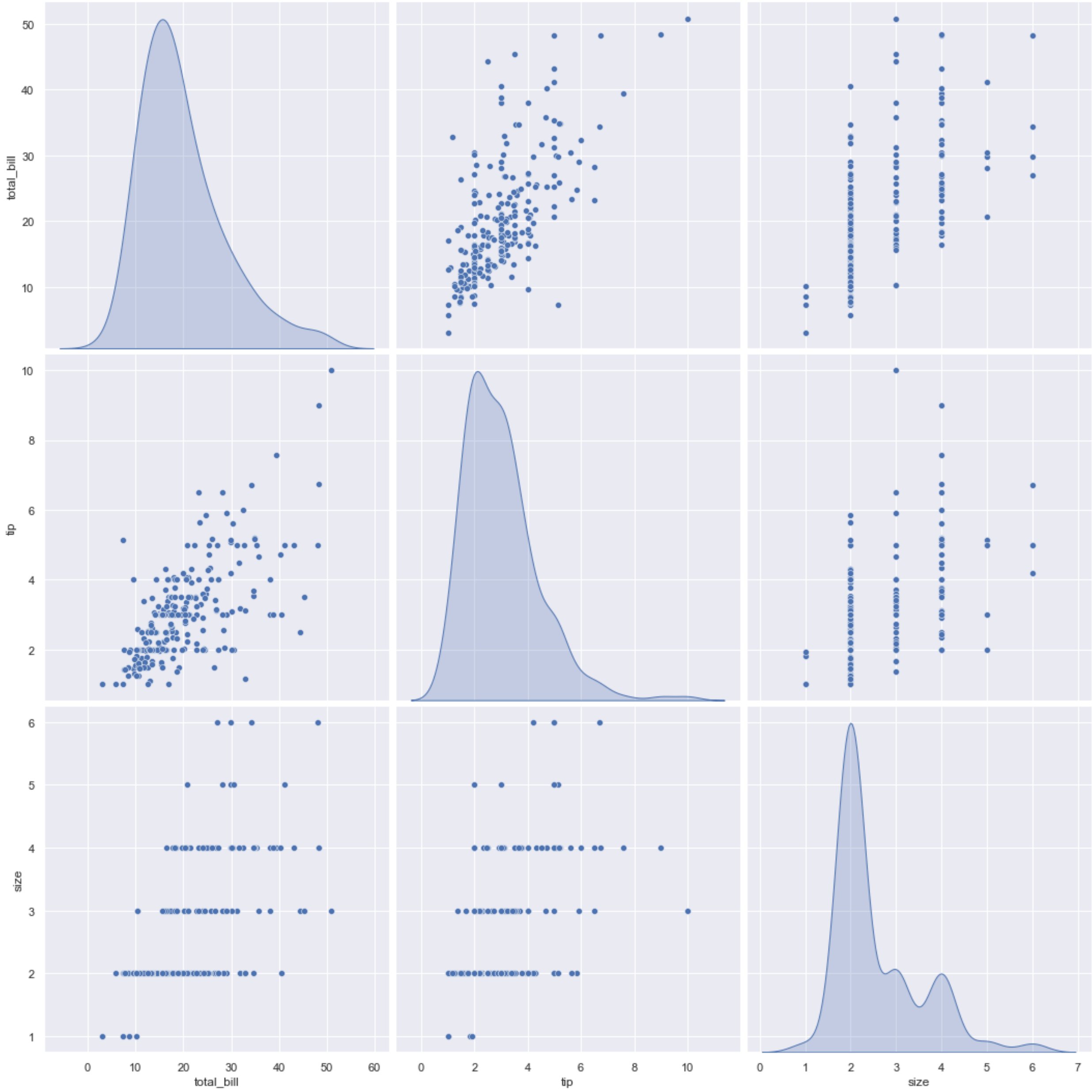
Out[87]: <seaborn.axisgrid.PairGrid at 0x20b5812e550>



9.4 Pairplot for tips dataset with kde

In [83]:
```
sns.set(rc={'figure.figsize':(15,15)})
sns.pairplot(df_numeric_data, diag_kind="kde", height=5)
```

Out[83]: <seaborn.axisgrid.PairGrid at 0x20b542afee0>


total_bill
tip
size
total_bill
tip
size
0
10
20
30
40
50
60
0
2
4
6
8
10
0
1
2
3
4
5
6
7