In [1]:

```
#Imports

#Data exploration
import time
import sklearn
import pandas as pd
import numpy as np
import datetime
import seaborn as sns
import matplotlib as m
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D



#Machine Learning
from sklearn.cluster import KMeans
from sklearn import metrics
from sklearn.preprocessing import MinMaxScaler

#Graphical Formatting
plt.style.use('fivethirtyeight')
plt.figure(1, figsize = (15,6))
%matplotlib inline
```

In [2]:

```
%pip install jupyter-cjk-xelatex
```

```
Requirement already satisfied: jupyter-cjk-xelatex in c:\users\vitor\anaconda3\lib\site-packages (0.2)
Requirement already satisfied: jupyter in c:\users\vitor\anaconda3\lib\site-packages (from jupyter-cjk-xelatex) (1.0.0)
Requirement already satisfied: qtconsole in c:\users\vitor\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xelatex) (4.7.5)
Requirement already satisfied: nbconvert in c:\users\vitor\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xelatex) (5.6.1)
Requirement already satisfied: ipykernel in c:\users\vitor\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xelatex) (5.3.2)
Requirement already satisfied: jupyter-console in c:\users\vitor\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xelatex) (6.1.0)
Requirement already satisfied: notebook in c:\users\vitor\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xelatex) (6.0.3)
Requirement already satisfied: ipywidgets in c:\users\vitor\anaconda3\lib\site-packages (from jupyter->jupyter-cjk-xelatex) (7.5.1)
Requirement already satisfied: pyzmq>=17.1 in c:\users\vitor\anaconda3\lib\site-packages (from qtconsole->jupyter->jupyter-cjk-xelatex) (19.0.1)
Requirement already satisfied: traitlets in c:\users\vitor\anaconda3\lib\site-packages (from qtconsole->jupyter->jupyter-cjk-xelatex) (4.3.3)
Requirement already satisfied: jupyter-client>=4.1 in c:\users\vitor\anaconda3\lib\site-packages (from qtconsole->jupyter->jupyter-cjk-xelatex) (6.1.6)
Requirement already satisfied: qtpy in c:\users\vitor\anaconda3\lib\site-packages (from qtconsole->jupyter->jupyter-cjk-xelatex) (1.9.0)
Requirement already satisfied: jupyter-core in c:\users\vitor\anaconda3\lib\site-packages (from qtconsole->jupyter->jupyter-cjk-xelatex) (4.6.3)
Requirement already satisfied: ipython-genutils in c:\users\vitor\anaconda3\lib\site-packages (from qtconsole->jupyter->jupyter-cjk-xelatex) (0.2.0)
Requirement already satisfied: pygments in c:\users\vitor\anaconda3\lib\site-packages (from qtconsole->jupyter->jupyter-cjk-xelatex) (2.6.1)
Requirement already satisfied: testpath in c:\users\vitor\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyter-cjk-xelatex) (0.4.4)
Requirement already satisfied: mistune<2,>=0.8.1 in c:\users\vitor\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyter-cjk-xelatex) (0.8.4)
Requirement already satisfied: entrypoints>=0.2.2 in c:\users\vitor\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyter-cjk-xelatex) (0.3)
Requirement already satisfied: nbformat>=4.4 in c:\users\vitor\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyter-cjk-xelatex) (5.0.7)
Requirement already satisfied: defusedxml in c:\users\vitor\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyter-cjk-xelatex) (0.6.0)
Requirement already satisfied: pandocfilters>=1.4.1 in c:\users\vitor\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyter-cjk-xelatex) (1.4.2)
Requirement already satisfied: bleach in c:\users\vitor\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyter-cjk-xelatex) (3.1.5)
Requirement already satisfied: jinja2>=2.4 in c:\users\vitor\anaconda3\lib\site-packages (from nbconvert->jupyter->jupyter-cjk-xelatex) (2.11.2)
Requirement already satisfied: ipython>=5.0.0 in c:\users\vitor\anaconda3\lib\site-packages (from ipykernel->jupyter->jupyter-cjk-xelatex) (7.16.1)
Requirement already satisfied: tornado>=4.2 in c:\users\vitor\anaconda3\lib\site-packages (from ipykernel->jupyter->jupyter-cjk-xelatex) (6.0.4)
Requirement already satisfied: prompt-toolkit!=3.0.0,!=3.0.1,<3.1.0,>=2.0.0 in c:\users\vitor\anaconda3\lib\site-packages (from jupyter-console->jupyter->jupyter-cjk-xelatex) (3.0.5)
Requirement already satisfied: Send2Trash in c:\users\vitor\anaconda3\lib\site-packages (from notebook->jupyter->jupyter-cjk-xelatex) (1.5.0)
Requirement already satisfied: terminado>=0.8.1 in c:\users\vitor\anaconda3\lib\site-packages (from notebook->jupyter->jupyter-cjk-xelatex) (0.8.3)
Requirement already satisfied: prometheus-client in c:\users\vitor\anaconda3\lib\site-packages (from notebook->jupyter->jupyter-cjk-xelatex) (0.8.0)
Requirement already satisfied: widgetsnbextension~=3.5.0 in c:\users\vitor\anaconda3\lib\site-packages (from ipywidgets->jupyter->jupyter-cjk-xelatex) (3.5.1)
Requirement already satisfied: six in c:\users\vitor\anaconda3\lib\site-packages (from traitlets->qtconsole->jupyter->jupyter-cjk-xelatex) (1.15.0)
Requirement already satisfied: decorator in c:\users\vitor\anaconda3\lib\site-packages (from traitlets->qtconsole->jupyter->jupyter-cjk-xelatex) (4.4.2)
Requirement already satisfied: python-dateutil>=2.1 in c:\users\vitor\anaconda3\lib\site-packages (from jupyter-client>=4.1->qtconsole->jupyter->jupyter-cjk-xelatex) (2.8.1)
Requirement already satisfied: pywin32>=1.0; sys_platform == "win32" in c:\users\vitor\anaconda3\lib\site-packages (from jupyter-core->qtconsole->jupyter->jupyter-cjk-xelatex) (227)
Requirement already satisfied: jsonschema!=2.5.0,>=2.4 in c:\users\vitor\anaconda3\lib\site-packages (from nbformat>=4.4->nbconvert->jupyter->jupyter-cjk-xelatex) (3.2.0)
Requirement already satisfied: packaging in c:\users\vitor\anaconda3\lib\site-packages (from bleach->nbconvert->jupyter->jupyter-cjk-xelatex) (20.4)
Requirement already satisfied: webencodings in c:\users\vitor\anaconda3\lib\site-packages (from bleach->nbconvert->jupyter->jupyter-cjk-xelatex) (0.5.1)
Requirement already satisfied: MarkupSafe>=0.23 in c:\users\vitor\anaconda3\lib\site-packages (from jinja2>=2.4->nbconvert->jupyter->jupyter-cjk-xelatex) (1.1.1)
Requirement already satisfied: colorama; sys_platform == "win32" in c:\users\vitor\anaconda3\lib\site-packages (from ipython>=5.0.0->ipykernel->jupyter->jupyter-cjk-xelatex) (0.4.3)
Requirement already satisfied: backcall in c:\users\vitor\anaconda3\lib\site-packages (from ipython>=5.0.0->ipykernel->jupyter->jupyter-cjk-xelatex) (0.2.0)
Requirement already satisfied: setuptools>=18.5 in c:\users\vitor\anaconda3\lib\site-packages (from ipython>=5.0.0->ipykernel->jupyter->jupyter-cjk-xelatex) (49.2.0.post20200714)
Requirement already satisfied: pickleshare in c:\users\vitor\anaconda3\lib\site-packages (from ipython>=5.0.0->ipykernel->jupyter->jupyter-cjk-xelatex) (0.7.5)
Requirement already satisfied: jedi>=0.10 in c:\users\vitor\anaconda3\lib\site-packages (from ipython>=5.0.0->ipykernel->jupyter->jupyter-cjk-xelatex) (0.17.1)
Note: you may need to restart the kernel to use updated packages.
Requirement already satisfied: wcwidth in c:\users\vitor\anaconda3\lib\site-packages (from prompt-toolkit!=3.0.0,!=3.0.1,<3.1.0,>=2.0.0->jupyter-console->jupyter->jupyter-cjk-xelatex) (0.2.5)
Requirement already satisfied: attrs>=17.4.0 in c:\users\vitor\anaconda3\lib\site-packages (from jsonschema!=2.5.0,>=2.4->nbformat>=4.4->nbconvert->jupyter->jupyter-cjk-xelatex) (19.3.0)
Requirement already satisfied: pyrsistent>=0.14.0 in c:\users\vitor\anaconda3\lib\site-packages (from jsonschema!=2.5.0,>=2.4->nbformat>=4.4->nbconvert->jupyter->jupyter-cjk-xelatex) (0.16.
0)
```

```
0)
Requirement already satisfied: pyparsing>=2.0.2 in c:\users\vitor\anaconda3\lib\site-packages (from packaging->bleach->nbconvert->jupyter->jupyter-cjk-xelatex) (2.4.7)
Requirement already satisfied: parso<0.8.0,>=0.7.0 in c:\users\vitor\anaconda3\lib\site-packages (from jedi>=0.10->ipython>=5.0.0->ipykernel->jupyter->jupyter-cjk-xelatex) (0.7.0)
```

In [3]:

```
%reload_ext watermark
%watermark -a "Marketing Analytics for Food Delivery by Vitor Marques" --iversions
```

```
sklearn    0.23.1
pandas     1.0.5
seaborn    0.10.1
matplotlib 3.2.2
numpy      1.18.5
Marketing Analytics for Food Delivery by Vitor Marques
```

Loading Dataset

Data dictionary

Localida = ID_Place
Quantidade_item = Quantity_items
Latitude = Latitude
Longitude = Longitude
Horario_pedido = order_time

In [4]:

```
#Dataset
df_food_delivery = pd.read_csv('dados/dataset.csv');
```

In [5]:

```
#Data Visualization
df_food_delivery.head(10)
```

	id_transacao	horario_pedido	localidade	nome_item	quantidade_item	latitude	longitude
0	0x7901ee	2019-01-16 18:33:00	7	bebida	2	41.794132	-88.010140
1	0x7901ee	2019-01-16 18:33:00	7	pizza	2	41.794132	-88.010140
2	0x7901ee	2019-01-16 18:33:00	7	sobremesa	2	41.794132	-88.010140
3	0x12b47f	2019-09-04 12:36:00	3	salada	1	41.884490	-87.627059
4	0x12b47f	2019-09-04 12:36:00	3	sobremesa	1	41.884490	-87.627059
5	0x6d6979	2019-03-18 00:27:00	6	pizza	2	41.784576	-87.607565
6	0x6d6979	2019-03-18 00:27:00	6	sobremesa	2	41.784576	-87.607565
7	0x78dd1e	2019-09-22 00:10:00	2	bebida	2	42.049306	-87.677606
8	0x78dd1e	2019-09-22 00:10:00	2	pizza	2	42.049306	-87.677606
9	0x78dd1e	2019-09-22 00:10:00	2	sobremesa	2	42.049306	-87.677606

In [6]:

```
df_food_delivery.shape
```

```
(260645, 7)
```

In [7]:

```
df_food_delivery.describe()
```

	localidade	quantidade_item	latitude	longitude
count	260645.000000	260645.000000	260645.000000	260645.000000
mean	5.134904	2.447010	41.836095	-87.733930

	localidade	quantidade_item	latitude	longitude
std	2.551846	1.330863	0.144459	0.136369
min	1.000000	1.000000	41.524598	-88.010140
25%	3.000000	1.000000	41.784576	-87.849468
50%	5.000000	2.000000	41.881818	-87.677606
75%	7.000000	4.000000	41.889047	-87.627059
max	9.000000	5.000000	42.049306	-87.607565

In [8]:

```
#Unique values
df_food_delivery.nunique()
```

```
id_transacao       100000
horario_pedido      76799
localidade              9
nome_item               4
quantidade_item         5
latitude                9
longitude               9
dtype: int64
```

In [9]:

```
df_food_delivery.dtypes
```

```
id_transacao        object
horario_pedido      object
localidade           int64
nome_item           object
quantidade_item      int64
latitude           float64
longitude          float64
dtype: object
```

Pivoting the dataset

In [10]:

```
order_all = df_food_delivery.pivot_table(index='id_transacao', columns='nome_item', values = 'quantidade_item')
```

In [11]:

```
order_all
```

nome_item	bebida	pizza	salada	sobremesa
id_transacao				
0x10000a	NaN	1.0	NaN	1.0
0x100058	NaN	2.0	NaN	2.0
0x1000c8	4.0	4.0	1.0	5.0
0x10014c	NaN	1.0	NaN	1.0
0x1001d8	3.0	3.0	NaN	3.0
...	...	...	...	...
0xffe96	4.0	4.0	NaN	4.0
0xffeed	NaN	1.0	NaN	1.0
0xfff07	1.0	1.0	NaN	1.0
0xfff4d	NaN	2.0	NaN	2.0
0xfffb8	NaN	1.0	NaN	1.0

100000 rows × 4 columns

In [12]:

```
order_all2 = order_all.fillna(0).reset_index()
```

In [13]:

```
order_all2
```

nome_item	id_transacao	bebida	pizza	salada	sobremesa
0	0x10000a	0.0	1.0	0.0	1.0
1	0x100058	0.0	2.0	0.0	2.0

nome_item	id_transacao	bebida	pizza	salada	sobremesa
2	0x1000c8	4.0	4.0	1.0	5.0
3	0x10014c	0.0	1.0	0.0	1.0
4	0x1001d8	3.0	3.0	0.0	3.0
...	...	...	...	...	...
99995	0xffe96	4.0	4.0	0.0	4.0
99996	0xffeed	0.0	1.0	0.0	1.0
99997	0xfff07	1.0	1.0	0.0	1.0
99998	0xfff4d	0.0	2.0	0.0	2.0
99999	0xfffb8	0.0	1.0	0.0	1.0

100000 rows × 5 columns

In [14]:

```
order_all2.columns
```

```
Index(['id_transacao', 'bebida', 'pizza', 'salada', 'sobremesa'], dtype='object', name='nome_item')
```

In [15]:

```
order_all2.head()
```

nome_item	id_transacao	bebida	pizza	salada	sobremesa
0	0x10000a	0.0	1.0	0.0	1.0
1	0x100058	0.0	2.0	0.0	2.0
2	0x1000c8	4.0	4.0	1.0	5.0
3	0x10014c	0.0	1.0	0.0	1.0
4	0x1001d8	3.0	3.0	0.0	3.0

In [16]:

```
order_all2.nunique()
```

```
nome_item
id_transacao    100000
bebida           6
pizza           6
salada           6
sobremesa          5
dtype: int64
```

In [17]:

```
order_all2.shape
```

```
(100000, 5)
```

In [18]:

```
order_all2.describe()
```

nome_item	bebida	pizza	salada	sobremesa
count	100000.000000	100000.000000	100000.000000	100000.000000
mean	1.239590	1.857840	0.711370	2.569210
std	1.627886	1.588589	1.086524	1.332084
min	0.000000	0.000000	0.000000	1.000000
25%	0.000000	1.000000	0.000000	1.000000
50%	0.000000	1.000000	0.000000	2.000000
75%	3.000000	3.000000	1.000000	4.000000
max	5.000000	5.000000	5.000000	5.000000

In [19]:

```
order_all2.isnull().sum()
```

```
nome_item
```

```
id_transacao    0
bebida          0
pizza           0
salada          0
sobremesa       0
dtype: int64
```

In [20]:

```
#Appending column Localidade with merge
order_all2 = order_all2.merge(df_food_delivery[['id_transacao', 'localidade']])
```

In [21]:

```
order_all2
```

	id_transacao	bebida	pizza	salada	sobremesa	localidade
0	0x10000a	0.0	1.0	0.0	1.0	9
1	0x10000a	0.0	1.0	0.0	1.0	9
2	0x100058	0.0	2.0	0.0	2.0	6
3	0x100058	0.0	2.0	0.0	2.0	6
4	0x1000c8	4.0	4.0	1.0	5.0	9
...	...	...	...	...	...	...
260640	0xfff07	1.0	1.0	0.0	1.0	2
260641	0xfff4d	0.0	2.0	0.0	2.0	3
260642	0xfff4d	0.0	2.0	0.0	2.0	3
260643	0xfffb8	0.0	1.0	0.0	1.0	2
260644	0xfffb8	0.0	1.0	0.0	1.0	2

260645 rows × 6 columns

In [22]:

```
order_all2.head(3)
```

	id_transacao	bebida	pizza	salada	sobremesa	localidade
0	0x10000a	0.0	1.0	0.0	1.0	9
1	0x10000a	0.0	1.0	0.0	1.0	9
2	0x100058	0.0	2.0	0.0	2.0	6

In [23]:

```
order_all2.nunique()
```

```
id_transacao    100000
bebida               6
pizza                6
salada               6
sobremesa            5
localidade           9
dtype: int64
```

In [24]:

```
order_all2.isnull().sum()
```

```
id_transacao    0
bebida          0
pizza           0
salada          0
sobremesa       0
localidade      0
dtype: int64
```

In [25]:

```
df_food_delivery['mes'] = df_food_delivery['horario_pedido'].apply(lambda x:time.strftime('%m', time.strptime(x, '%Y-%m-%d %H:%M
:%S')))
```

In [26]:

```
order_all2
```

	id_transacao	bebida	pizza	salada	sobremesa	localidade
0	0x10000a	0.0	1.0	0.0	1.0	9
1	0x10000a	0.0	1.0	0.0	1.0	9
2	0x100058	0.0	2.0	0.0	2.0	6
3	0x100058	0.0	2.0	0.0	2.0	6
4	0x1000c8	4.0	4.0	1.0	5.0	9
...	...	...	...	...	...	...
260640	0xfff07	1.0	1.0	0.0	1.0	2
260641	0xfff4d	0.0	2.0	0.0	2.0	3
260642	0xfff4d	0.0	2.0	0.0	2.0	3
260643	0xfffb8	0.0	1.0	0.0	1.0	2
260644	0xfffb8	0.0	1.0	0.0	1.0	2

260645 rows × 6 columns

Index adjustment

In [27]:

```
df_order = order_all2.reset_index()
```

In [28]:

```
df_order.head()
```

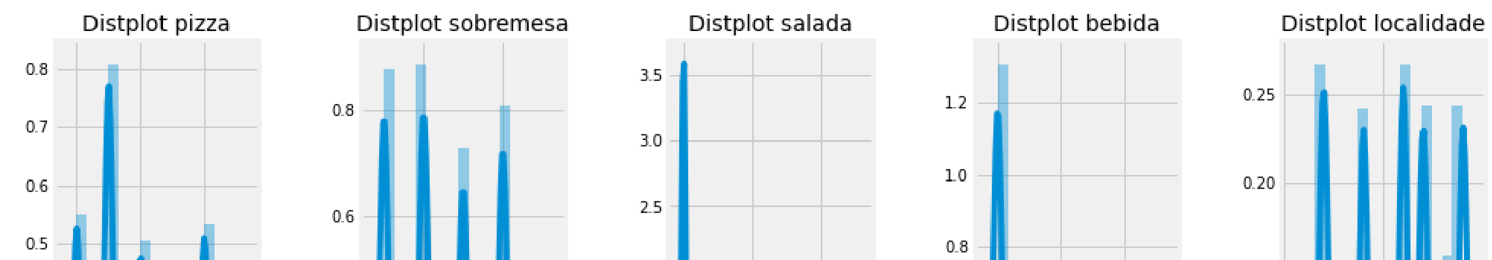
	index	id_transacao	bebida	pizza	salada	sobremesa	localidade
0	0	0x10000a	0.0	1.0	0.0	1.0	9
1	1	0x10000a	0.0	1.0	0.0	1.0	9
2	2	0x100058	0.0	2.0	0.0	2.0	6
3	3	0x100058	0.0	2.0	0.0	2.0	6
4	4	0x1000c8	4.0	4.0	1.0	5.0	9

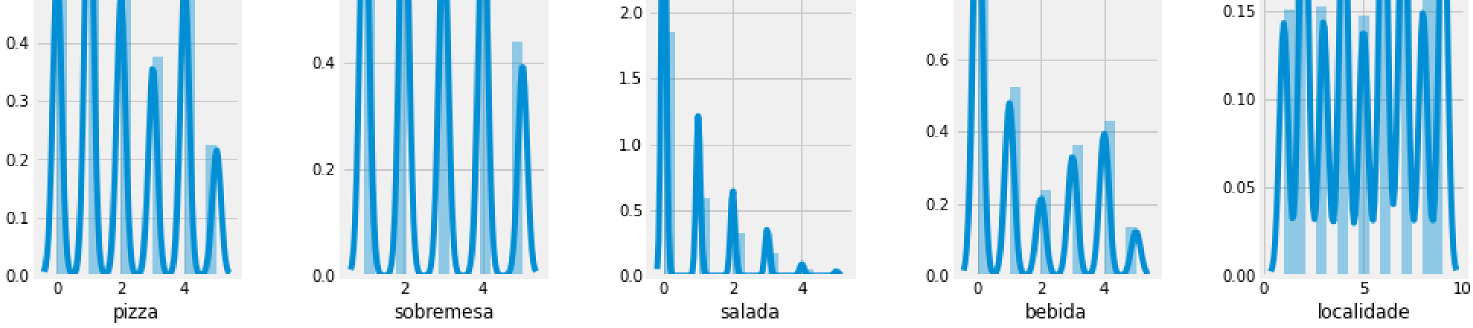
Data Analysis

Distplot for segmentation

In [29]:

```
# Plot

# Figure Size
plt.figure(1, figsize = (15,6))

#Counter
n = 0

# Loop by columns

for x in ['pizza', 'sobremesa', 'salada', 'bebida', 'localidade']:
    n +=1
    plt.subplot(1,5,n)
    plt.subplots_adjust(hspace=0.5,wspace = 0.5)
    sns.distplot(df_order[x], bins = 15)
    plt.title('Distplot {}'.format(x))
plt.show()
```

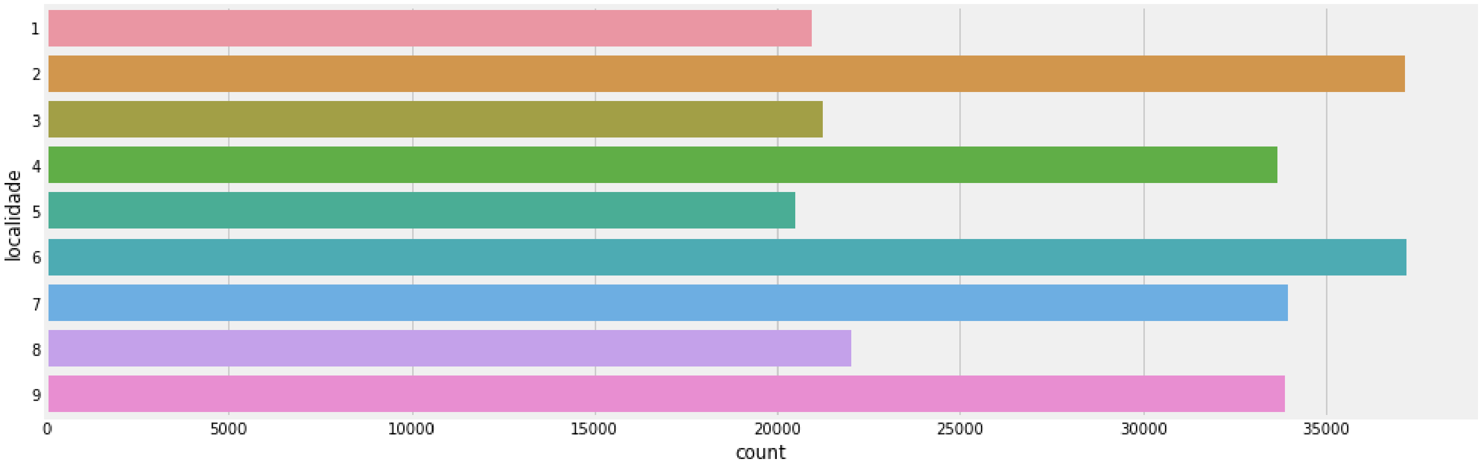




Countplot

In [30]:

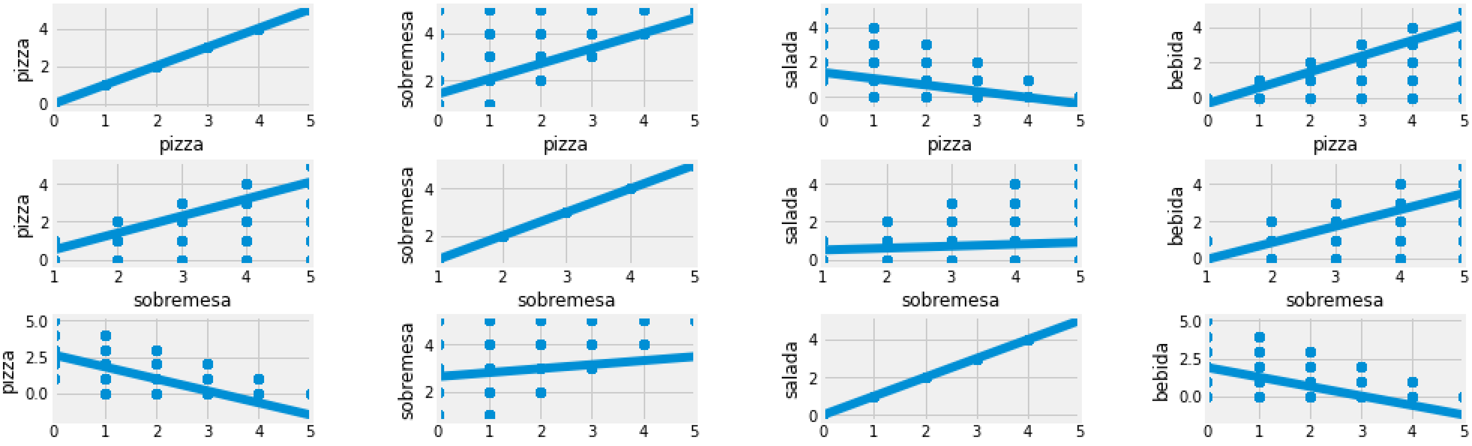
```
plt.figure(1, figsize=(15,5))
sns.countplot(y = 'localidade',data =df_order)
plt.show()
```

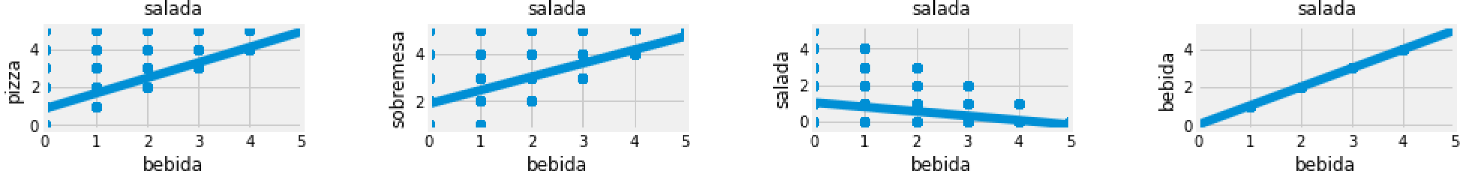


Regplot for segmentation

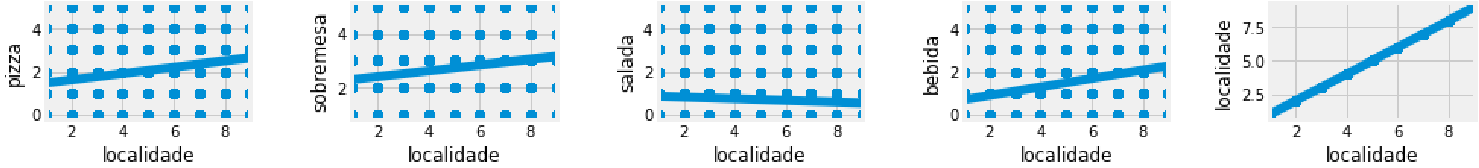
In [31]:

```
#Figura Size
plt.figure(1, figsize = (15,7))

# Counter
n = 0

for x in  ['pizza', 'sobremesa', 'salada', 'bebida']:
    for y in ['pizza', 'sobremesa', 'salada', 'bebida']:
        n +=1
        plt.subplot(4,4,n)
        plt.subplots_adjust(hspace = 0.5, wspace = 0.5)
        sns.regplot(x=x, y=y, data = df_order)
        plt.ylabel(y)
plt.show()
```





In [32]:
```
plt.figure(1, figsize = (15,10))

# Counter
n = 0

for x in  ['localidade']:
    for y in ['pizza', 'sobremesa', 'salada', 'bebida', 'localidade']:
        n +=1
        plt.subplot(5,5,n)
        plt.subplots_adjust(hspace = 0.5, wspace = 0.5)
        sns.regplot(x=x, y=y, data = df_order)
        plt.ylabel(y)
plt.show()
```



Feature Selection

In [33]:
```
df_order.columns
```

```
Index(['index', 'id_transacao', 'bebida', 'pizza', 'salada', 'sobremesa',
       'localidade'],
      dtype='object')
```

In [34]:
```
df_order_feature = df_order[['index', 'bebida', 'pizza', 'salada', 'sobremesa', 'localidade']]
```

In [35]:
```
df_order_feature.head()
```

	index	bebida	pizza	salada	sobremesa	localidade
0	0	0.0	1.0	0.0	1.0	9
1	1	0.0	1.0	0.0	1.0	9
2	2	0.0	2.0	0.0	2.0	6
3	3	0.0	2.0	0.0	2.0	6
4	4	4.0	4.0	1.0	5.0	9

Cluster Analysis

- K-means
- Mean-Shift Clustering
- Density-Based Spatial Clustering of Applications with Noise (DBSCAN)
- Expectation–Maximization (EM) Clustering using Gaussian Mixture Models (GMM)
- Agglomerative Hierarchical Clustering Reference:

https://scikit-learn.org/stable/modules/generated/sklearn.cluster.KMeans.html

https://scikit-learn.org/stable/modules/generated/sklearn.cluster.MeanShift.html

https://scikit-learn.org/stable/modules/generated/sklearn.cluster.DBSCAN.html

https://scikit-learn.org/stable/modules/mixture.html https://scikit-learn.org/stable/modules/mixture.html

https://scikit-learn.org/stable/modules/generated/sklearn.cluster.AgglomerativeClustering.html

1º Segmentation

In [36]:

```
X1 = df_order_feature[['pizza', 'sobremesa']].iloc[:,:].values
```

In [37]:

```
X1
```

```
array([[1., 1.],
       [1., 1.],
       [2., 2.],
       ...,
       [2., 2.],
       [1., 1.],
       [1., 1.]])
```

In [38]:

```
wcss = []
```

In [39]:

```
#1º Machine Learning Model

model = KMeans(n_clusters= 2,
               init = 'k-means++',
               n_init= 10,
               max_iter= 300,
               tol = 0.0001,
               random_state = 111,
               algorithm = 'elkan')
```

In [40]:

```
#Fitting Model
model.fit(X1)
```

```
KMeans(algorithm='elkan', n_clusters=2, random_state=111)
```

In [41]:

```
labels = model.labels_
labels
```

```
array([0, 0, 0, ..., 0, 0, 0])
```

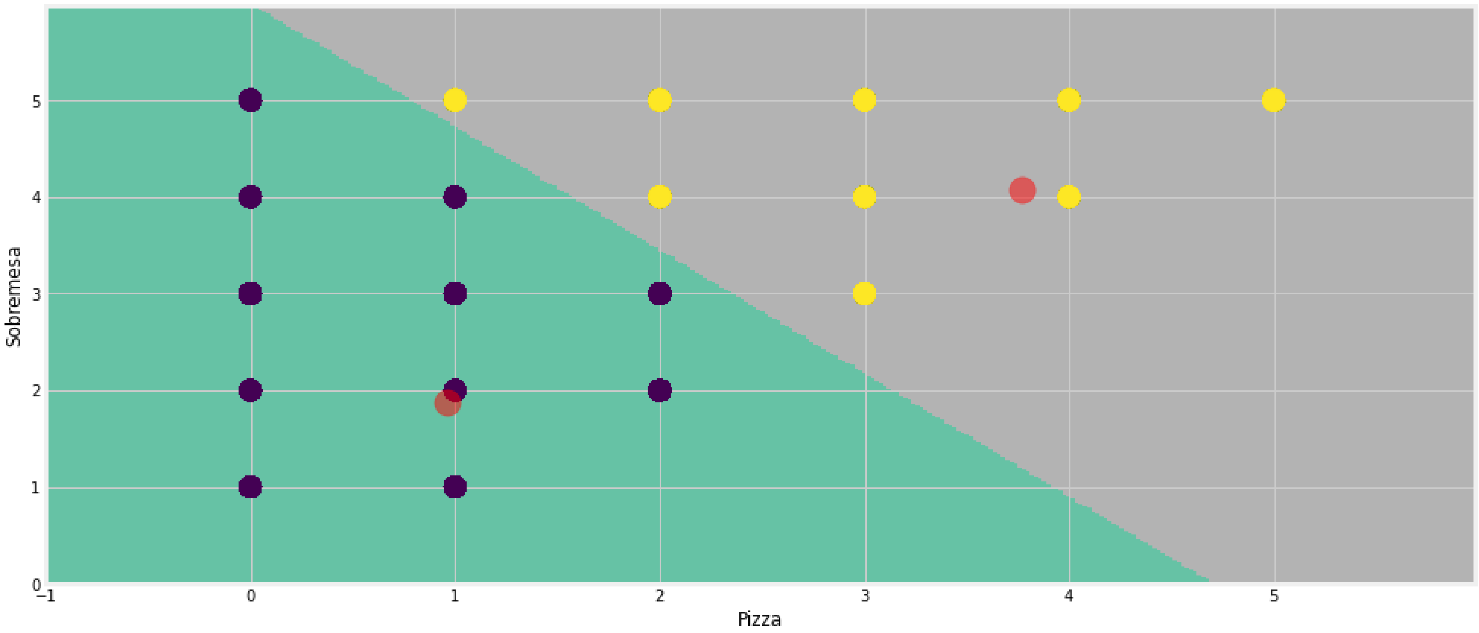
In [42]:

```
centers = model.cluster_centers_
centers
```

```
array([[0.9613099 , 1.87537776],
       [3.76652414, 4.07619962]])
```

In [43]:

```
# Plot

# Parâmetros do Meshgrid
h = 0.02
x_min, x_max = X1[:, 0].min() - 1, X1[:, 0].max() + 1
y_min, y_max = X1[:, 1].min() - 1, X1[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
Z = model.predict(np.c_[xx.ravel(), yy.ravel()])
plt.figure(1 , figsize = (15, 7) )
plt.clf()
Z = Z.reshape(xx.shape)

# Plot da imagem
# Plot da imagem
plt.imshow(Z,
           interpolation = 'nearest',
           extent = (xx.min(), xx.max(), yy.min(), yy.max()),
           cmap = plt.cm.Set2,
           aspect = 'auto',
           origin = 'lower')

# Plot dos pontos de dados
plt.scatter( x = 'pizza', y = 'sobremesa', data = df_order_feature , c = labels, s = 200 )
plt.scatter(x = centers[: , 0], y =  centers[: , 1], s = 300, c = 'red', alpha = 0.5)
plt.xlabel('Pizza')
plt.ylabel('Sobremesa')
plt.show()
```



For the 1º Segmentation, we can see that when there is no purchase of Pizza's, soon there is a greater number of purchases in desserts, however, those who usually buy more pizza happen to end up buying more dessert. For an improvement in sales, if it is possible to offer a free dessert when buying a 3, 4 or 5 pizza of greater value than the others.

2º Segmentation

In [44]:

```
X2 = df_order_feature[['pizza', 'salada']].iloc[:,:].values
```

In [45]:

```
model.fit(X2);
labelsx2 = model.labels_;
centersx2 = model.cluster_centers_
```

In [46]:

```
labelsx2
```

```
array([0, 0, 0, ..., 0, 0, 0])
```

In [47]:

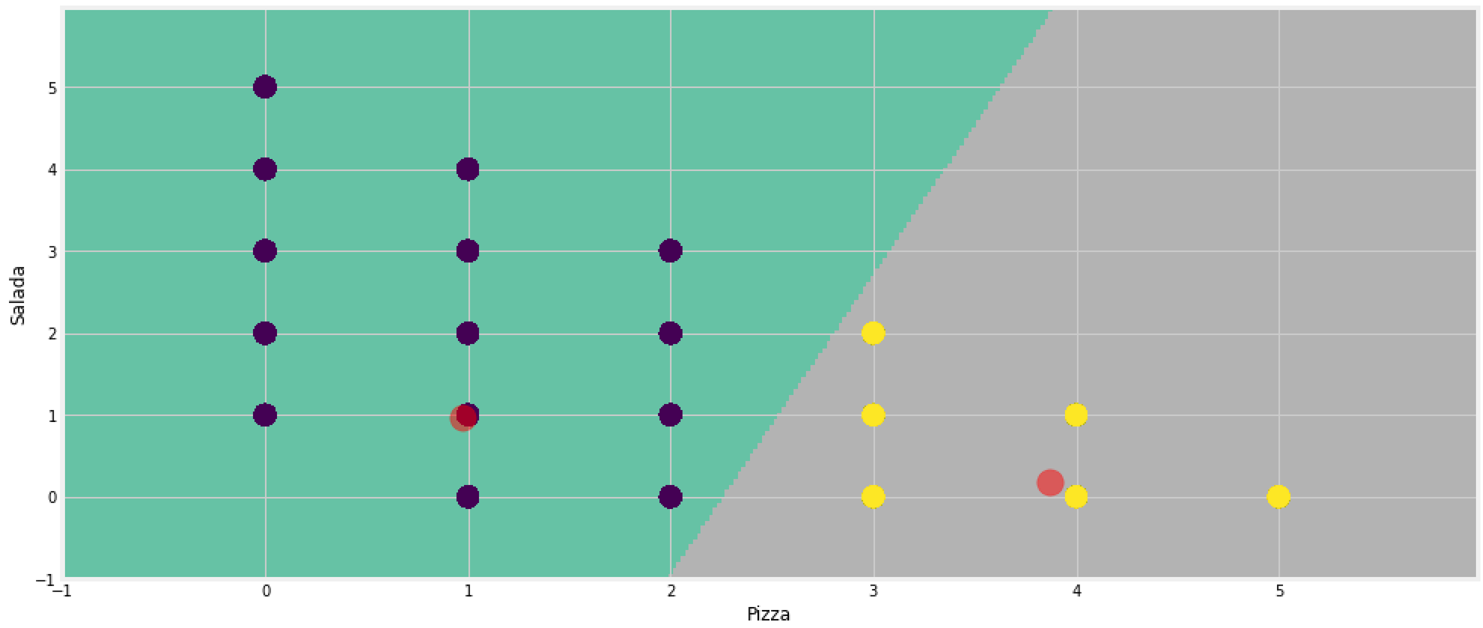
```
centersx2
```

```
array([[0.97591999, 0.97495629],
       [3.86666734, 0.18314636]])
```

In [48]:

```
# Plot

# Parâmetros do Meshgrid
h = 0.02
```

```
x_min, x_max = X2[:, 0].min() - 1, X2[:, 0].max() + 1
y_min, y_max = X2[:, 1].min() - 1, X2[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
Z = model.predict(np.c_[xx.ravel(), yy.ravel()])
plt.figure(1 , figsize = (15, 7) )
plt.clf()
Z = Z.reshape(xx.shape)

# Plot da imagem
plt.imshow(Z,
          interpolation = 'nearest',
          extent = (xx.min(), xx.max(), yy.min(), yy.max()),
          cmap = plt.cm.Set2,
          aspect = 'auto',
          origin = 'lower')

# Plot dos pontos de dados
plt.scatter( x = 'pizza', y = 'salada', data = df_order_feature , c = labelsx2, s = 200 )
plt.scatter(x = centersx2[: , 0], y =  centersx2[: , 1], s = 300, c = 'red', alpha = 0.5)
plt.xlabel('Pizza')
plt.ylabel('Salada')
plt.show()
```



Different of previous segmentation, in this case the analysis informs that those who order more salads as a meal, usually also order less pizza's. If the situation is for the meals to be healthier, we can create the situation in which when buying a second pizza, a salad is won, thus encouraging conscious and healthy consumption

3º Segmentation

In [49]:

```
model3 = KMeans(n_clusters=4,
              init='k-means++',
              n_init=10,
               max_iter=300,
               tol=0.00001,
               algorithm='elkan'
          )
X3 = df_order_feature[['pizza', 'localidade']].iloc[:,:].values
```

In [50]:

```
model3.fit(X3);
labelsx3 = model3.labels_;
centrsx3= model3.cluster_centers_;
```

In [51]:

```
labelsx3
```

```
labelsx3
```

```
array([0, 0, 0, ..., 1, 1, 1])
```

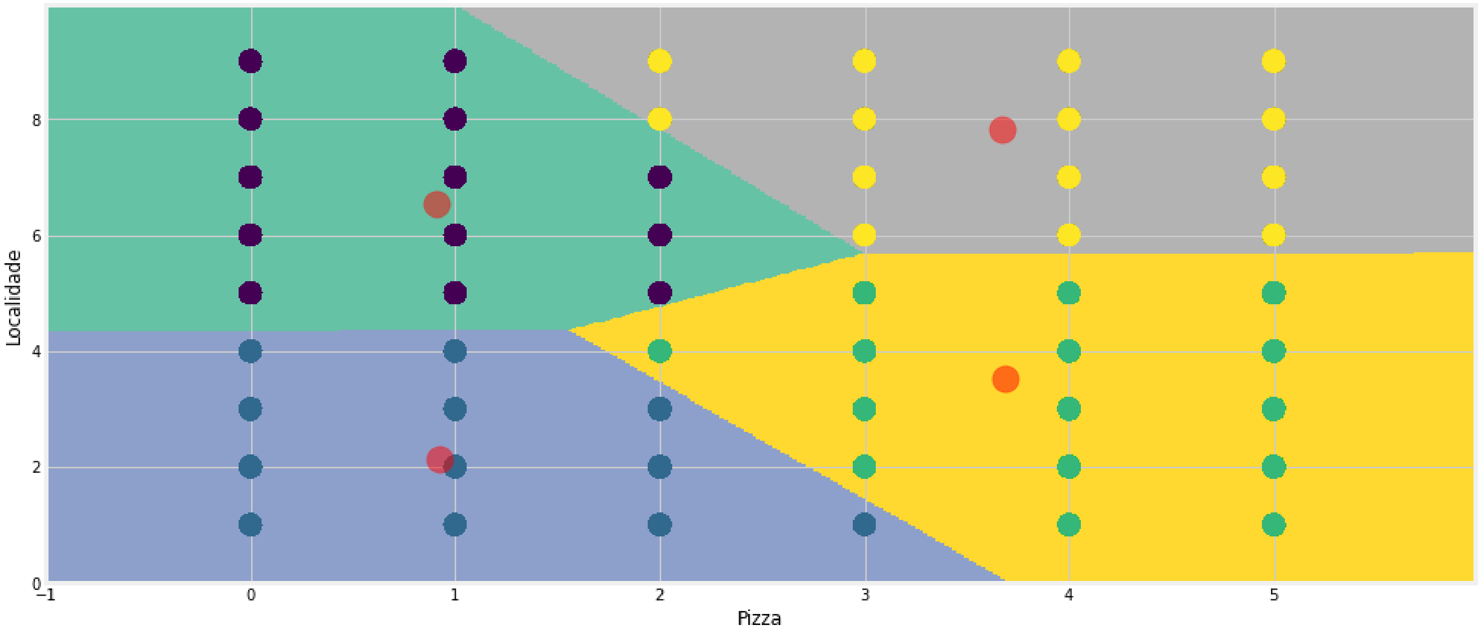
In [52]:

```
centrsx3
```

```
array([[0.90639264, 6.54022191],
       [0.92032286, 2.14283736],
       [3.6877518 , 3.51603578],
       [3.67495742, 7.83203167]])
```

In [53]:

```
# Plot

# Parâmetros do Meshgrid
h = 0.02
x_min, x_max = X3[:, 0].min() - 1, X3[:, 0].max() + 1
y_min, y_max = X3[:, 1].min() - 1, X3[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
Z = model3.predict(np.c_[xx.ravel(), yy.ravel()])
plt.figure(1 , figsize = (15, 7) )
plt.clf()
Z = Z.reshape(xx.shape)

# Plot da imagem
plt.imshow(Z,
           interpolation = 'nearest',
           extent = (xx.min(), xx.max(), yy.min(), yy.max()),
           cmap = plt.cm.Set2,
           aspect = 'auto',
           origin = 'lower')

# Plot dos pontos de dados
plt.scatter( x = 'pizza', y = 'localidade', data = df_order_feature , c = labelsx3, s = 200 )
plt.scatter(x = centrsx3[: , 0], y =  centrsx3[: , 1], s = 300, c = 'red', alpha = 0.5)
plt.xlabel('Pizza')
plt.ylabel('Localidade')
plt.show()
```



For the 3º Segmentation, all locations order pizza, however it should be noted that at some point in the day, these locations fail to place orders. In order for there to be a greater number of orders at times when demand is 0, you can create a promotion stating that from time X to Y the orders are 15% off, thus increasing the number of orders at those times