In [364...
```python
import pandas as pd
import numpy as np
import scipy.stats as stats
import random as r
import matplotlib.pyplot as plt
import seaborn as sns
import scipy as sp

# ignore stupid warnings
import warnings
warnings.filterwarnings('ignore')
```

In [365...
```python
### Typography/styles

color_list = ['blue','green', 'red' , 'cyan','magenta','yellow']
seaborn_styles = ['darkgrid', 'whitegrid', 'dark', 'white', 'ticks']
```

In [366...
```python
df = pd.read_csv('pizza_updated.csv')
df.head()
```

Out[366...

	Company	Type	Diameter(inches)	Toppings	Price_Level	Price
0	Domino's Pizza	other	10	cheese	low	5.99
1	Domino's Pizza	other	12	cheese	low	7.99
2	Domino's Pizza	other	14	cheese	low	9.99
3	Domino's Pizza	other	12	cheese	low	7.99
4	Domino's Pizza	other	10	cheese	low	5.99

summarize price first then summarize it by company

then you can look for relationships between price and other factors such as size

In [254...
```python
def hist_freqTable_function(dataframe,variable_name):
    ''' This will make a histogram and frequency table for a numeric variable in the dataframe'''

    ##### Variables to make the Histogram
    df = dataframe[variable_name]
    observations = len(df)
    num_of_bins = round(len(df)**(1/2))
    min_num = min(df)
    max_num = max(df)
    range_num = max_num - min_num
    bin_width = round(range_num/num_of_bins)
    bin_range = np.arange(min_num,max_num+bin_width,bin_width)
    ######################################################################

    ##### My Histogram ###
    fig, axes = plt.subplots(figsize = (20,7),dpi=200)
    color = r.choice(color_list)
    style = r.choice(seaborn_styles)
    sns.set_style(style)
    sns.histplot(data=df,bins=bin_range,color=color);
    axes.set_title(f'histogram for {variable_name}',color='black', fontsize = 15);
    plt.show()



    ##### My Frequency Table ###
    FTable= df.groupby(pd.cut(df,bin_range, right=False)).count()
    FTable = FTable.to_frame()
    FTable.columns = ['Frequencies']
    FTable['Relative Frequencies'] = \
    FTable['Frequencies']/FTable['Frequencies'].sum()
    print(FTable)
    print('#'*120)
    print('#'*120)
```

In [255...
```python
def summary_statisics(dataframe,variable_name):
    '''This function will find and displays the count, mean, standard deviation, min, Q1,
    median, Q3, and max of the variable.
    '''
    ### Summary Stats Varaibles
    df = dataframe[variable_name].describe()
    count = df[0]
    mean = df[1]
    std =  df[2]
    min_num =  df[3]
    q1 = df[4]
    median = df[5]
    q3 = df[6]
    max_num = df[7]

    summary_statisics_names = ['Count','Mean','Standard Deviation','Min','Q1','Median','Q3','Max']
    summary_statisics_values = [count,mean,std,min_num,q1,median,q3,max_num]


    for i,j in zip(summary_statisics_names,summary_statisics_values):
        print(f"The {i} for {variable_name} is {j}")
    print('#'*120)
    print('#'*120)
```

In [256...
```python
def boxplot_function(dataframe,variable_name,whis=1.5):
    '''
    This function will display outliers of the variable (outside the fences) and makes a boxwhisker plot of the
    Whis argument is optional in case you want to change the outlier sensitivity
    '''

    df = dataframe[variable_name]
    Q1 = df.quantile(0.25)
    Q3 = df.quantile(0.75)

    IQR = Q3 - Q1
    lower_bound = Q1 - IQR*whis
    upper_bound = Q3 + IQR*whis
    outliers = []

    fig, axes = plt.subplots(figsize = (20,7),dpi=200)

    color = r.choice(color_list)
    style = r.choice(seaborn_styles)
    sns.set_style(style)
    sns.boxplot(data=df,color=color, orient="h",whis=whis);
    axes.set_title('boxplot',color='black', fontsize = 15);
    plt.show()

    for i in df:
        if (i>upper_bound) or (i<lower_bound):
            outliers.append(i)

    if outliers == []:
        print('There are no outliers')
    else:
        outliers.sort()
        print(f'Here are the outlier(s): {outliers}')
```

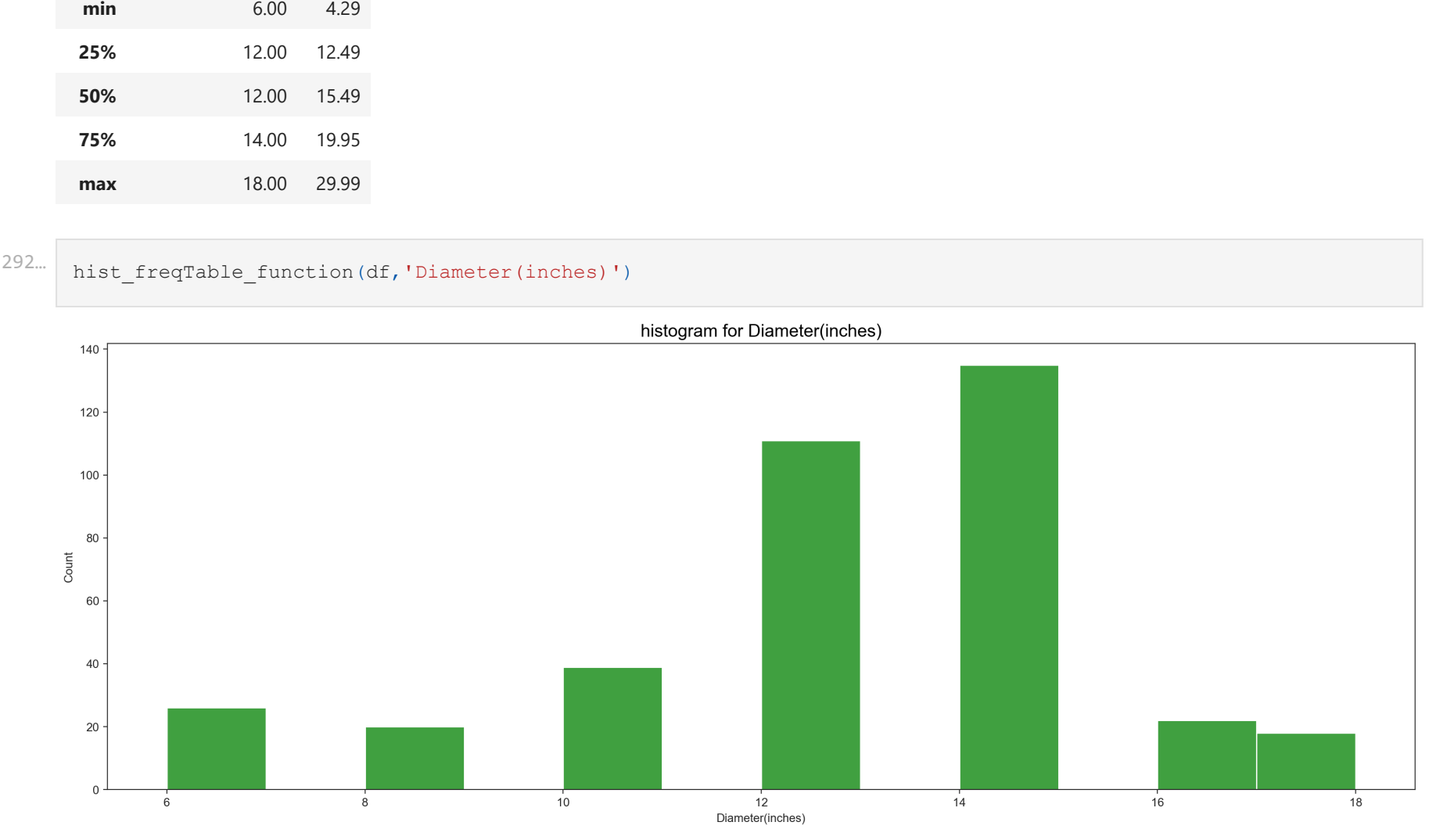
1.) Summary For Price

In [291...
```python
df.describe().round(2)
```

Out[291...

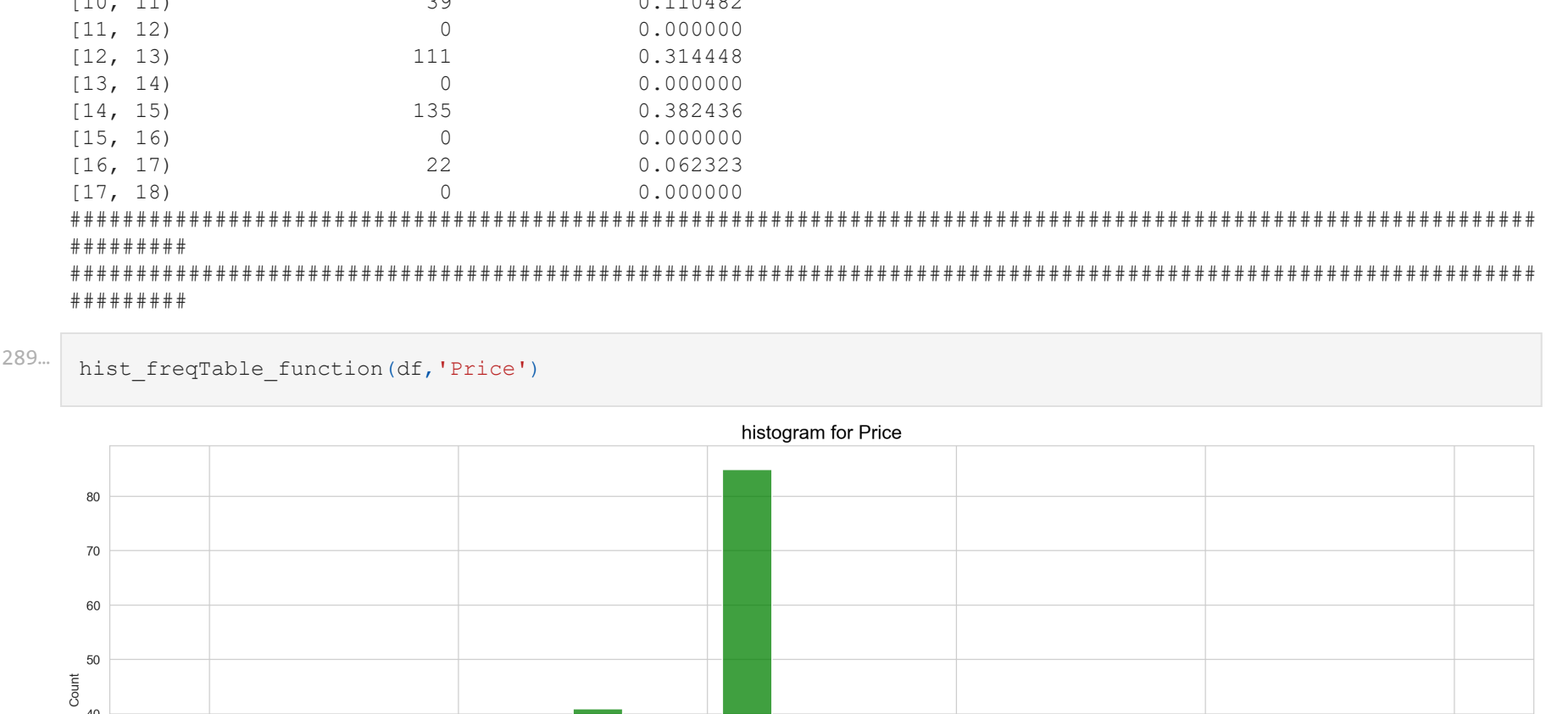
	Diameter(inches)	Price
count	371.00	371.00
mean	12.41	16.32
std	2.79	5.71
min	6.00	4.29
25%	12.00	12.49
50%	12.00	15.49
75%	14.00	19.95
max	18.00	29.99

In [292...
```python
hist_freqTable_function(df,'Diameter(inches)')
```




```
                  Frequencies  Relative Frequencies
Diameter(inches)
[6, 7)                     26              0.073654
[7, 8)                      0              0.000000
[8, 9)                     20              0.056657
[9, 10)                     0              0.000000
[10, 11)                   39              0.110482
[11, 12)                    0              0.000000
[12, 13)                  111              0.314448
[13, 14)                    0              0.000000
[14, 15)                  135              0.382436
[15, 16)                    0              0.000000
[16, 17)                   22              0.062323
[17, 18)                    0              0.000000
########################################################################################################################
########################################################################################################################
```

In [289...
```python
hist_freqTable_function(df,'Price')
```




```
                Frequencies  Relative Frequencies
Price
[4.29, 5.29)             12              0.032345
[5.29, 6.29)             16              0.043127
[6.29, 7.29)              0              0.000000
[7.29, 8.29)              3              0.008086
[8.29, 9.29)              4              0.010782
[9.29, 10.29)             6              0.016173
[10.29, 11.29)            5              0.013477
[11.29, 12.29)           19              0.051213
[12.29, 13.29)           41              0.110512
[13.29, 14.29)           23              0.061995
[14.29, 15.29)           18              0.048518
[15.29, 16.29)           85              0.229111
[16.29, 17.29)           13              0.035040
[17.29, 18.29)           24              0.064690
[18.29, 19.29)            7              0.018868
[19.29, 20.29)           16              0.043127
[20.29, 21.29)            1              0.002695
[21.29, 22.29)           17              0.045822
[22.29, 23.29)            6              0.016173
[23.29, 24.29)           17              0.045822
[24.29, 25.29)            1              0.002695
[25.29, 26.29)           15              0.040431
[26.29, 27.29)            5              0.013477
[27.29, 28.29)           12              0.032345
[28.29, 29.29)            1              0.002695
[29.29, 30.29)            4              0.010782
########################################################################################################################
########################################################################################################################
```

Interpretation:

In [259...
```python
summary_statisics(df,'Price')
```

```
The Count for Price is 371.0
The Mean for Price is 16.319326145552562
The Standard Deviation for Price is 5.714661781280032
The Min for Price is 4.29
The Q1 for Price is 12.49
The Median for Price is 15.49
The Q3 for Price is 19.95
The Max for Price is 29.99
########################################################################################################################
########################################################################################################################
```

Interpretation:

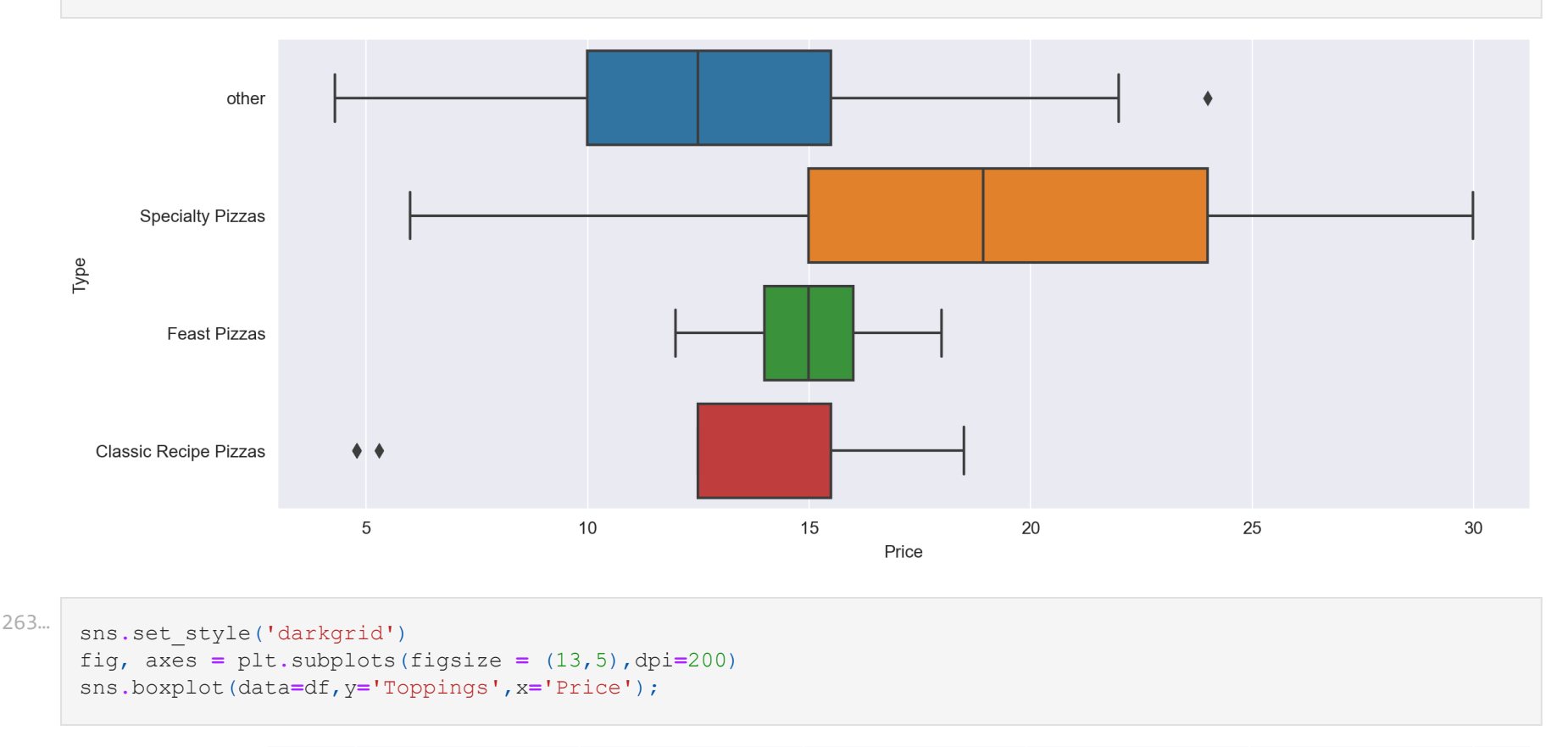
In [260...
```python
boxplot_function(df,'Price')
```


```
There are no outliers
```

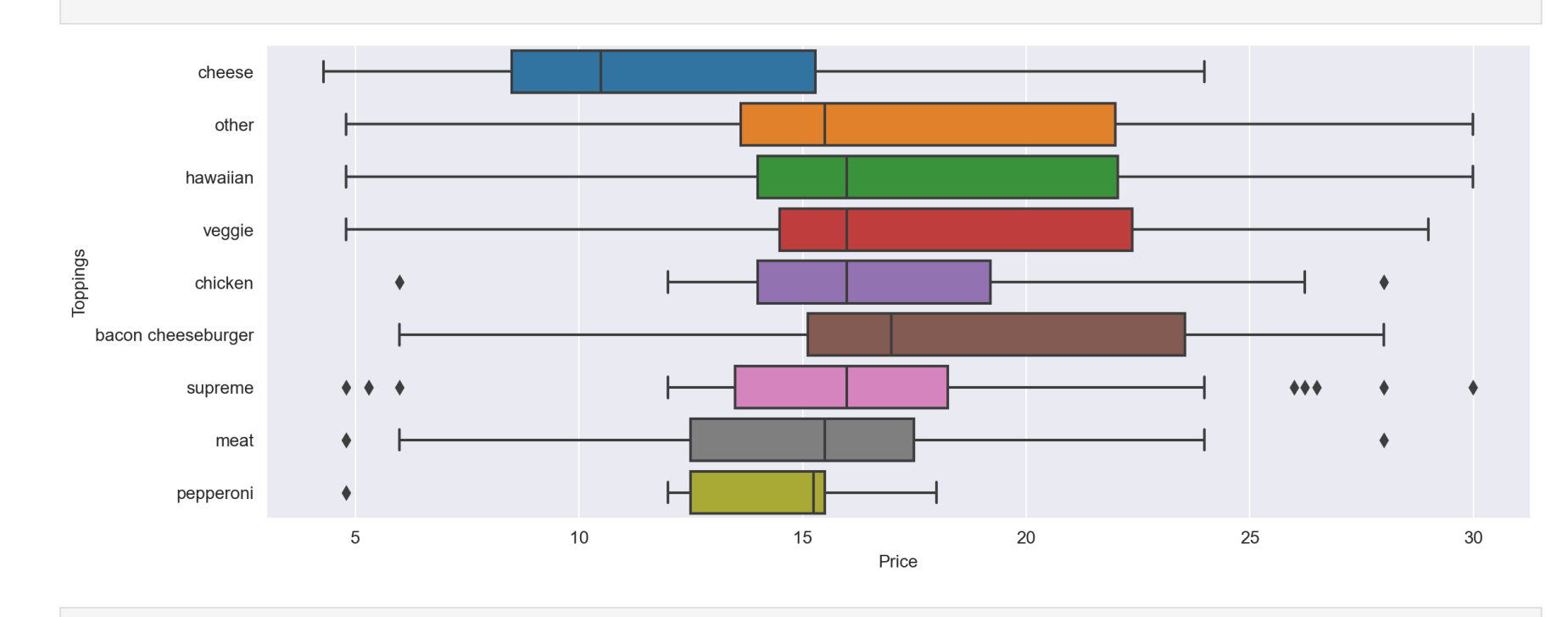
Interpretation:

2.) Summary For Price by Group

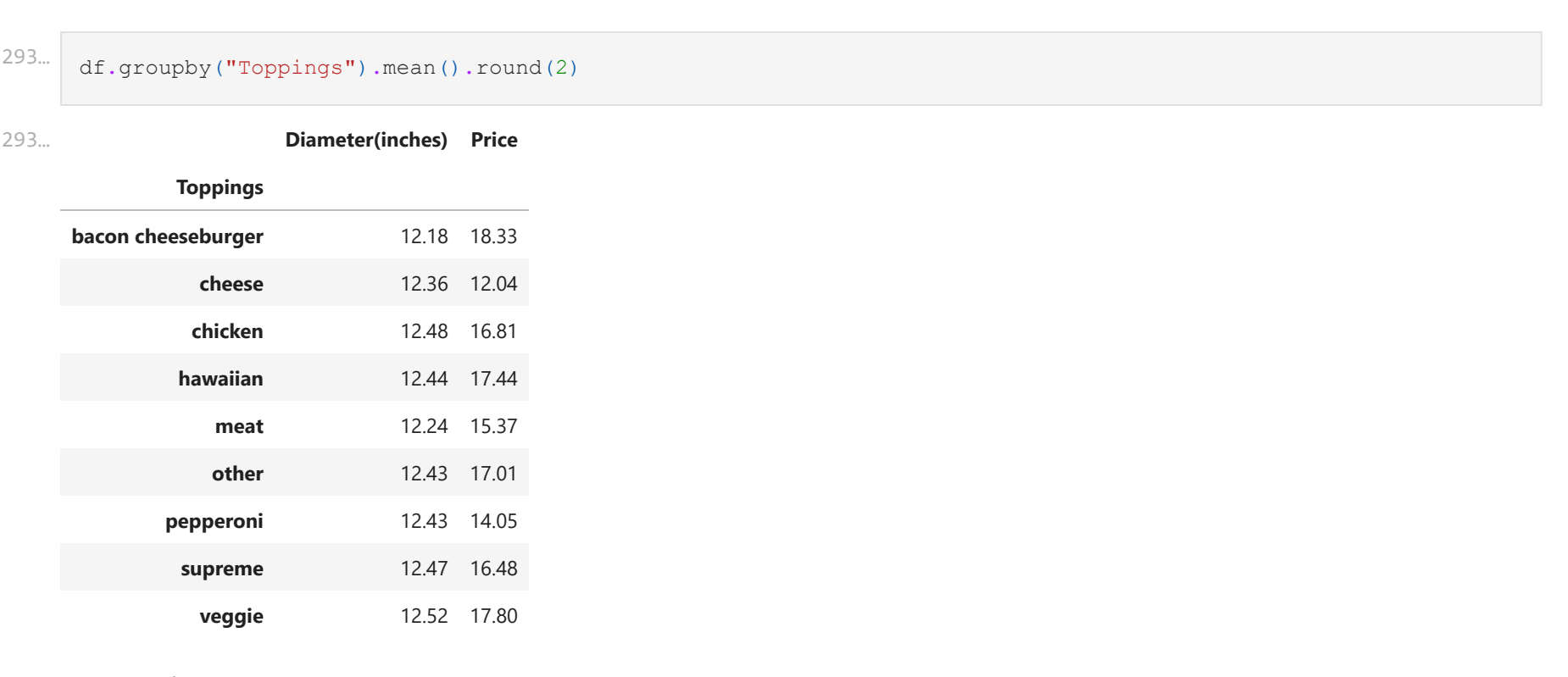
In [261...
```python
sns.set_style('darkgrid')
fig, axes = plt.subplots(figsize = (13,5),dpi=200)
sns.boxplot(data=df,y='Company',x='Price');
```



In [262...
```python
sns.set_style('darkgrid')
fig, axes = plt.subplots(figsize = (13,5),dpi=200)
sns.boxplot(data=df,y='Type',x='Price');
```



In [263...
```python
sns.set_style('darkgrid')
fig, axes = plt.subplots(figsize = (13,5),dpi=200)
sns.boxplot(data=df,y='Toppings',x='Price');
```



In [26...
```python
df.groupby("Toppings").mean().round(2)
```

Out[26...

Toppings	Diameter(inches)	Price
bacon cheeseburger	12.18	18.33
cheese	12.36	12.04
chicken	12.48	16.81
hawaiian	12.44	17.44
meat	12.24	15.37
other	12.43	17.01
pepperoni	12.43	14.05
supreme	12.47	16.48
veggie	12.52	17.80

Interpretation:

In [265...
```python
df.groupby("Company").std().round()
```

Out[265...

Company	Diameter(inches)	Price
Domino's Pizza	2.0	3.0
Godfather's Pizza	3.0	7.0
IMO's Pizza	2.0	4.0
Pizza Hut	2.0	3.0

Interpretation:

In [ ]:

In [266...
```python
df.groupby("Company").min()
```

Out[266...

Company	Type	Diameter(inches)	Toppings	Price_Level	Price
Domino's Pizza	Feast Pizzas	10	bacon cheeseburger	high	5.99
Godfather's Pizza	Specialty Pizzas	6	bacon cheeseburger	high	4.99
IMO's Pizza	Specialty Pizzas	10	cheese	high	9.30
Pizza Hut	Classic Recipe Pizzas	6	bacon cheeseburger	high	4.29

Interpretation:

In [ ]:

In [ ]:

Interpretation:

In [267...
```python
df.groupby("Company").count()
```

Out[267...

Company	Type	Diameter(inches)	Toppings	Price_Level	Price
Domino's Pizza	88	88	88	88	88
Godfather's Pizza	133	133	133	133	133
IMO's Pizza	24	24	24	24	24
Pizza Hut	126	126	126	126	126

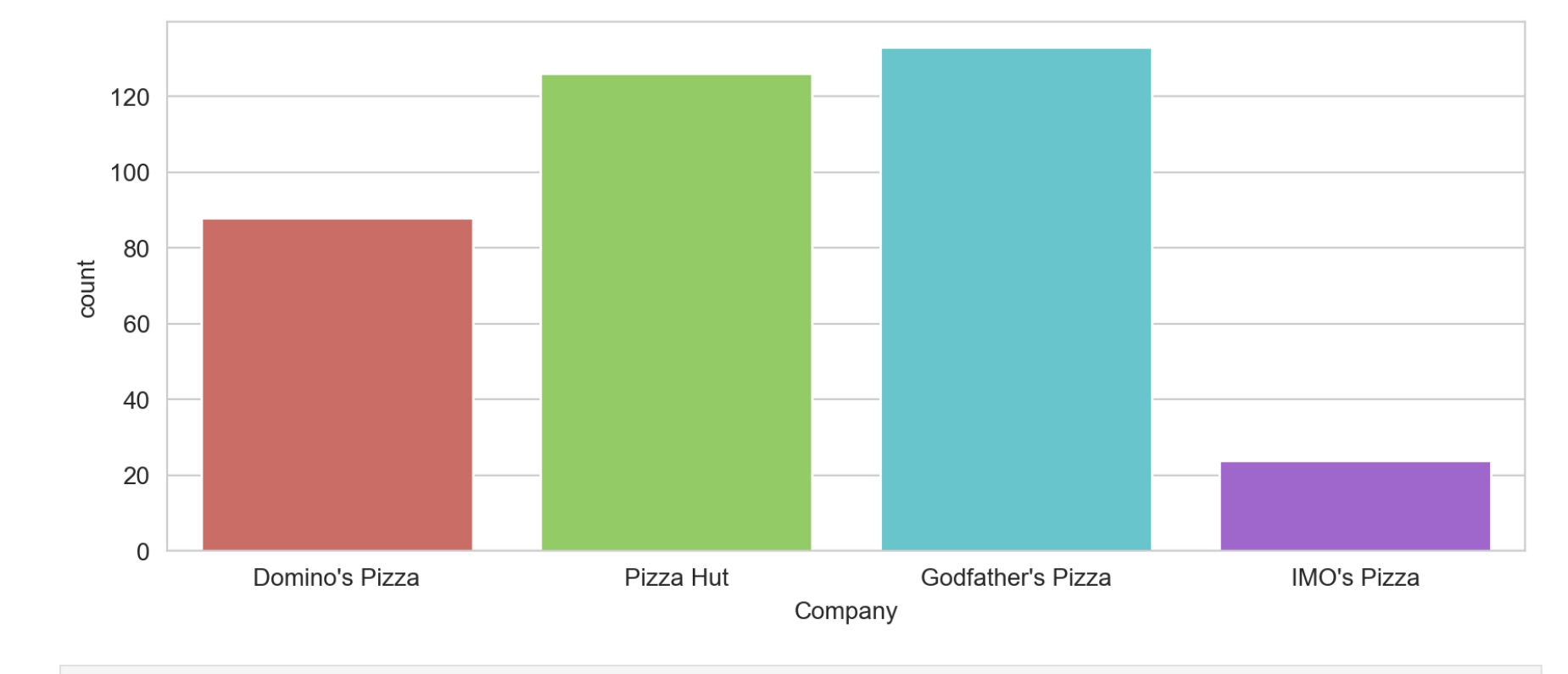
In [268...
```python
df.groupby("Company").describe().round(2)
```

Out[268...

	Diameter(inches)								Price							
	count	mean	std	min	25%	50%	75%	max	count	mean	std	min	25%	50%	75%	max
Company																
Domino's Pizza	88.0	12.39	2.27	10.0	10.0	12.0	14.0	16.0	88.0	14.29	2.81	5.99	11.99	14.99	15.99	17.99
Godfather's Pizza	133.0	12.23	3.50	6.0	12.0	12.0	14.0	18.0	133.0	20.27	6.70	4.99	15.99	22.24	25.99	29.99
IMO's Pizza	24.0	12.28	2.28	10.0	11.5	13.0	14.0	16.0	24.0	17.10	4.43	9.30	12.70	16.20	19.95	23.85
Pizza Hut	126.0	11.41	2.36	6.0	10.0	12.0	14.0	14.0	126.0	13.42	3.46	4.29	12.49	15.49	15.49	18.49

Interpretation:

In [269...
```python
sns.set_style('whitegrid')
fig, axes = plt.subplots(figsize = (10,4),dpi=200)
sns.countplot(data=df,x='Company',palette='hls');
```



In [270...
```python
df['Company'].value_counts()
```

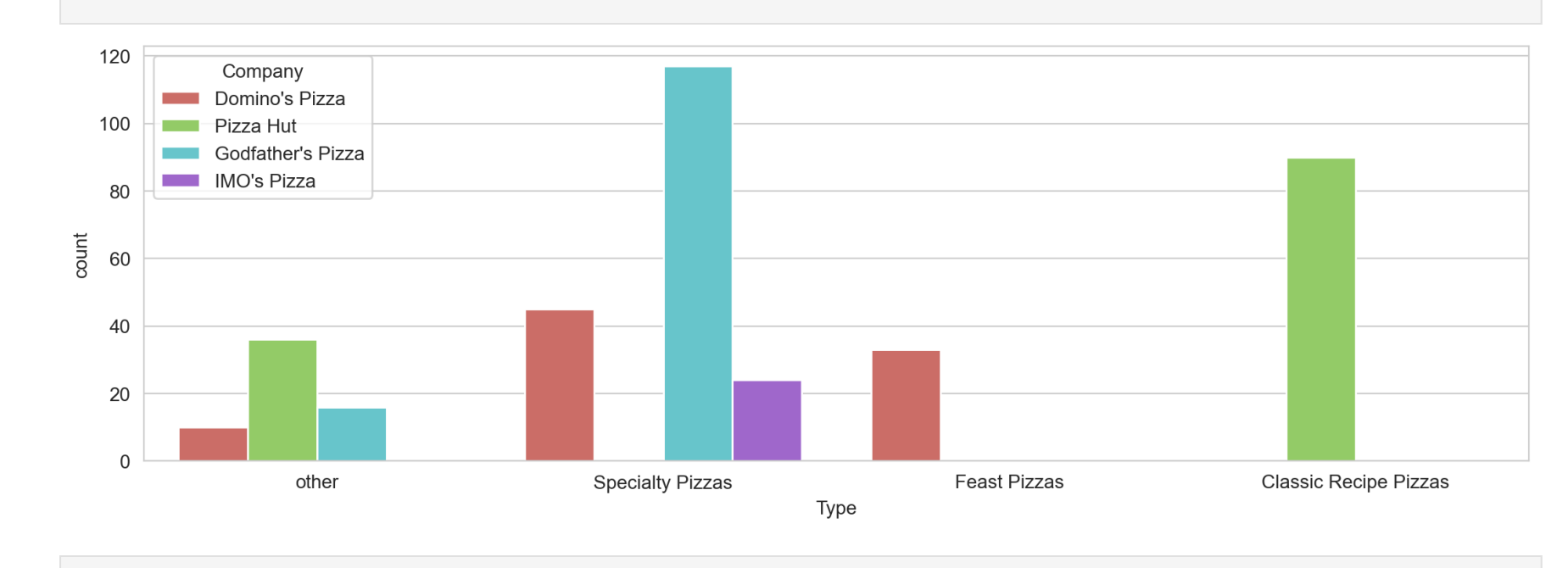
Out[270...
```
Godfather's Pizza    133
Pizza Hut            126
Domino's Pizza        88
IMO's Pizza           24
Name: Company, dtype: int64
```

In [271...
```python
sns.set_style('whitegrid')
fig, axes = plt.subplots(figsize = (13,4),dpi=200)
sns.countplot(data=df,x='Toppings',hue='Company',palette='hls');
```

In [272...
```python
df['Toppings'].value_counts()
```

Out[272...
```
other                 120
supreme                55
cheese                 39
meat                   33
hawaiian               32
veggie                 31
chicken                25
bacon cheeseburger     22
pepperoni              14
Name: Toppings, dtype: int64
```

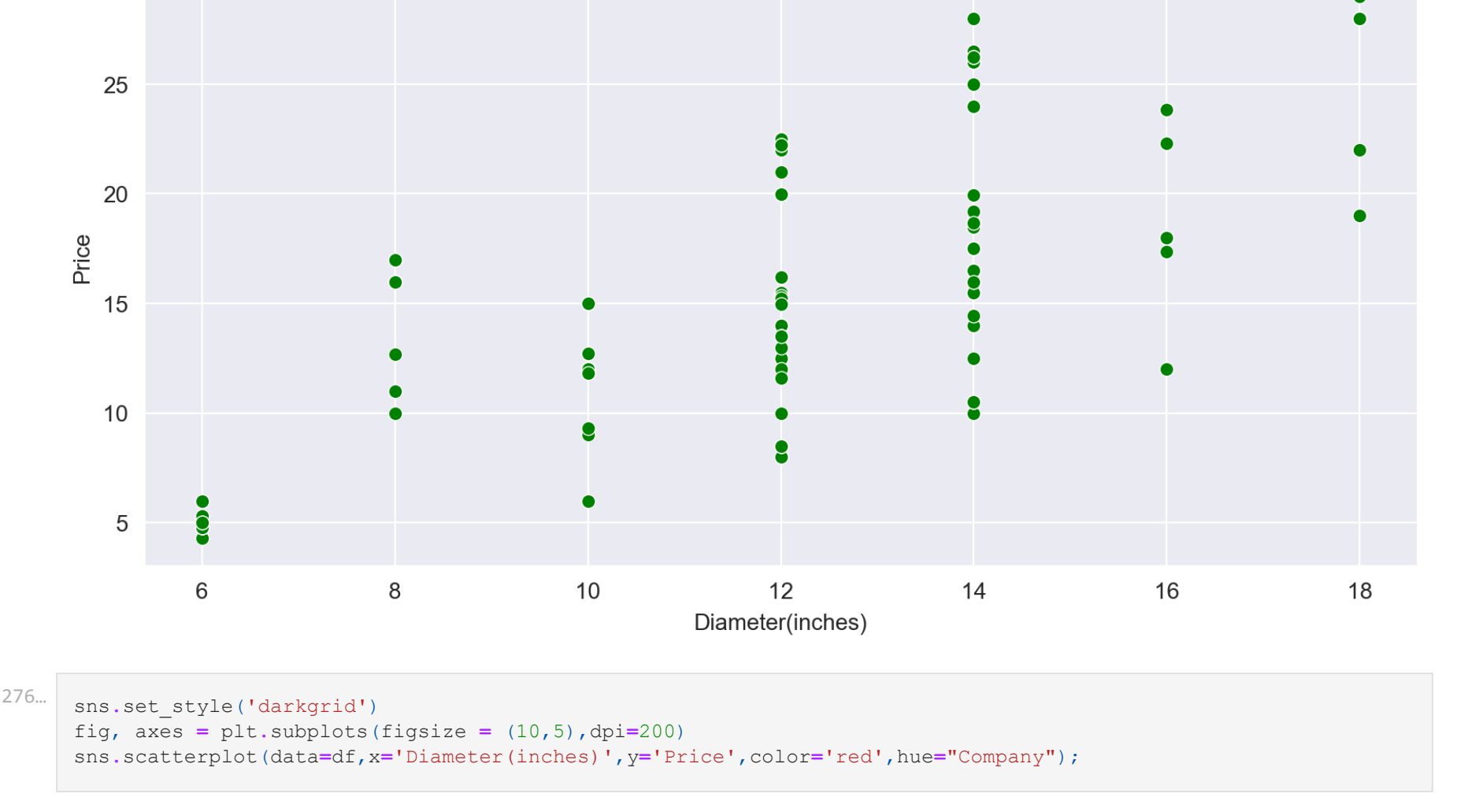
In [273...
```python
sns.set_style('whitegrid')
fig, axes = plt.subplots(figsize = (13,4),dpi=200)
sns.countplot(data=df,x='Type',hue='Company',palette='hls');
```



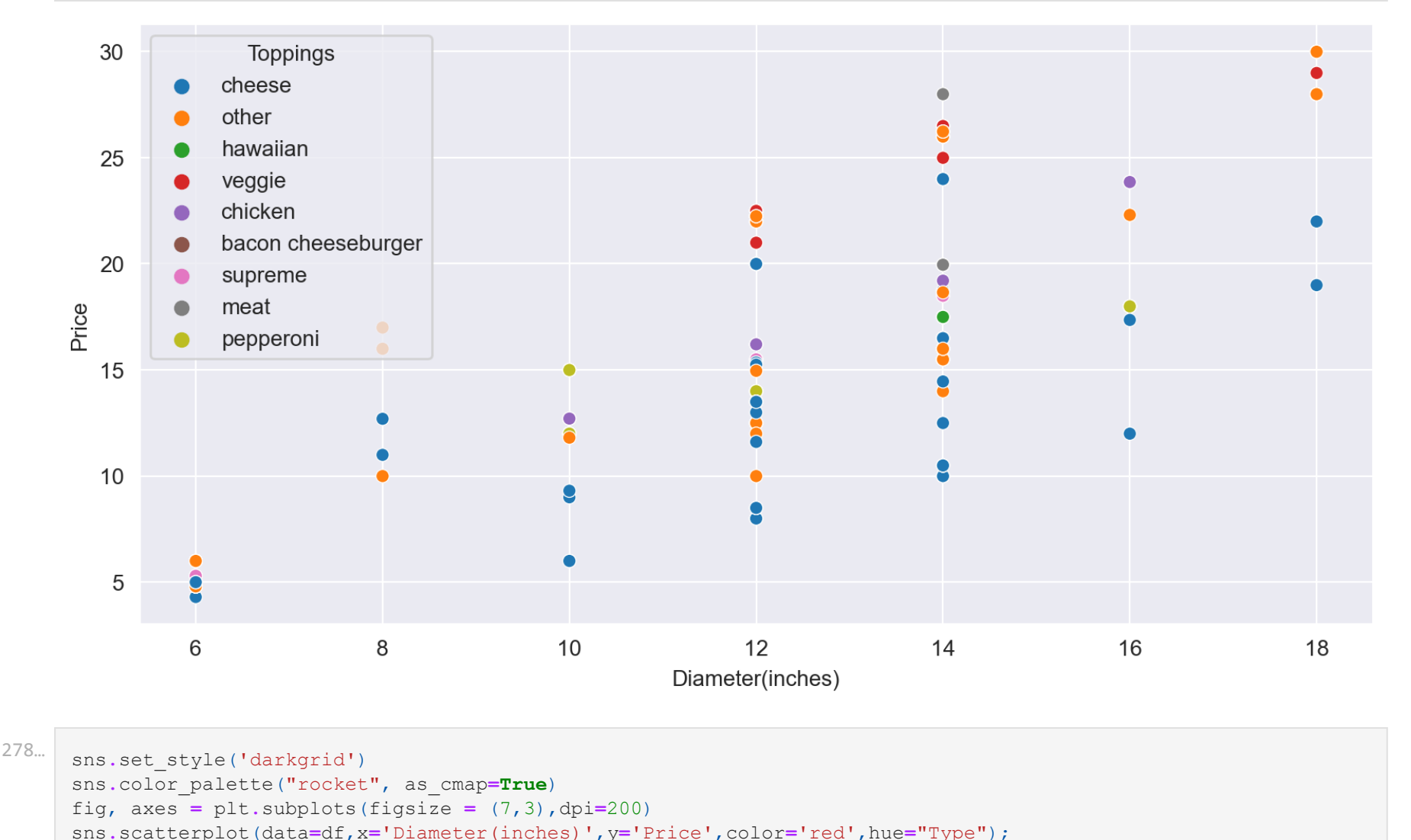
In [274...
```python
df['Type'].value_counts()
```

Out[274...
```
Specialty Pizzas         186
Classic Recipe Pizzas     90
other                     62
Feast Pizzas              33
Name: Type, dtype: int64
```

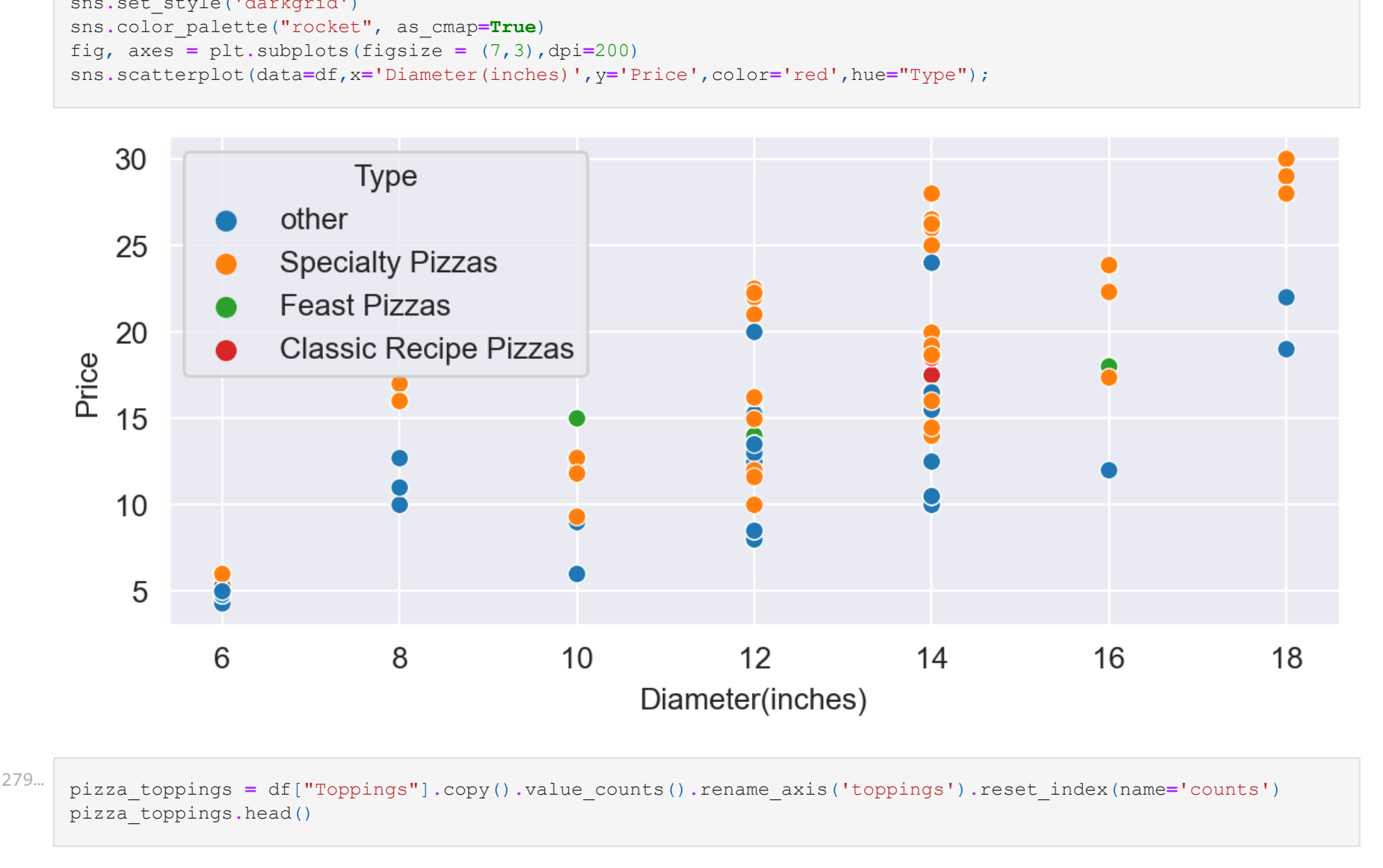
In [275...
```python
sns.set_style('darkgrid')
fig, axes = plt.subplots(figsize = (10,5),dpi=200)
sns.scatterplot(data=df,x='Diameter(inches)',y='Price',color='green');
```



In [276...
```python
sns.set_style('darkgrid')
fig, axes = plt.subplots(figsize = (10,5),dpi=200)
sns.scatterplot(data=df,x='Diameter(inches)',y='Price',color='red',hue='Company');
```



In [277...
```python
sns.set_style('darkgrid')
fig, axes = plt.subplots(figsize = (10,5),dpi=200)
sns.scatterplot(data=df,x='Diameter(inches)',y='Price',color='red',hue='Toppings');
```



In [278...
```python
sns.set_style('darkgrid')
sns.color_palette("rocket", as_cmap=True)
fig, axes = plt.subplots(figsize = (7,3),dpi=200)
sns.scatterplot(data=df,x='Diameter(inches)',y='Price',color='red',hue='Type');
```

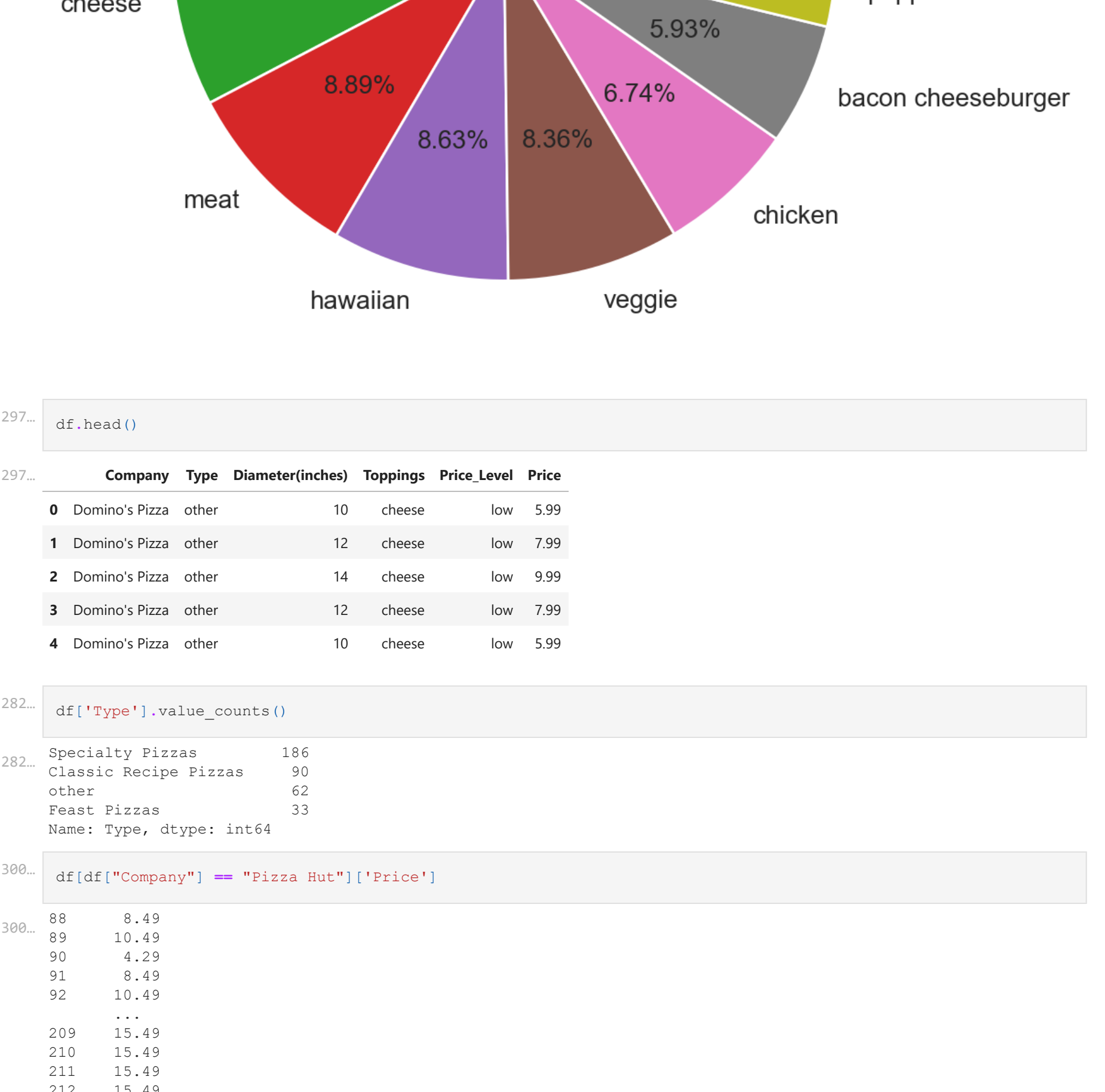
In [279...
```python
pizza_toppings = df["Toppings"].copy().value_counts().rename_axis('toppings').reset_index(name='counts')
pizza_toppings.head()
```

Out[279...

	toppings	counts
0	other	120
1	supreme	55
2	cheese	39
3	meat	33
4	hawaiian	32

In [280...
```python
labels = pizza_toppings['toppings']
values = pizza_toppings['counts']

sns.set_style('darkgrid')
sns.color_palette("rocket", as_cmap=True)
fig, axes = plt.subplots(figsize = (15,4),dpi=200)
axes.pie(x=values, labels = labels, autopct='%1.2f%%');
```



In [297...
```python
df.head()
```

Out[297...

	Company	Type	Diameter(inches)	Toppings	Price_Level	Price
0	Domino's Pizza	other	10	cheese	low	5.99
1	Domino's Pizza	other	12	cheese	low	7.99
2	Domino's Pizza	other	14	cheese	low	9.99
3	Domino's Pizza	other	12	cheese	low	7.99
4	Domino's Pizza	other	10	cheese	low	5.99

In [282...
```python
df['Type'].value_counts()
```

Out[282...
```
Specialty Pizzas         186
Classic Recipe Pizzas     90
other                     62
Feast Pizzas              33
Name: Type, dtype: int64
```

In [300...
```python
df[df["Company"] == "Pizza Hut"]['Price']
```

Out[300...
```
88      8.49
89     10.49
90      4.29
91      8.49
92     10.49
       ...
209    15.49
210    15.49
211    15.49
212    15.49
213     9.99
Name: Price, Length: 126, dtype: float64
```

In [311...
```python
from scipy.stats import shapiro

#perform Shapiro-Wilk test
shapiro(df[df["Company"] == "Domino's Pizza"]['Price'])
```

Out[311...
```
ShapiroResult(statistic=0.9109892249107361, pvalue=1.5932768292259425e-05)
```

In [302...
```python
len(df[df["Company"] == "Pizza Hut"]['Price'])
```

Out[302...
```
126
```

In [307...
```python
from numpy.random import randn
x = randn(100)
```

In [305...

Out[305...
```
array([ 1.93730049,  0.98354739, -0.84883118, -0.6294406 ,  1.51554104,
       -1.40893533,  0.49618245, -0.92989667, -0.16003932,  0.50246659,
       -0.50228612,  0.13866332,  2.83745153,  0.48600118,  0.24168631,
        0.77907227,  1.42773895,  0.98829734,  0.58633558,  0.30592244,
        0.58918696, -0.9435654 , -0.36820417,  0.94376733, -1.55419022,
        2.06879149,  0.35671413,  0.28859382, -1.22331509,  0.30679563,
       -1.57186709, -1.95715839, -1.48292831,  1.41121357,  1.36013391,
       -1.96044748,  0.79890853,  0.53493037, -0.37049966,  0.39753966,
       -0.72540663,  0.6431433 ,  1.4033386 , -0.70836375, -0.44016166,
       -0.91548504,  0.37951384, -0.88015254, -0.64736486,  0.58228621,
       -0.69579443, -0.06776179,  1.14165957,  0.70215191, -0.93319318,
       -1.13623131,  0.83054953, -0.6782413 , -0.9434587 ,  0.67788138,
        1.27190523, -0.57105076,  1.08788241,  0.42054931,  1.82746718,
        1.5520978 , -1.35490107,  0.98125824,  1.22046467,  0.49397383,
        1.10015357,  0.92725848,  0.13247936,  0.76301643, -0.16739016,
       -1.42582733, -0.00756953, -0.3078414 ,  1.64600486,  0.0083341 ,
        0.48640985,  0.64942949,  2.47457071, -0.87033326, -0.09089041,
        0.57712028, -0.18523084, -0.92781354,  0.73675575, -1.25297535,
       -0.88350733, -0.89848403,  0.3169077 , -1.41096712, -0.28860331,
        0.0035183 , -0.86660631,  0.24544136,  0.5569019 , -0.95442727])
```

In [309...
```python
df[df["Company"] == "Pizza Hut"]['Price']
```

```
Out[389]: 88     8.49
          89    10.49
          90     4.29
          91     8.49
          92    10.49
                 ...
          209   15.49
          210   15.49
          211   15.49
          212   15.49
          213    9.99
          Name: Price, Length: 126, dtype: float64
```

In [358]:
```
df[df["Toppings"]== 'cheese']["Price_Level"].value_counts()
```

```
Out[358]: low       27
          high       6
          medium     6
          Name: Price_Level, dtype: int64
```

In [339]:
```
df[df["Toppings"]== 'bacon cheeseburger']["Price_Level"].value_counts()
```

```
Out[339]: high      11
          medium     7
          low        4
          Name: Price_Level, dtype: int64
```

In [340]:
```
df[df["Toppings"]== 'chicken']["Price_Level"].value_counts()
```

```
Out[340]: medium    10
          high       9
          low        6
          Name: Price_Level, dtype: int64
```

In [341]:
```
df[df["Toppings"]== 'hawaiian']["Price_Level"].value_counts()
```

```
Out[341]: high      13
          medium    12
          low        7
          Name: Price_Level, dtype: int64
```

In [342]:
```
df[df["Toppings"]== 'meat']["Price_Level"].value_counts()
```

```
Out[342]: medium    13
          low       11
          high       9
          Name: Price_Level, dtype: int64
```

In [344]:
```
df[df["Toppings"]== 'other']["Price_Level"].value_counts()
```

```
Out[344]: medium    46
          high      44
          low       30
          Name: Price_Level, dtype: int64
```

In [345]:
```
df[df["Toppings"]== 'pepperoni']["Price_Level"].value_counts()
```

```
Out[345]: medium     7
          low        5
          high       2
          Name: Price_Level, dtype: int64
```

In [347]:
```
df[df["Toppings"]== 'supreme']["Price_Level"].value_counts()
```

```
Out[347]: medium    22
          high      17
          low       16
          Name: Price_Level, dtype: int64
```

In [348]:
```
df[df["Toppings"]== 'veggie']["Price_Level"].value_counts()
```

```
Out[348]: high      14
          medium    10
          low        7
          Name: Price_Level, dtype: int64
```

In [357]:
```
len(df[df['Toppings']== 'veggie']["Price_Level"])
```

```
Out[357]: 31
```

In [365]:
```
col = list(df['Toppings'].unique())
for i in col:
    print(i)
    print(len(df[df["Toppings"]== i]["Price_Level"]))
```

```
cheese
39
other
120
hawaiian
32
veggie
31
chicken
25
bacon cheeseburger
22
supreme
55
meat
33
pepperoni
14
```

Chi-Square Test

In [380]:
```
table = pd.crosstab(df['Toppings'],df['Price_Level'])
table
```

Out[380]:

Price_Level	high	low	medium
Toppings			
bacon cheeseburger	11	4	7
cheese	6	27	6
chicken	9	6	10
hawaiian	13	7	12
meat	9	11	13
other	44	30	46
pepperoni	2	5	7
supreme	17	16	22
veggie	14	7	10

observe values

In [381]:
```
observe_values = table.values
observe_values
```

```
Out[381]: array([[11,  4,  7],
                 [ 6, 27,  6],
                 [ 9,  6, 10],
                 [13,  7, 12],
                 [ 9, 11, 13],
                 [44, 30, 46],
                 [ 2,  5,  7],
                 [17, 16, 22],
                 [14,  7, 10]], dtype=int64)
```

expect values

In [382]:
```
val = stats.chi2_contingency(table)
expected_values = val[3]
expected_values
```

```
Out[382]: array([[ 7.41239892,  6.70080863,  7.88679245],
                 [13.14016173, 11.8787062 , 13.98113208],
                 [ 8.42318059,  7.61455526,  8.96226415],
                 [10.78167116,  9.74663073, 11.47169811],
                 [11.11859838, 10.05121294, 11.83018868],
                 [40.43126685, 36.54986523, 43.01886792],
                 [ 4.71698113,  4.26415094,  5.01886792],
                 [18.5309973 , 16.75202156, 19.71698113],
                 [10.44474394,  9.44204852, 11.11320755]])
```

In [383]:
```
degree_of_freedoms = (9-1)*(3-1)
```

In [391]:
```
# chi square statistic
from scipy.stats import chi2
chi_square = sum([(o-e)**2/e for o,e in zip(observe_values,expected_values)])
chi_square_statistic = chi_square[0] + chi_square[1]
chi_square_statistic
```

```
Out[391]: 33.24211749964566
```

In [394]:
```
# critical Value
critical_value = chi2.ppf(q=1-0.05, df=degree_of_freedoms)
critical_value
```

```
Out[394]: 26.29622760486423
```

In [ ]:
```

```