case01

March 20, 2022

0.0.1 Package Python

[ ]:
```
# Packages Manipulation
import pandas as pd
from pandas.plotting import autocorrelation_plot
import numpy as np
import xarray as xr
import os as os

# Packages Graph
%matplotlib inline
import seaborn as sns
import plotly.express as px
import matplotlib.pyplot as plt

# Packages ML
import statsmodels.api as sm
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.tree import DecisionTreeRegressor

# Metrics of errors
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_absolute_error
```

0.0.2 Reading of bases

[ ]:
```
_current_path = os.getcwd()
_current_path
```

[ ]:
```
'c:\\git\\Gol_Cases'
```

[ ]:
```
_path1 = os.path.join(_current_path, 'data', 'Case Analytics-DS.xlsx')
_path1
_df = pd.read_excel(io=_path1, sheet_name='Dados')
_df.head(2)
```

[ ]:

	Data Venda	Canal de Venda	Local de Venda	PAX	Monetário Vendido	RPK
0	2016-11-01	Telégrafo	Mindscape	30	2188.109487	3476
1	2016-11-01	TeleVenda	Arena	52	3302.375951	8197

[ ]:
```
_path2 = os.path.join(_current_path, 'data', 'cotacao_dolar.csv')
_df_cot = pd.read_csv(_path2, sep=';',  encoding='latin1')
_df_cot.columns = _df_cot.columns.str.lower()
_df_cot.columns = _df_cot.columns.str.replace(' ', '_')
_df_cot = _df_cot[['data', 'último']].rename(columns={'último':'usd_rate'})
_df_cot['data'] = pd.to_datetime(_df_cot['data'])
_df_cot['data'] = _df_cot['data'].dt.strftime('%Y-%m-%d')
_df_cot = _df_cot.sort_values(['data', 'usd_rate']).reset_index(drop=True)
_df_cot['data'] = pd.to_datetime(_df_cot['data'])
_df_cot['usd_rate'] = _df_cot['usd_rate'].str.replace(',','.').astype(float)
_df_cot.head(5)
```

[ ]:

	data	usd_rate
0	2016-01-11	3.2367
1	2016-01-12	3.4718
2	2016-02-11	3.2359
3	2016-02-12	3.4755
4	2016-03-11	3.2425

[ ]:
```
_df_cot.dtypes
```

[ ]:
```
data        datetime64[ns]
usd_rate           float64
dtype: object
```

[ ]:
```
_df
```

[ ]:

	Data Venda	Canal de Venda	Local de Venda	PAX	Monetário Vendido	RPK
0	2016-11-01	Telégrafo	Mindscape	30	2188.109487	3476
1	2016-11-01	TeleVenda	Arena	52	3302.375951	8197
2	2016-11-01	TeleVenda	Mindscape	19	1041.544400	2425
3	2016-11-01	Porta a Porta	Mindscape	496	15566.340547	53278
4	2016-11-01	TeleVenda	Vast	46	2721.427289	2039
…	…	…	…	…	…	…
2427	2017-04-01	Porta a Porta	Vast	1079	28486.396741	54551
2428	2017-04-01	Porta a Porta	Ellipsis	841	23600.998318	46988
2429	2017-04-01	TeleVenda	Arena	175	10270.292519	26599
2430	2017-04-01	Telégrafo	Arena	105	5470.410450	15130
2431	2017-04-01	Telégrafo	Vast	61	2911.981488	3050

[2432 rows x 6 columns]

[ ]:
```
# Merge data

_df = _df.merge(_df_cot, left_on='Data Venda', right_on='data', how='left')
_df = _df.drop('data', axis=1)
_df['usd_rate'] = _df['usd_rate'].fillna(_df['usd_rate'].mean())
_df
```

[ ]:
```
     Data Venda Canal de Venda Local de Venda   PAX  Monetário Vendido    RPK  \
0    2016-11-01      Telégrafo      Mindscape    30        2188.109487   3476
1    2016-11-01      TeleVenda          Arena    52        3302.375951   8197
2    2016-11-01      TeleVenda      Mindscape    19        1041.544400   2425
3    2016-11-01  Porta a Porta      Mindscape   496       15566.340547  53278
4    2016-11-01      TeleVenda           Vast    46        2721.427289   2039
…           …              …              …   …                   …     …
2427 2017-04-01  Porta a Porta           Vast  1079       28486.396741  54551
2428 2017-04-01  Porta a Porta       Ellipsis   841       23600.998318  46988
2429 2017-04-01      TeleVenda          Arena   175       10270.292519  26599
2430 2017-04-01      Telégrafo          Arena   105        5470.410450  15130
2431 2017-04-01      Telégrafo           Vast    61        2911.981488   3050

      usd_rate
0     3.217581
1     3.217581
2     3.217581
3     3.217581
4     3.217581
…        …
2427  3.216300
2428  3.216300
2429  3.216300
2430  3.216300
2431  3.216300

[2432 rows x 7 columns]
```

[ ]:
```
_df.columns = _df.columns.str.lower()
_df.columns
```

[ ]:
```
Index(['data venda', 'canal de venda', 'local de venda', 'pax',
       'monetário vendido', 'rpk', 'usd_rate'],
      dtype='object')
```

[ ]:
```
_df.columns = _df.columns.str.replace(' ', '_')
_df.columns
```

[ ]:
```
Index(['data_venda', 'canal_de_venda', 'local_de_venda', 'pax',
       'monetário_vendido', 'rpk', 'usd_rate'],
```

```
dtype='object')
```

[ ]:
```
_df.describe()
```

[ ]:
```
                pax  monetário_vendido            rpk     usd_rate
count  2432.000000        2432.000000    2432.000000  2432.000000
mean    723.002878       24638.740498   66738.389391     3.217581
std     735.936451       22424.842904   83479.039478     0.085241
min      18.000000        1041.544400    1127.000000     3.057500
25%     100.000000        6122.920492   11372.000000     3.168875
50%     395.500000       17755.421730   33361.500000     3.217581
75%    1160.250000       35535.323991   95116.750000     3.217581
max    4705.000000      144890.731053  695824.000000     3.440400
```

[ ]:
```
_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 2432 entries, 0 to 2431
Data columns (total 7 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   data_venda         2432 non-null   datetime64[ns]
 1   canal_de_venda     2432 non-null   object
 2   local_de_venda     2432 non-null   object
 3   pax                2432 non-null   int64
 4   monetário_vendido  2432 non-null   float64
 5   rpk                2432 non-null   int64
 6   usd_rate           2432 non-null   float64
dtypes: datetime64[ns](1), float64(2), int64(2), object(2)
memory usage: 152.0+ KB
```

[ ]:
```
_df.dtypes
```

[ ]:
```
data_venda           datetime64[ns]
canal_de_venda                 object
local_de_venda                 object
pax                             int64
monetário_vendido             float64
rpk                             int64
usd_rate                      float64
dtype: object
```

- Checking values nan or nulls

[ ]:
```
_df.isna().sum()
```

[ ]:
```
data_venda          0
canal_de_venda      0
```

```
local_de_venda       0
pax                  0
monetário_vendido    0
rpk                  0
usd_rate             0
dtype: int64
```

[ ]:
```
_df.isnull().sum()
```

[ ]:
```
data_venda           0
canal_de_venda       0
local_de_venda       0
pax                  0
monetário_vendido    0
rpk                  0
usd_rate             0
dtype: int64
```

[ ]:
```
_df.shape
```

[ ]:
```
(2432, 7)
```

- PAX é o total de passageiros.
- RPK (Revenue Passenger-Kilometers) é um indicador diretamente relacionada com o número de PAX. $ {RPK} = {PAX } * {KM} $

[ ]:
```
_df = _df.dropna()
_df.head(5)
```

[ ]:
```
  data_venda canal_de_venda local_de_venda  pax  monetário_vendido    rpk  \
0 2016-11-01      Telégrafo      Mindscape   30        2188.109487   3476
1 2016-11-01      TeleVenda          Arena   52        3302.375951   8197
2 2016-11-01      TeleVenda      Mindscape   19        1041.544400   2425
3 2016-11-01  Porta a Porta      Mindscape  496       15566.340547  53278
4 2016-11-01      TeleVenda           Vast   46        2721.427289   2039

   usd_rate
0  3.217581
1  3.217581
2  3.217581
3  3.217581
4  3.217581
```

[ ]:
```
_df['km'] = _df['rpk'] / _df['pax']
_df
```

[ ]:
```
     data_venda canal_de_venda local_de_venda   pax  monetário_vendido    rpk  \
0    2016-11-01      Telégrafo      Mindscape    30        2188.109487   3476
```

```
1     2016-11-01      TeleVenda          Arena    52        3302.375951   8197
2     2016-11-01      TeleVenda      Mindscape    19        1041.544400   2425
3     2016-11-01  Porta a Porta      Mindscape   496       15566.340547  53278
4     2016-11-01      TeleVenda           Vast    46        2721.427289   2039
…            …              …              …    …                  …     …
2427  2017-04-01  Porta a Porta           Vast  1079       28486.396741  54551
2428  2017-04-01  Porta a Porta       Ellipsis   841       23600.998318  46988
2429  2017-04-01      TeleVenda          Arena   175       10270.292519  26599
2430  2017-04-01      Telégrafo          Arena   105        5470.410450  15130
2431  2017-04-01      Telégrafo           Vast    61        2911.981488   3050

      usd_rate          km
0     3.217581  115.866667
1     3.217581  157.634615
2     3.217581  127.631579
3     3.217581  107.415323
4     3.217581   44.326087
…          …           …
2427  3.216300   50.556997
2428  3.216300   55.871581
2429  3.216300  151.994286
2430  3.216300  144.095238
2431  3.216300   50.000000

[2432 rows x 8 columns]
```

- Adding km

[ ]:
```
def plotar(titulo: str, labelx: str, labely: str, x: str, y: str, dataset:␣
↪dict, fontt: int, fontlx: int, fontly: int) -> dict:
    """Função para plotagem de gráfico"""
    sns.set_palette('Accent')
    sns.set_style('darkgrid')
    ax = sns.lineplot(x = x, y = y, data = dataset)
    ax.figure.set_size_inches(12, 6)
    ax.set_title(titulo, loc='left', fontsize=fontt)
    ax.set_xlabel(labelx, fontsize=fontlx)
    ax.set_ylabel(labely, fontsize=fontly)
    ax = ax
    return ax
```

[ ]:
```
def plot_comparacao(x, y1,y2,y3, y4=None, params=False, dataset=None,␣
↪titulo=None):
    plt.figure(figsize=(16,12))
    if params:
        ax = plt.subplot(4,1,1)
        ax.set_title(titulo, fontsize=18, loc='left')
```

```
        sns.lineplot(x = x, y = y1, data = dataset)
        ax = plt.subplot(4,1,2)
        sns.lineplot(x = x, y = y2, data = dataset)
        ax = plt.subplot(4,1,3)
        sns.lineplot(x = x, y = y3, data = dataset)
        ax = plt.subplot(4,1,4)
        sns.lineplot(x = x, y = y4, data = dataset)
    else:
        ax = plt.subplot(3,1,1)
        ax.set_title(titulo, fontsize=18, loc='left')
        sns.lineplot(x = x, y = y1, data = dataset)
        ax = plt.subplot(3,1,2)
        sns.lineplot(x = x, y = y2, data = dataset)
        ax = plt.subplot(3,1,3)
        sns.lineplot(x = x, y = y3, data = dataset)
    ax = ax
    return ax
```

[ ]:
```
_df['aceleracao_pax'] = _df['pax'].diff()
_df['aumento_pax'] = _df['aceleracao_pax'].diff()
_df['aceleracao_rpk'] = _df['rpk'].diff()
_df['aumento_rpk'] = _df['aceleracao_rpk'].diff()
_df['aceleracao_km'] = _df['km'].diff()
_df['aumento_km'] = _df['aceleracao_km'].diff()
_df = _df.fillna(0)
_df
```

[ ]:

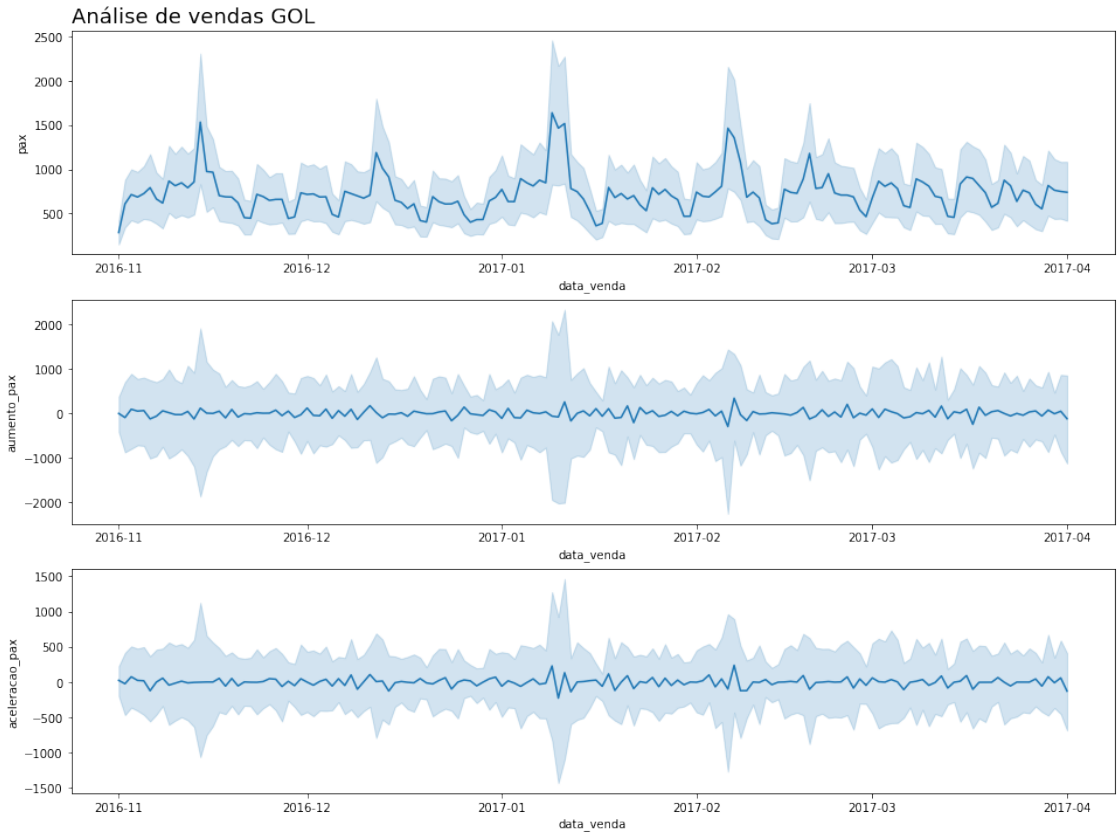
	data_venda	canal_de_venda	local_de_venda	pax	monetário_vendido	rpk	\
0	2016-11-01	Telégrafo	Mindscape	30	2188.109487	3476	
1	2016-11-01	TeleVenda	Arena	52	3302.375951	8197	
2	2016-11-01	TeleVenda	Mindscape	19	1041.544400	2425	
3	2016-11-01	Porta a Porta	Mindscape	496	15566.340547	53278	
4	2016-11-01	TeleVenda	Vast	46	2721.427289	2039	
…	…	…	…	…	…	…	
2427	2017-04-01	Porta a Porta	Vast	1079	28486.396741	54551	
2428	2017-04-01	Porta a Porta	Ellipsis	841	23600.998318	46988	
2429	2017-04-01	TeleVenda	Arena	175	10270.292519	26599	
2430	2017-04-01	Telégrafo	Arena	105	5470.410450	15130	
2431	2017-04-01	Telégrafo	Vast	61	2911.981488	3050	

	usd_rate	km	aceleracao_pax	aumento_pax	aceleracao_rpk	\
0	3.217581	115.866667	0.0	0.0	0.0	
1	3.217581	157.634615	22.0	0.0	4721.0	
2	3.217581	127.631579	-33.0	-55.0	-5772.0	
3	3.217581	107.415323	477.0	510.0	50853.0	
4	3.217581	44.326087	-450.0	-927.0	-51239.0	
…	…	…	…	…	…	

```
2427  3.216300   50.556997          -707.0      -2426.0       -212781.0
2428  3.216300   55.871581          -238.0       469.0          -7563.0
2429  3.216300  151.994286          -666.0      -428.0         -20389.0
2430  3.216300  144.095238           -70.0       596.0         -11469.0
2431  3.216300   50.000000           -44.0        26.0         -12080.0

      aumento_rpk  aceleracao_km  aumento_km
0             0.0       0.000000    0.000000
1             0.0      41.767949    0.000000
2        -10493.0     -30.003036  -71.770985
3         56625.0     -20.216256    9.786780
4       -102092.0     -63.089236  -42.872979
…             …             …           …
2427    -472112.0     -99.124974 -129.389034
2428     205218.0       5.314584  104.439558
2429     -12826.0      96.122704   90.808120
2430       8920.0      -7.899048 -104.021752
2431       -611.0     -94.095238  -86.196190

[2432 rows x 14 columns]
```

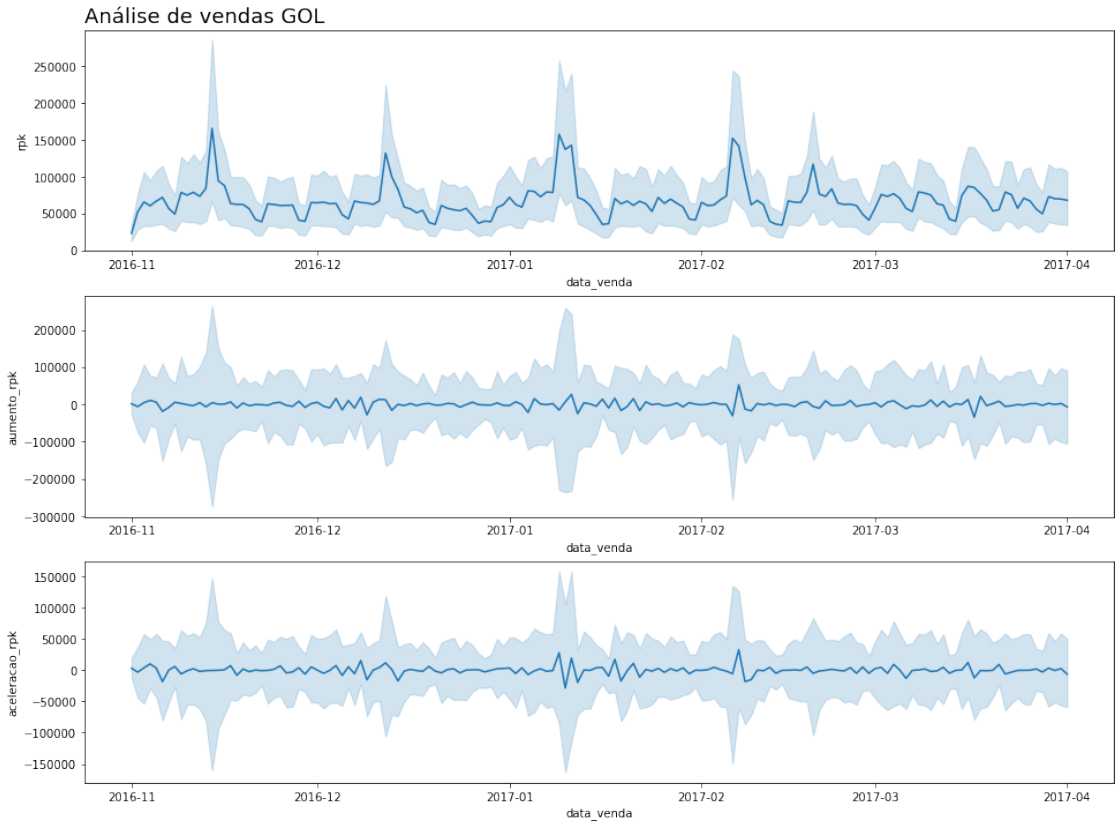
[ ]:
```
plot_comparacao(x='data_venda', y1='pax', y2='aumento_pax',␣
↪y3='aceleracao_pax', dataset=_df, titulo='Análise de vendas GOL')
```

[ ]:
```
<AxesSubplot:xlabel='data_venda', ylabel='aceleracao_pax'>
```



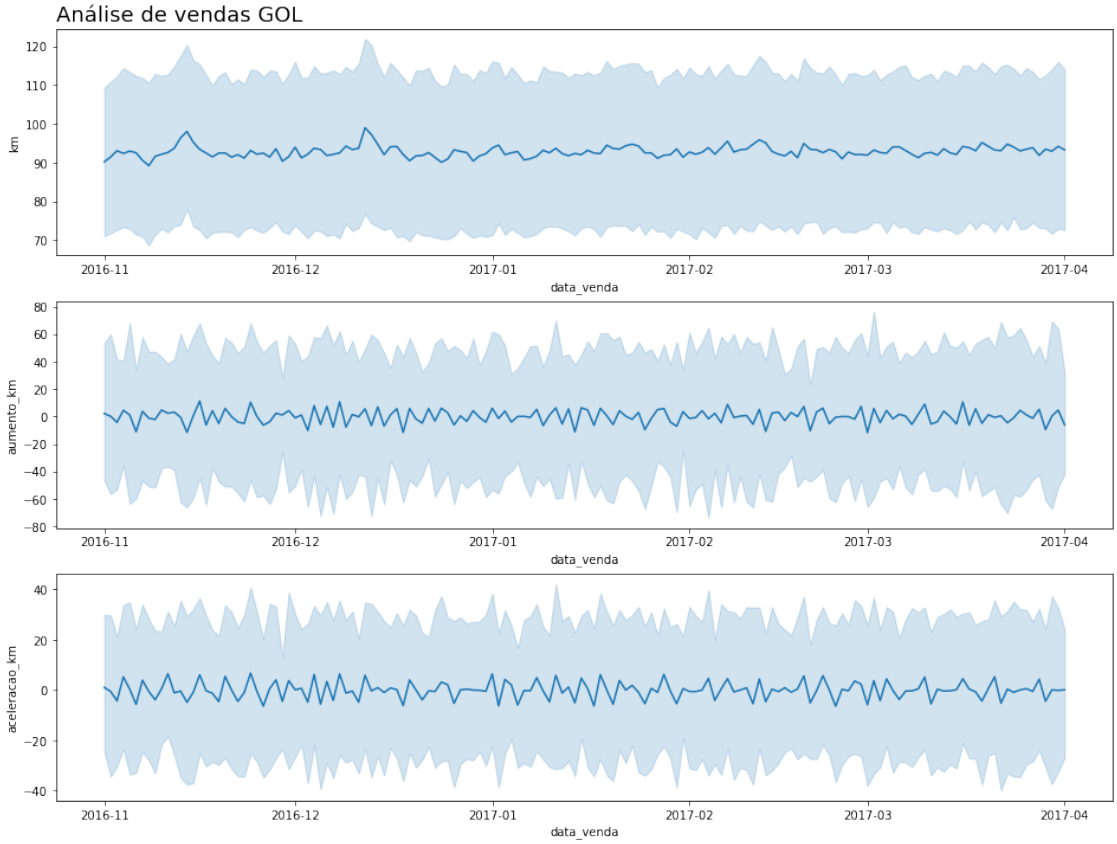
[ ]:
```
plot_comparacao(x='data_venda', y1='rpk', y2='aumento_rpk',␣
↪y3='aceleracao_rpk', dataset=_df, titulo='Análise de vendas GOL')
```

[ ]:
```
<AxesSubplot:xlabel='data_venda', ylabel='aceleracao_rpk'>
```



[ ]:
```
plot_comparacao(x='data_venda', y1='km', y2='aumento_km', y3='aceleracao_km',␣
↪dataset=_df, titulo='Análise de vendas GOL')
```

[ ]:
```
<AxesSubplot:xlabel='data_venda', ylabel='aceleracao_km'>
```



1. Faça um ranking para o número total de PAX por dia da semana.

```
[ ]: _ranking = _df.groupby(['data_venda'])['pax'].sum().reset_index()
     _ranking = _ranking.sort_values('pax').reset_index(drop=True)
     _ranking['ranking'] = _ranking.index
     _ranking
```

```
[ ]:     data_venda    pax  ranking
     0   2016-11-01   4538        0
     1   2017-01-16   5751        1
     2   2017-02-13   6127        2
     3   2017-01-17   6197        3
     4   2017-02-14   6298        4
     ..         …     …       …
     147 2017-02-06  23444      147
     148 2017-01-10  23460      148
     149 2017-01-11  24298      149
     150 2016-11-14  24551      150
     151 2017-01-09  26247      151

     [152 rows x 3 columns]
```

- Shoing the 5 first and lasts PAX of Ranking.

[ ]:
```
_ranking.head(5)
```

[ ]:
```
   data_venda   pax  ranking
0 2016-11-01  4538        0
1 2017-01-16  5751        1
2 2017-02-13  6127        2
3 2017-01-17  6197        3
4 2017-02-14  6298        4
```

[ ]:
```
_ranking.tail(5)
```

[ ]:
```
     data_venda    pax  ranking
147 2017-02-06  23444      147
148 2017-01-10  23460      148
149 2017-01-11  24298      149
150 2016-11-14  24551      150
151 2017-01-09  26247      151
```

- Sum of total of pax

[ ]:
```
_df['pax'].sum()
```

[ ]:
```
1758343
```

[ ]:
```
_ranking['pax'].sum()
```

[ ]:
```
1758343
```

[ ]:
```
_df['rpk'].sum()
```

[ ]:
```
162307763
```

2. Qual a correlação de sábado e domingo somados com o total de RPK?

[ ]:
```
from datetime import date

def find_day(year,  month, day):

    DIAS = [
        'Segunda-feira',
        'Terça-feira',
        'Quarta-feira',
        'Quinta-feira',
        'Sexta-feira',
        'Sábado',
        'Domingo'
    ]
```

```
    data = date(year=year,  month=month, day=day)
    # print(data)

    indice_da_semana = data.weekday()
    # print(indice_da_semana)

    dia_da_semana = DIAS[indice_da_semana]
    # print(dia_da_semana)
    return dia_da_semana
```

[ ]:
```
_df['data_venda_str'] = _df['data_venda'].astype(str)
_df.head(5)
```

[ ]:
```
  data_venda canal_de_venda local_de_venda  pax  monetário_vendido    rpk  \
0 2016-11-01      Telégrafo      Mindscape   30        2188.109487   3476
1 2016-11-01      TeleVenda          Arena   52        3302.375951   8197
2 2016-11-01      TeleVenda      Mindscape   19        1041.544400   2425
3 2016-11-01  Porta a Porta      Mindscape  496       15566.340547  53278
4 2016-11-01      TeleVenda           Vast   46        2721.427289   2039

   usd_rate          km  aceleracao_pax  aumento_pax  aceleracao_rpk  \
0  3.217581  115.866667             0.0          0.0             0.0
1  3.217581  157.634615            22.0          0.0          4721.0
2  3.217581  127.631579           -33.0        -55.0         -5772.0
3  3.217581  107.415323           477.0        510.0         50853.0
4  3.217581   44.326087          -450.0       -927.0        -51239.0

   aumento_rpk  aceleracao_km  aumento_km data_venda_str
0          0.0       0.000000    0.000000     2016-11-01
1          0.0      41.767949    0.000000     2016-11-01
2     -10493.0     -30.003036  -71.770985     2016-11-01
3      56625.0     -20.216256    9.786780     2016-11-01
4    -102092.0     -63.089236  -42.872979     2016-11-01
```

[ ]:
```
_df['data_venda_str'].str.split('-', expand=True)
```

[ ]:
```
         0   1   2
0     2016  11  01
1     2016  11  01
2     2016  11  01
3     2016  11  01
4     2016  11  01
…     …   ..  ..
2427  2017  04  01
2428  2017  04  01
2429  2017  04  01
```

```
2430  2017  04  01
2431  2017  04  01

[2432 rows x 3 columns]
```

[ ]:
```
_df['year'] = _df['data_venda_str'].str.split('-', expand=True)[0]
_df['month'] = _df['data_venda_str'].str.split('-', expand=True)[1]
_df['day'] = _df['data_venda_str'].str.split('-', expand=True)[2]
```

[ ]:
```
_df.head()
```

[ ]:
```
  data_venda canal_de_venda local_de_venda  pax  monetário_vendido    rpk  \
0 2016-11-01      Telégrafo      Mindscape   30        2188.109487   3476
1 2016-11-01      TeleVenda          Arena   52        3302.375951   8197
2 2016-11-01      TeleVenda      Mindscape   19        1041.544400   2425
3 2016-11-01  Porta a Porta      Mindscape  496       15566.340547  53278
4 2016-11-01      TeleVenda           Vast   46        2721.427289   2039

   usd_rate          km  aceleracao_pax  aumento_pax  aceleracao_rpk  \
0  3.217581  115.866667             0.0          0.0             0.0
1  3.217581  157.634615            22.0          0.0          4721.0
2  3.217581  127.631579           -33.0        -55.0         -5772.0
3  3.217581  107.415323           477.0        510.0         50853.0
4  3.217581   44.326087          -450.0       -927.0        -51239.0

   aumento_rpk  aceleracao_km  aumento_km data_venda_str  year month day
0          0.0       0.000000    0.000000     2016-11-01  2016    11  01
1          0.0      41.767949    0.000000     2016-11-01  2016    11  01
2     -10493.0     -30.003036  -71.770985     2016-11-01  2016    11  01
3      56625.0     -20.216256    9.786780     2016-11-01  2016    11  01
4    -102092.0     -63.089236  -42.872979     2016-11-01  2016    11  01
```

[ ]:
```
_df['dias_da_semana'] = _df.apply( lambda x: find_day(int(x['year']),␣
↪int(x['month']), int(x['day'])), axis=1 )
```

[ ]:
```
_df.head(5)
```

[ ]:
```
  data_venda canal_de_venda local_de_venda  pax  monetário_vendido    rpk  \
0 2016-11-01      Telégrafo      Mindscape   30        2188.109487   3476
1 2016-11-01      TeleVenda          Arena   52        3302.375951   8197
2 2016-11-01      TeleVenda      Mindscape   19        1041.544400   2425
3 2016-11-01  Porta a Porta      Mindscape  496       15566.340547  53278
4 2016-11-01      TeleVenda           Vast   46        2721.427289   2039

   usd_rate          km  aceleracao_pax  aumento_pax  aceleracao_rpk  \
0  3.217581  115.866667             0.0          0.0             0.0
1  3.217581  157.634615            22.0          0.0          4721.0
```

```
2  3.217581  127.631579          -33.0        -55.0         -5772.0
3  3.217581  107.415323          477.0        510.0         50853.0
4  3.217581   44.326087          -450.0       -927.0        -51239.0

   aumento_rpk  aceleracao_km  aumento_km data_venda_str  year month day  \
0          0.0       0.000000    0.000000     2016-11-01  2016    11  01
1          0.0      41.767949    0.000000     2016-11-01  2016    11  01
2     -10493.0     -30.003036  -71.770985     2016-11-01  2016    11  01
3      56625.0     -20.216256    9.786780     2016-11-01  2016    11  01
4    -102092.0     -63.089236  -42.872979     2016-11-01  2016    11  01

  dias_da_semana
0    Terça-feira
1    Terça-feira
2    Terça-feira
3    Terça-feira
4    Terça-feira
```

[ ]:
```
_df2 = _df[['data_venda', 'dias_da_semana', 'rpk']]
_df2 = _df2.groupby(['data_venda']).sum().reset_index()
_df2.head(5)
```

[ ]:
```
  data_venda      rpk
0 2016-11-01   367479
1 2016-11-02   837263
2 2016-11-03  1051716
3 2016-11-04   968225
4 2016-11-05  1069765
```

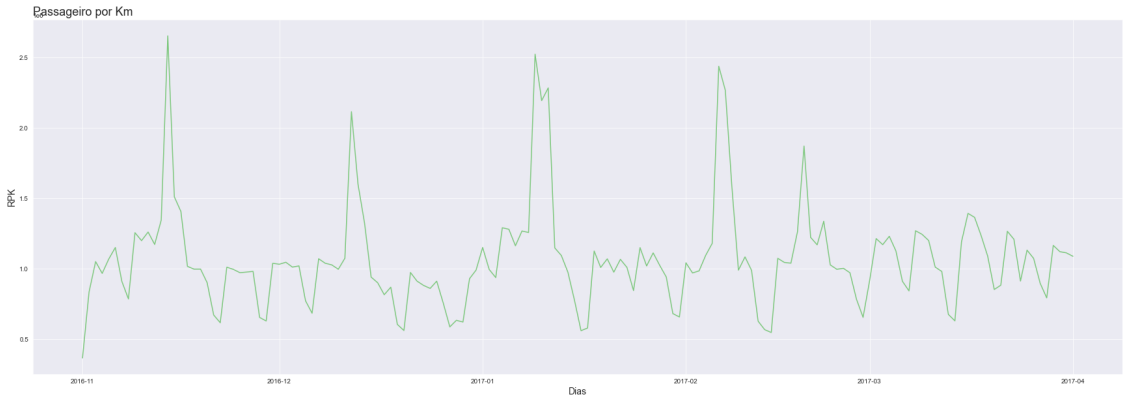
[ ]:
```
_df2['data_venda'].min()
```

[ ]:
```
Timestamp('2016-11-01 00:00:00')
```

[ ]:
```
_df2['data_venda'].max()
```

[ ]:
```
Timestamp('2017-04-01 00:00:00')
```

[ ]:
```
sns.set_palette('Accent')
sns.set_style('darkgrid')
ax = sns.lineplot(x = 'data_venda', y = 'rpk', data = _df2)
ax.figure.set_size_inches(30, 10)
# ax.set(xticks=_df2.data_venda.values)
ax.set_title('Passageiro por Km', loc='left', fontsize=18)
ax.set_xlabel('Dias', fontsize=14)
ax.set_ylabel('RPK', fontsize=14)
ax = ax
```



[ ]:
```
_df2['rpk'].max()
```

[ ]:
```
2653733
```

[ ]:
```
_df2[_df2['rpk'] > 2000000]
_df2['data_venda_str'] = _df2['data_venda'].astype(str)
_df2['year'] = _df2['data_venda_str'].str.split('-', expand=True)[0]
_df2['month'] = _df2['data_venda_str'].str.split('-', expand=True)[1]
_df2['day'] = _df2['data_venda_str'].str.split('-', expand=True)[2]
_df2['dias_da_semana'] = _df2.apply( lambda x: find_day(int(x['year']),␣
↪int(x['month']), int(x['day'])), axis=1 )
_df2.drop(columns=['data_venda_str','year','month','day'], inplace=True)
_df2.groupby(['dias_da_semana'])['rpk'].sum().sort_values()
```

[ ]:
```
dias_da_semana
Terça-feira      20366840
Domingo          22388695
Sábado           23201577
Segunda-feira    23275908
Sexta-feira      23309936
Quinta-feira     23501102
Quarta-feira     26263705
Name: rpk, dtype: int64
```

[ ]:
```
_df4 = _df[['data_venda', 'dias_da_semana', 'rpk']]
_df4['order'] = _df4['dias_da_semana'].map({'Segunda-feira':1, 'Terça-feira':2,␣
↪'Quarta-feira':3, 'Quinta-feira':4, 'Sexta-feira':5, 'Sábado':6, 'Domingo':
↪7})
_df4 = _df4.groupby(['dias_da_semana']).sum().reset_index()
_df4['order'] = _df4['dias_da_semana'].map({'Segunda-feira':1, 'Terça-feira':2,␣
↪'Quarta-feira':3, 'Quinta-feira':4, 'Sexta-feira':5, 'Sábado':6, 'Domingo':
↪7})
_df4 = _df4.sort_values(['order'])
```

```
_df4 = _df4.drop(columns='order')
_df4
```

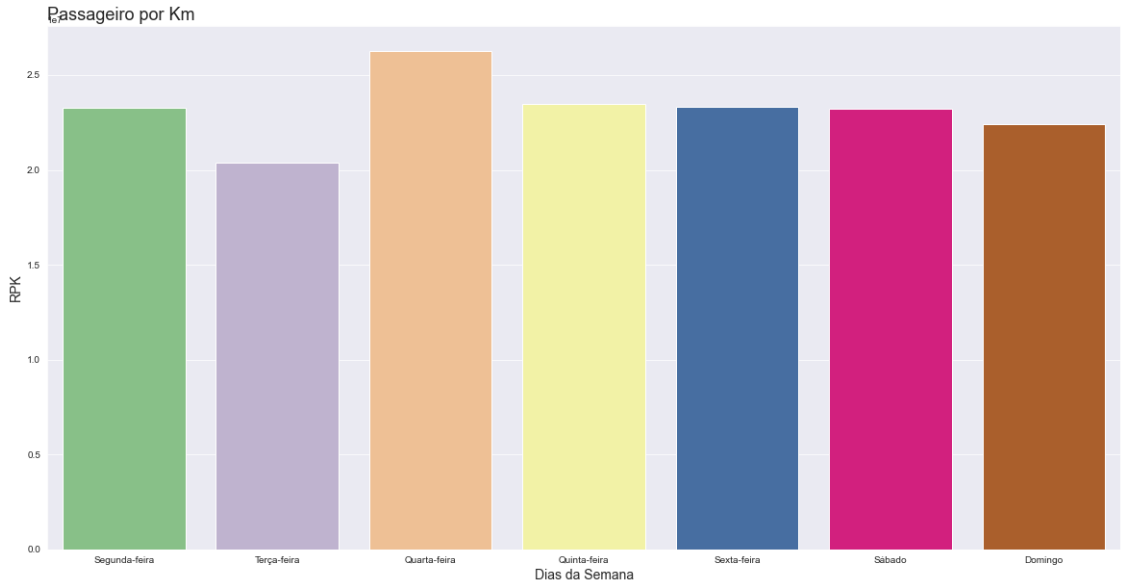
```
C:\Users\conta\AppData\Local\Temp/ipykernel_12276/3433924337.py:2:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  _df4['order'] = _df4['dias_da_semana'].map({'Segunda-feira':1, 'Terça-
feira':2, 'Quarta-feira':3, 'Quinta-feira':4, 'Sexta-feira':5, 'Sábado':6,
'Domingo':7})
```

[ ]:

	dias_da_semana	rpk
3	Segunda-feira	23275908
6	Terça-feira	20366840
1	Quarta-feira	26263705
2	Quinta-feira	23501102
4	Sexta-feira	23309936
5	Sábado	23201577
0	Domingo	22388695

[ ]:
```
sns.set_palette('Accent')
sns.set_style('darkgrid')
ax = sns.barplot(x = 'dias_da_semana', y = 'rpk', data = _df4)
ax.figure.set_size_inches(20, 10)
ax.set_title('Passageiro por Km', loc='left', fontsize=18)
ax.set_xlabel('Dias da Semana', fontsize=14)
ax.set_ylabel('RPK', fontsize=14)
# for i in ax.containers:
#     ax.bar_label(i)
```

[ ]:
```
Text(0, 0.5, 'RPK')
```



[ ]:
```
_data_prk_sab_dom = _df[(_df['dias_da_semana']=='Sábado') |␣
↪(_df['dias_da_semana']=='Domingo')]
_data_prk_sab_dom.head(5)
```

[ ]:

	data_venda	canal_de_venda	local_de_venda	pax	monetário_vendido	rpk	\
64	2016-11-05	TeleVenda	Mindscape	1378	60813.490656	164710	
65	2016-11-05	Telégrafo	Ellipsis	42	2695.438460	2399	
66	2016-11-05	TeleVenda	Arena	206	15726.530904	32153	
67	2016-11-05	Porta a Porta	Vast	1314	30005.759983	61962	
68	2016-11-05	Porta a Porta	Mindscape	877	34594.723120	98153	

	usd_rate	km	aceleracao_pax	aumento_pax	aceleracao_rpk	\
64	3.217581	119.528302	-307.0	-1191.0	-72156.0	
65	3.217581	57.119048	-1336.0	-1029.0	-162311.0	
66	3.217581	156.082524	164.0	1500.0	29754.0	
67	3.217581	47.155251	1108.0	944.0	29809.0	
68	3.217581	111.919042	-437.0	-1545.0	36191.0	

	aumento_rpk	aceleracao_km	aumento_km	data_venda_str	year	month	day	\
64	-264109.0	-21.044992	-105.547125	2016-11-05	2016	11	05	
65	-90155.0	-62.409254	-41.364262	2016-11-05	2016	11	05	
66	192065.0	98.963477	161.372731	2016-11-05	2016	11	05	
67	55.0	-108.927273	-207.890750	2016-11-05	2016	11	05	
68	6382.0	64.763791	173.691064	2016-11-05	2016	11	05	

	dias_da_semana
64	Sábado

```
65          Sábado
66          Sábado
67          Sábado
68          Sábado
```

```
[ ]: _quantidade_de_dias_fds = _data_prk_sab_dom.
     ↪groupby(['data_venda','dias_da_semana'])['dias_da_semana'].count()
     _quantidade_de_dias_fds.head(5)
```

```
[ ]: data_venda  dias_da_semana
     2016-11-05  Sábado            16
     2016-11-06  Domingo           16
     2016-11-12  Sábado            16
     2016-11-13  Domingo           16
     2016-11-19  Sábado            16
     Name: dias_da_semana, dtype: int64
```

```
[ ]: _data_prk_sab_dom.shape
```

```
[ ]: (688, 19)
```

```
[ ]: _data_prk_sab_dom['rpk'].describe()
```

```
[ ]: count       688.000000
     mean      66264.930233
     std       77345.549978
     min        1671.000000
     25%       12829.750000
     50%       31592.500000
     75%       95087.500000
     max      474353.000000
     Name: rpk, dtype: float64
```

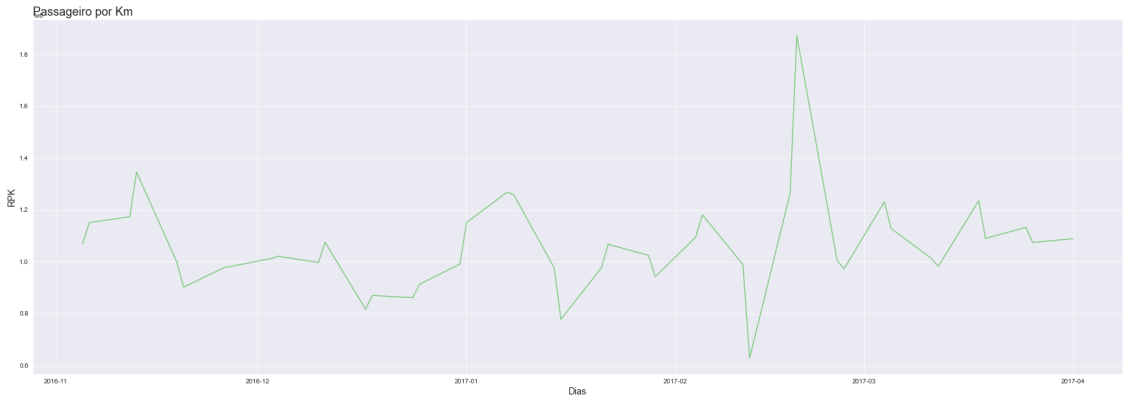
```
[ ]: _df3 = _data_prk_sab_dom.copy()
     _df3 = _df3[['data_venda', 'dias_da_semana', 'rpk']]
     _df3.head(5)
```

```
[ ]:    data_venda dias_da_semana     rpk
     64 2016-11-05         Sábado  164710
     65 2016-11-05         Sábado    2399
     66 2016-11-05         Sábado   32153
     67 2016-11-05         Sábado   61962
     68 2016-11-05         Sábado   98153
```

```
[ ]: _df3 = _df3.groupby(['data_venda']).sum()
     _df3.head(5)
```

[ ]:
```
                rpk
data_venda
2016-11-05  1069765
2016-11-06  1151471
2016-11-12  1173772
2016-11-13  1346138
2016-11-19   998433
```

[ ]:
```
sns.set_palette('Accent')
sns.set_style('darkgrid')
ax = sns.lineplot(x = 'data_venda', y = 'rpk', data = _df3)
ax.figure.set_size_inches(30, 10)
ax.set_title('Passageiro por Km', loc='left', fontsize=18)
ax.set_xlabel('Dias', fontsize=14)
ax.set_ylabel('RPK', fontsize=14)
ax = ax
```



[ ]:
```
total_rpk = _df2['rpk'].sum()
total_rpk
```

[ ]:
```
162307763
```

[ ]:
```
_data_prk_sab_dom = _data_prk_sab_dom['rpk'].sum()
_data_prk_sab_dom
```

[ ]:
```
45590272
```

[ ]:
```
_representativeness = round( ( ( _data_prk_sab_dom / total_rpk) ) * 100, 2)
print(f"O RPK de Sábado e Domingo representam {_representativeness}% de um␣
 ↪total de {total_rpk:,.2f} do RPK de todos os períodos ")
```

```
O RPK de Sábado e Domingo representam 28.09% de um total de 162,307,763.00 do
RPK de todos os períodos
```

[ ]:
```
_df.head(2)
```

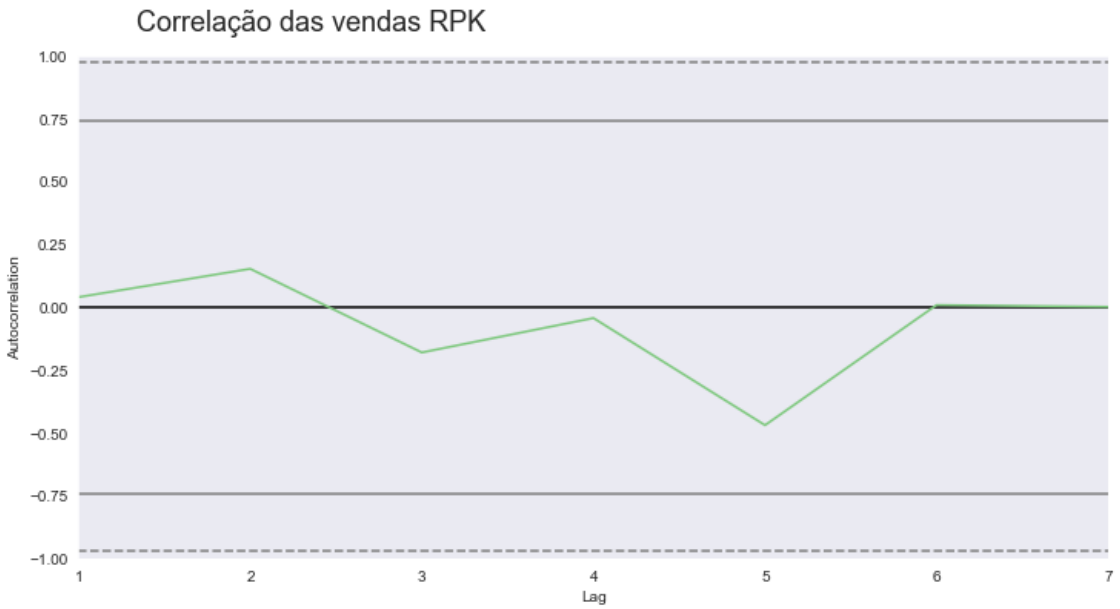
[ ]:
```
  data_venda canal_de_venda local_de_venda  pax  monetário_vendido   rpk  \
0 2016-11-01      Telégrafo      Mindscape   30        2188.109487  3476
1 2016-11-01      TeleVenda          Arena   52        3302.375951  8197

   usd_rate          km  aceleracao_pax  aumento_pax  aceleracao_rpk  \
0  3.217581  115.866667             0.0          0.0             0.0
1  3.217581  157.634615            22.0          0.0          4721.0

   aumento_rpk  aceleracao_km  aumento_km data_venda_str  year month day  \
0          0.0       0.000000         0.0     2016-11-01  2016    11  01
1          0.0      41.767949         0.0     2016-11-01  2016    11  01

  dias_da_semana
0    Terça-feira
1    Terça-feira
```

[ ]:
```
vendas_rpk_agrupadas = _df.
↪groupby('dias_da_semana')['rpk','aumento_rpk','aceleracao_rpk'].mean().
↪round()
vendas_rpk_agrupadas
```

```
C:\Users\conta\AppData\Local\Temp/ipykernel_12276/626739433.py:1: FutureWarning:
Indexing with multiple keys (implicitly converted to a tuple of keys) will be
deprecated, use a list instead.
  vendas_rpk_agrupadas = _df.groupby('dias_da_semana')['rpk','aumento_rpk','acel
eracao_rpk'].mean().round()
```

[ ]:
```
                    rpk  aumento_rpk  aceleracao_rpk
dias_da_semana
Domingo         66633.0      -1533.0          -640.0
Quarta-feira    74613.0       -460.0          -590.0
Quinta-feira    66764.0       -651.0          -453.0
Segunda-feira   69274.0      -1358.0           811.0
Sexta-feira     66221.0      -1123.0          -397.0
Sábado          65914.0       2365.0           840.0
Terça-feira     57860.0       2581.0           437.0
```

[ ]:
```
ax = plt.figure(figsize=(12,6))
ax.suptitle('Correlação das vendas RPK', fontsize=18, x=0.3, y=0.95)
autocorrelation_plot(vendas_rpk_agrupadas['rpk'])
ax = ax
```



3. Qual a média de 'Monetário' por mês por Canal? E a mediana?

[ ]:
```
_df_sum_channels = _df.groupby(['data_venda',␣
↪'canal_de_venda'])['monetário_vendido'].sum().reset_index()
_df_sum_channels = _df_sum_channels.sort_values(['monetário_vendido']).
↪reset_index(drop=True).rename(columns={'monetário_vendido':
↪'soma_monetário_vendido'})
_df_sum_channels
```

[ ]:

	data_venda	canal_de_venda	soma_monetário_vendido
0	2017-02-14	Telégrafo	7500.944465
1	2017-03-07	Telégrafo	9887.166630
2	2016-11-01	Telégrafo	10158.006555
3	2016-12-29	Telégrafo	10405.957828
4	2017-01-31	Telégrafo	10664.869419
..	…	…	…
451	2017-02-08	TeleVenda	349715.586496
452	2017-02-05	TeleVenda	358595.468696
453	2017-01-18	TeleVenda	365814.443628
454	2017-02-18	TeleVenda	374294.488479
455	2017-01-11	TeleVenda	433647.486098

[456 rows x 3 columns]

[ ]:
```
_df_mean_channels = _df.groupby(['data_venda',␣
↪'canal_de_venda'])['monetário_vendido'].mean().reset_index()
```

```
_df_mean_channels = _df_mean_channels.sort_values(['monetário_vendido']).
↪reset_index(drop=True).rename(columns={'monetário_vendido':
↪'media_monetário_vendido'})
_df_mean_channels
```

[ ]:

	data_venda	canal_de_venda	media_monetário_vendido
0	2017-02-14	Telégrafo	1875.236116
1	2017-03-07	Telégrafo	2471.791657
2	2016-11-01	Telégrafo	2539.501639
3	2016-12-29	Telégrafo	2601.489457
4	2017-01-31	Telégrafo	2666.217355
..	…	…	…
451	2017-02-07	Porta a Porta	57817.974229
452	2016-12-12	Porta a Porta	60264.692703
453	2016-11-15	Porta a Porta	61025.684473
454	2017-02-06	Porta a Porta	62582.661791
455	2016-11-14	Porta a Porta	82225.661478

[456 rows x 3 columns]

[ ]:
```
_df_median_channels = _df.groupby(['data_venda',␣
↪'canal_de_venda'])['monetário_vendido'].median().reset_index()
_df_median_channels = _df_median_channels.sort_values('monetário_vendido').
↪reset_index(drop=True).rename(columns={'monetário_vendido':
↪'mediana_monetário_vendido'})
_df_median_channels
```

[ ]:

	data_venda	canal_de_venda	mediana_monetário_vendido
0	2017-02-14	Telégrafo	1855.066440
1	2016-11-29	Telégrafo	1927.050453
2	2017-01-24	Telégrafo	1952.403237
3	2017-03-07	Telégrafo	2131.861597
4	2016-11-22	Telégrafo	2291.569788
..	…	…	…
451	2017-01-10	Porta a Porta	54620.850069
452	2017-02-07	Porta a Porta	54622.131114
453	2017-02-06	Porta a Porta	54958.440086
454	2016-11-15	Porta a Porta	56412.237777
455	2016-11-14	Porta a Porta	71461.353773

[456 rows x 3 columns]

[ ]:
```
_mediana  = _df_median_channels['mediana_monetário_vendido'].median()
_mediana
```

[ ]:
```
23402.420995328324
```

4. Crie um forecast de PAX por 'Local de Venda' para os próximos 15 dias a contar da última

data de venda. (Aqui a técnica é livre)

Fazendo média móvel de 7 e 21 dias de PAX.

[ ]:
```
_df.head()
```

[ ]:
```
  data_venda canal_de_venda local_de_venda  pax  monetário_vendido    rpk  \
0 2016-11-01      Telégrafo      Mindscape   30        2188.109487   3476
1 2016-11-01      TeleVenda          Arena   52        3302.375951   8197
2 2016-11-01      TeleVenda      Mindscape   19        1041.544400   2425
3 2016-11-01  Porta a Porta      Mindscape  496       15566.340547  53278
4 2016-11-01      TeleVenda           Vast   46        2721.427289   2039

   usd_rate          km  aceleracao_pax  aumento_pax  aceleracao_rpk  \
0  3.217581  115.866667             0.0          0.0             0.0
1  3.217581  157.634615            22.0          0.0          4721.0
2  3.217581  127.631579           -33.0        -55.0         -5772.0
3  3.217581  107.415323           477.0        510.0         50853.0
4  3.217581   44.326087          -450.0       -927.0        -51239.0

   aumento_rpk  aceleracao_km  aumento_km data_venda_str  year month day  \
0          0.0       0.000000    0.000000     2016-11-01  2016    11  01
1          0.0      41.767949    0.000000     2016-11-01  2016    11  01
2     -10493.0     -30.003036  -71.770985     2016-11-01  2016    11  01
3      56625.0     -20.216256    9.786780     2016-11-01  2016    11  01
4    -102092.0     -63.089236  -42.872979     2016-11-01  2016    11  01

  dias_da_semana
0    Terça-feira
1    Terça-feira
2    Terça-feira
3    Terça-feira
4    Terça-feira
```

[ ]:
```
_df['media_movel_7'] = _df['pax'].rolling(7).mean().fillna(0)
_df['media_movel_21'] = _df['pax'].rolling(21).mean().fillna(0)
```

[ ]:
```
_df.head(30)
```

[ ]:
```
   data_venda canal_de_venda local_de_venda   pax  monetário_vendido     rpk  \
0  2016-11-01      Telégrafo      Mindscape    30        2188.109487    3476
1  2016-11-01      TeleVenda          Arena    52        3302.375951    8197
2  2016-11-01      TeleVenda      Mindscape    19        1041.544400    2425
3  2016-11-01  Porta a Porta      Mindscape   496       15566.340547   53278
4  2016-11-01      TeleVenda           Vast    46        2721.427289    2039
5  2016-11-01      TeleVenda          Arena   485       19002.649824   66096
6  2016-11-01      TeleVenda           Vast   701       11588.271344   30866
7  2016-11-01      Telégrafo          Arena    39        3538.393295    5471
8  2016-11-01      TeleVenda       Ellipsis    44        2277.585505    2788
```

```
9  2016-11-01  Porta a Porta           Vast   910       14451.803370   40112
10 2016-11-01      Telégrafo       Ellipsis    18        1187.121138    1127
11 2016-11-01      TeleVenda      Mindscape   425       12875.537138   48274
12 2016-11-01  Porta a Porta       Ellipsis   383        9065.617291   20355
13 2016-11-01      Telégrafo           Vast    47        3244.382635    2055
14 2016-11-01      TeleVenda       Ellipsis   406        9846.590575   22846
15 2016-11-01  Porta a Porta          Arena   437       18994.865877   58074
16 2016-11-02      TeleVenda       Ellipsis  1007       29177.233024   54696
17 2016-11-02  Porta a Porta          Arena   900       42869.439284  119470
18 2016-11-02      TeleVenda      Mindscape  1029       39705.820891  122484
19 2016-11-02      TeleVenda          Arena   166       11210.853141   25105
20 2016-11-02  Porta a Porta           Vast  1451       28139.791984   63743
21 2016-11-02      Telégrafo           Vast    70        4766.677333    3312
22 2016-11-02  Porta a Porta       Ellipsis   757       20897.438732   41533
23 2016-11-02      Telégrafo       Ellipsis    65        4097.487588    3679
24 2016-11-02      TeleVenda          Arena  1397       60879.213113  194489
25 2016-11-02      Telégrafo      Mindscape    79        7312.083598   10169
26 2016-11-02      TeleVenda           Vast   178       10462.444496    8409
27 2016-11-02      Telégrafo          Arena   105        7222.100806   14970
28 2016-11-02      TeleVenda       Ellipsis   147        9058.084044    9326
29 2016-11-02  Porta a Porta      Mindscape   778       28082.068824   87943

    usd_rate          km  aceleracao_pax  aumento_pax  …  aumento_rpk  \
0   3.217581  115.866667             0.0          0.0  …          0.0
1   3.217581  157.634615            22.0          0.0  …          0.0
2   3.217581  127.631579           -33.0        -55.0  …     -10493.0
3   3.217581  107.415323           477.0        510.0  …      56625.0
4   3.217581   44.326087          -450.0       -927.0  …    -102092.0
5   3.217581  136.280412           439.0        889.0  …     115296.0
6   3.217581   44.031384           216.0       -223.0  …     -99287.0
7   3.217581  140.282051          -662.0       -878.0  …       9835.0
8   3.217581   63.363636             5.0        667.0  …      22712.0
9   3.217581   44.079121           866.0        861.0  …      40007.0
10  3.217581   62.611111          -892.0      -1758.0  …     -76309.0
11  3.217581  113.585882           407.0       1299.0  …      86132.0
12  3.217581   53.146214           -42.0       -449.0  …     -75066.0
13  3.217581   43.723404          -336.0       -294.0  …       9619.0
14  3.217581   56.270936           359.0        695.0  …      39091.0
15  3.217581  132.892449            31.0       -328.0  …      14437.0
16  3.217581   54.315789           570.0        539.0  …     -38606.0
17  3.217581  132.744444          -107.0       -677.0  …      68152.0
18  3.217581  119.032070           129.0        236.0  …     -61760.0
19  3.217581  151.234940          -863.0       -992.0  …    -100393.0
20  3.217581   43.930393          1285.0       2148.0  …     136017.0
21  3.217581   47.314286         -1381.0      -2666.0  …     -99069.0
22  3.217581   54.865258           687.0       2068.0  …      98652.0
23  3.217581   56.600000          -692.0      -1379.0  …     -76075.0
```

```
24  3.217581  139.219041          1332.0       2024.0  …     228664.0
25  3.217581  128.721519         -1318.0      -2650.0  …    -375130.0
26  3.217581   47.241573            99.0       1417.0  …     182560.0
27  3.217581  142.571429           -73.0       -172.0  …       8321.0
28  3.217581   63.442177            42.0        115.0  …     -12205.0
29  3.217581  113.037275           631.0        589.0  …      84261.0

    aceleracao_km  aumento_km  data_venda_str  year month day dias_da_semana  \
0        0.000000    0.000000      2016-11-01  2016    11  01    Terça-feira
1       41.767949    0.000000      2016-11-01  2016    11  01    Terça-feira
2      -30.003036  -71.770985      2016-11-01  2016    11  01    Terça-feira
3      -20.216256    9.786780      2016-11-01  2016    11  01    Terça-feira
4      -63.089236  -42.872979      2016-11-01  2016    11  01    Terça-feira
5       91.954325  155.043561      2016-11-01  2016    11  01    Terça-feira
6      -92.249029 -184.203354      2016-11-01  2016    11  01    Terça-feira
7       96.250668  188.499696      2016-11-01  2016    11  01    Terça-feira
8      -76.918415 -173.169082      2016-11-01  2016    11  01    Terça-feira
9      -19.284515   57.633899      2016-11-01  2016    11  01    Terça-feira
10      18.531990   37.816506      2016-11-01  2016    11  01    Terça-feira
11      50.974771   32.442781      2016-11-01  2016    11  01    Terça-feira
12     -60.439668 -111.414439      2016-11-01  2016    11  01    Terça-feira
13      -9.422810   51.016858      2016-11-01  2016    11  01    Terça-feira
14      12.547532   21.970342      2016-11-01  2016    11  01    Terça-feira
15      76.621513   64.073981      2016-11-01  2016    11  01    Terça-feira
16     -78.576659 -155.198172      2016-11-02  2016    11  02   Quarta-feira
17      78.428655  157.005314      2016-11-02  2016    11  02   Quarta-feira
18     -13.712374  -92.141029      2016-11-02  2016    11  02   Quarta-feira
19      32.202870   45.915244      2016-11-02  2016    11  02   Quarta-feira
20    -107.304547 -139.507417      2016-11-02  2016    11  02   Quarta-feira
21       3.383893  110.688440      2016-11-02  2016    11  02   Quarta-feira
22       7.550972    4.167079      2016-11-02  2016    11  02   Quarta-feira
23       1.734742   -5.816229      2016-11-02  2016    11  02   Quarta-feira
24      82.619041   80.884298      2016-11-02  2016    11  02   Quarta-feira
25     -10.497522  -93.116563      2016-11-02  2016    11  02   Quarta-feira
26     -81.479946  -70.982424      2016-11-02  2016    11  02   Quarta-feira
27      95.329856  176.809801      2016-11-02  2016    11  02   Quarta-feira
28     -79.129252 -174.459107      2016-11-02  2016    11  02   Quarta-feira
29      49.595098  128.724350      2016-11-02  2016    11  02   Quarta-feira

   media_movel_7  media_movel_21
0       0.000000        0.000000
1       0.000000        0.000000
2       0.000000        0.000000
3       0.000000        0.000000
4       0.000000        0.000000
5       0.000000        0.000000
6     261.285714        0.000000
```

```
7     262.571429        0.000000
8     261.428571        0.000000
9     388.714286        0.000000
10    320.428571        0.000000
11    374.571429        0.000000
12    360.000000        0.000000
13    266.571429        0.000000
14    319.000000        0.000000
15    375.142857        0.000000
16    389.000000        0.000000
17    515.000000        0.000000
18    601.285714        0.000000
19    570.285714        0.000000
20    770.857143      432.904762
21    722.857143      434.809524
22    768.571429      468.380952
23    634.000000      470.571429
24    705.000000      513.476190
25    569.285714      515.047619
26    571.000000      500.428571
27    378.714286      472.047619
28    389.714286      477.190476
29    392.714286      512.142857

[30 rows x 21 columns]
```

[ ]:
```
titulo = 'Comparando as PAX com as Médias móveis'
plot_comparacao(dataset=_df, x='data_venda', y1='pax', y2='media_movel_7',␣
↪y3='media_movel_21', titulo=titulo )
```

[ ]:
```
<AxesSubplot:xlabel='data_venda', ylabel='media_movel_21'>
```

[ ]:
```
_df['data_venda'].max()
```

[ ]:
```
Timestamp('2017-04-01 00:00:00')
```

[ ]:
```
_time_forecast = pd.Series(pd.date_range("2017-04-02", freq="D", periods=15))
_time_forecast
```

[ ]:
```
0    2017-04-02
1    2017-04-03
2    2017-04-04
3    2017-04-05
4    2017-04-06
5    2017-04-07
6    2017-04-08
7    2017-04-09
8    2017-04-10
9    2017-04-11
10   2017-04-12
11   2017-04-13
12   2017-04-14
13   2017-04-15
```

```
14   2017-04-16
dtype: datetime64[ns]
```

[ ]:
```
_forecast_moving_average = _df
```

[ ]:
```
_last_row = _forecast_moving_average.index[-1]
_last_row
```

[ ]:
```
2431
```

[ ]:
```
index_row = list(range(_last_row,(_last_row+16)))
```

[ ]:
```
values_rows = pd.Series(pd.date_range("2017-04-02", freq="D", periods=15)).
↪to_list()
```

[ ]:
```
for i, j in zip(index_row, values_rows):
    _forecast_moving_average.loc[i] = j
    # print(i, j)
```

[ ]:
```
_forecast_moving_average.iloc[2431:2446, 1:] = 0
```

[ ]:
```
_forecast_moving_average =␣
↪_forecast_moving_average[['data_venda','local_de_venda', 'pax']]
_forecast_moving_average
```

[ ]:
```
     data_venda local_de_venda  pax
0    2016-11-01      Mindscape   30
1    2016-11-01          Arena   52
2    2016-11-01      Mindscape   19
3    2016-11-01      Mindscape  496
4    2016-11-01           Vast   46
…           …              …  …
2441 2017-04-12              0    0
2442 2017-04-13              0    0
2443 2017-04-14              0    0
2444 2017-04-15              0    0
2445 2017-04-16              0    0

[2446 rows x 3 columns]
```

[ ]:
```
_forecast_moving_average = _forecast_moving_average.
↪groupby(['data_venda','local_de_venda'])['pax'].sum()
_forecast_moving_average = _forecast_moving_average.reset_index().
↪drop(columns='local_de_venda')
```

[ ]:
```
_forecast_moving_average
```

[ ]:
```
     data_venda   pax
0    2016-11-01  1013
1    2016-11-01   851
2    2016-11-01   970
3    2016-11-01  1704
4    2016-11-02  2568
..          …   …
618 2017-04-12     0
619 2017-04-13     0
620 2017-04-14     0
621 2017-04-15     0
622 2017-04-16     0

[623 rows x 2 columns]
```

[ ]:
```
_forecast_moving_average['media_movel_7'] = _forecast_moving_average['pax'].
↪rolling(7).mean().fillna(0)
_forecast_moving_average['media_movel_21'] = _forecast_moving_average['pax'].
↪rolling(21).mean().fillna(0)
```

[ ]:
```
_forecast_moving_average
```

[ ]:
```
     data_venda   pax  media_movel_7  media_movel_21
0    2016-11-01  1013            0.0        0.000000
1    2016-11-01   851            0.0        0.000000
2    2016-11-01   970            0.0        0.000000
3    2016-11-01  1704            0.0        0.000000
4    2016-11-02  2568            0.0        0.000000
..          …   …              …               …
618 2017-04-12     0            0.0     1434.380952
619 2017-04-13     0            0.0     1305.619048
620 2017-04-14     0            0.0     1131.047619
621 2017-04-15     0            0.0      976.285714
622 2017-04-16     0            0.0      852.857143

[623 rows x 4 columns]
```

[ ]:
```
titulo = 'Comparando as PAX com as Médias móveis'
plot_comparacao(dataset=_forecast_moving_average, x='data_venda', y1='pax',␣
↪y2='media_movel_7', y3='media_movel_21', titulo=titulo )
```

[ ]:
```
<AxesSubplot:xlabel='data_venda', ylabel='media_movel_21'>
```

Criando Primeira Regressão Linear

[ ]:
```
_forecast = _df.drop('usd_rate', axis=1)
_forecast.head(2)
```

[ ]:
```
  data_venda canal_de_venda local_de_venda pax monetário_vendido   rpk  \
0 2016-11-01      Telégrafo      Mindscape  30       2188.109487  3476
1 2016-11-01      TeleVenda          Arena  52       3302.375951  8197

           km aceleracao_pax aumento_pax aceleracao_rpk aumento_rpk  \
0  115.866667            0.0         0.0            0.0         0.0
1  157.634615           22.0         0.0         4721.0         0.0

  aceleracao_km aumento_km data_venda_str  year month day dias_da_semana  \
0           0.0        0.0     2016-11-01  2016    11  01    Terça-feira
1     41.767949        0.0     2016-11-01  2016    11  01    Terça-feira

  media_movel_7 media_movel_21
0           0.0            0.0
1           0.0            0.0
```

[ ]:
```
convert_dict = {
                'data_venda':str, 'canal_de_venda':str, 'local_de_venda':str,␣
↪'pax':float,
                'monetário_vendido':float, 'rpk':float, 'km':float,␣
↪'aceleracao_pax':float, 'aumento_pax':float,
                'aceleracao_rpk':float, 'aumento_rpk':float, 'aceleracao_km':
↪float, 'aumento_km':float,
                'dias_da_semana':str,'media_movel_7':float, 'media_movel_21':
↪float
              }

_forecast = _forecast.astype(convert_dict)
```

[ ]:
```
_forecast.dtypes
```

[ ]:
```
data_venda            object
canal_de_venda        object
local_de_venda        object
pax                  float64
monetário_vendido    float64
rpk                  float64
km                   float64
aceleracao_pax       float64
aumento_pax          float64
aceleracao_rpk       float64
aumento_rpk          float64
aceleracao_km        float64
aumento_km           float64
data_venda_str        object
year                  object
month                 object
day                   object
dias_da_semana        object
media_movel_7        float64
media_movel_21       float64
dtype: object
```

[ ]:
```
_forecast.columns
```

[ ]:
```
Index(['data_venda', 'canal_de_venda', 'local_de_venda', 'pax',
       'monetário_vendido', 'rpk', 'km', 'aceleracao_pax', 'aumento_pax',
       'aceleracao_rpk', 'aumento_rpk', 'aceleracao_km', 'aumento_km',
       'data_venda_str', 'year', 'month', 'day', 'dias_da_semana',
       'media_movel_7', 'media_movel_21'],
      dtype='object')
```

[ ]:
```
_forecast = _forecast.groupby(['data_venda', 'monetário_vendido', 'rpk', 'km',␣
↪'local_de_venda'])['pax'].sum()
_forecast = _forecast.reset_index()
_forecast['data_venda'] = _forecast['data_venda'].astype(str)
_forecast.head(2)
```

[ ]:

	data_venda	monetário_vendido	rpk	km	local_de_venda	pax
0	2016-11-01	1041.544400	2425.0	127.631579	Mindscape	19.0
1	2016-11-01	1187.121138	1127.0	62.611111	Ellipsis	18.0

[ ]:
```
_forecast.shape
```

[ ]:
```
(2446, 6)
```

[ ]:
```
_forecast.columns
```

[ ]:
```
Index(['data_venda', 'monetário_vendido', 'rpk', 'km', 'local_de_venda',
       'pax'],
      dtype='object')
```

[ ]:
```
x = _forecast.drop(columns=['pax'])
y = _forecast['pax']
```

[ ]:
```
_forecast.dtypes
```

[ ]:
```
data_venda            object
monetário_vendido    float64
rpk                  float64
km                   float64
local_de_venda        object
pax                  float64
dtype: object
```

[ ]:
```
x = _forecast.drop(columns=['pax','data_venda','local_de_venda'])
y = _forecast['pax']
```

[ ]:
```
x_train, x_val, y_train, y_val = train_test_split(x,y, test_size=0.3,␣
↪random_state=0)
modelo = DecisionTreeRegressor(random_state=24)
modelo.fit(x_train, y_train)
prediction = modelo.predict(x_val)
print(f"Predictions  {prediction[:5]}")
print(f"Target       {y[:5].values}")
print(f"Error        {y[:5].values - prediction[:5]}")
print(f"MAE        {abs(y[:5].values - prediction[:5])}")
```

```
Predictions  [217. 946. 307. 883. 996.]
Target       [19. 18. 30. 44. 46.]
```

```
Error        [-198. -928. -277. -839. -950.]
MAE        [198. 928. 277. 839. 950.]
```

[ ]:
```python
x_train, x_val, y_train, y_val = train_test_split(x,y, test_size=0.3,␣
 ↪random_state=0)
print(x_train.shape, x_val.shape, y_train.shape, y_val.shape)

# Normalizando os dados
scaler = StandardScaler()
x_train_scaled = scaler.fit_transform(x_train)
x_val_scaled = scaler.transform(x_val)

modelo = LinearRegression(fit_intercept=False , normalize=False)
modelo.fit(x_train_scaled, y_train)
prediction = modelo.predict(x_val_scaled)
mse = np.sqrt(mean_squared_error(y_val, p))
cof = modelo.coef_

print(f"Predictions  {prediction[:5]}")
print(f"Predictions len  {len(prediction)}")
print(f"Coeficient  {cof}")
print(f"Target       {y[:5].values}")
print(f"Error        {y[:5].values - prediction[:5]}")
print(f"MAE        {abs(y[:5].values - prediction[:5])}")
```

```
(1712, 3) (734, 3) (1712,) (734,)
```

```
C:\Users\conta\AppData\Local\Programs\Python\Python39\lib\site-
packages\sklearn\linear_model\_base.py:148: FutureWarning: 'normalize' was
deprecated in version 1.0 and will be removed in 1.2. Please leave the normalize
parameter to its default value to silence this warning. The default behavior of
this estimator is to not do any normalization. If normalization is needed please
use sklearn.preprocessing.StandardScaler instead.
  warnings.warn(
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
~\AppData\Local\Temp/ipykernel_12276/4131988690.py in <module>
     10 modelo.fit(x_train_scaled, y_train)
     11 prediction = modelo.predict(x_val_scaled)
---> 12 mse = np.sqrt(mean_squared_error(y_val, p))
     13 cof = modelo.coef_
     14

NameError: name 'p' is not defined
```

5. Supondo que você precisa gerar um estudo para a área responsável, com base em qualquer modelo ou premissa, qual 'Local de Venda' você considera mais crítico. Por quê?

[ ]:
```
_df.head(5)
```

[ ]:
```
  data_venda canal_de_venda local_de_venda  pax monetário_vendido    rpk  \
0 2016-11-01      Telégrafo      Mindscape   30       2188.109487   3476
1 2016-11-01      TeleVenda          Arena   52       3302.375951   8197
2 2016-11-01      TeleVenda      Mindscape   19         1041.5444   2425
3 2016-11-01  Porta a Porta      Mindscape  496      15566.340547  53278
4 2016-11-01      TeleVenda           Vast   46       2721.427289   2039

   usd_rate          km aceleracao_pax aumento_pax  … aumento_rpk  \
0  3.217581  115.866667            0.0         0.0  …         0.0
1  3.217581  157.634615           22.0         0.0  …         0.0
2  3.217581  127.631579          -33.0       -55.0  …    -10493.0
3  3.217581  107.415323          477.0       510.0  …     56625.0
4  3.217581   44.326087         -450.0      -927.0  …   -102092.0

  aceleracao_km aumento_km data_venda_str  year month day dias_da_semana  \
0           0.0        0.0     2016-11-01  2016    11  01    Terça-feira
1     41.767949        0.0     2016-11-01  2016    11  01    Terça-feira
2    -30.003036 -71.770985     2016-11-01  2016    11  01    Terça-feira
3    -20.216256    9.78678     2016-11-01  2016    11  01    Terça-feira
4    -63.089236 -42.872979     2016-11-01  2016    11  01    Terça-feira

  media_movel_7 media_movel_21
0           0.0            0.0
1           0.0            0.0
2           0.0            0.0
3           0.0            0.0
4           0.0            0.0

[5 rows x 21 columns]
```

[ ]:
```
_analise_pv = _df[['data_venda', 'local_de_venda', 'pax', 'rpk',␣
↪'monetário_vendido']]
_analise_pv
```

[ ]:
```
     data_venda local_de_venda  pax    rpk monetário_vendido
0    2016-11-01      Mindscape   30   3476       2188.109487
1    2016-11-01          Arena   52   8197       3302.375951
2    2016-11-01      Mindscape   19   2425         1041.5444
3    2016-11-01      Mindscape  496  53278      15566.340547
4    2016-11-01           Vast   46   2039       2721.427289
…           …              …  …    …                …
2441 2017-04-12              0    0      0                0
2442 2017-04-13              0    0      0                0
2443 2017-04-14              0    0      0                0
2444 2017-04-15              0    0      0                0
```

```
2445 2017-04-16              0    0      0                  0

[2446 rows x 5 columns]
```

```
[ ]: _analise_pv.groupby([ 'local_de_venda'])['monetário_vendido'].sum()
```

```
[ ]: local_de_venda
     0                          0
     Arena         19208088.389657
     Ellipsis      11215405.080307
     Mindscape     14739708.149936
     Vast          14755303.289166
     Name: monetário_vendido, dtype: object
```

```
[ ]: _analise_pv.groupby([ 'local_de_venda'])['pax'].sum()
```

```
[ ]: local_de_venda
     0                 0
     Arena        474388
     Ellipsis     373971
     Mindscape    399322
     Vast         510601
     Name: pax, dtype: object
```

```
[ ]: _analise_pv.groupby([ 'local_de_venda'])['rpk'].sum()
```

```
[ ]: local_de_venda
     0                   0
     Arena        69162961
     Ellipsis     20974154
     Mindscape    47899376
     Vast         24268222
     Name: rpk, dtype: object
```

R: O local de vendas mais crítico seria Ellipsis poris tem os menores números de pax, rpk e valor monetário.

6. Criar modelo relacionando o comporatamento de venda com variaveis não apresentada nos dados (Ex : PIB, Dolar, e etc)

```
[ ]: _forecast_com_exo = _df.copy()
     _forecast_com_exo.head(2)
```

```
[ ]:   data_venda canal_de_venda local_de_venda pax monetário_vendido   rpk  \
     0 2016-11-01      Telégrafo      Mindscape  30       2188.109487  3476
     1 2016-11-01      TeleVenda          Arena  52       3302.375951  8197

        usd_rate          km aceleracao_pax aumento_pax  … aumento_rpk  \
     0  3.217581  115.866667            0.0         0.0  …         0.0
```

```
1  3.217581  157.634615           22.0         0.0  …         0.0

  aceleracao_km aumento_km data_venda_str  year month day dias_da_semana  \
0           0.0        0.0     2016-11-01  2016    11  01    Terça-feira
1     41.767949        0.0     2016-11-01  2016    11  01    Terça-feira

  media_movel_7 media_movel_21
0           0.0            0.0
1           0.0            0.0

[2 rows x 21 columns]
```

[ ]:
```
convert_dict = {
                'data_venda':str, 'canal_de_venda':str, 'local_de_venda':str,␣
↪'pax':float, 'usd_rate':float,
                'monetário_vendido':float, 'rpk':float, 'km':float,␣
↪'aceleracao_pax':float, 'aumento_pax':float,
                'aceleracao_rpk':float, 'aumento_rpk':float, 'aceleracao_km':
↪float, 'aumento_km':float,
                'dias_da_semana':str,'media_movel_7':float, 'media_movel_21':
↪float
               }

_forecast_com_exo = _forecast_com_exo.astype(convert_dict)
```

[ ]:
```
_forecast_com_exo.dtypes
```

[ ]:
```
data_venda            object
canal_de_venda        object
local_de_venda        object
pax                  float64
monetário_vendido    float64
rpk                  float64
usd_rate             float64
km                   float64
aceleracao_pax       float64
aumento_pax          float64
aceleracao_rpk       float64
aumento_rpk          float64
aceleracao_km        float64
aumento_km           float64
data_venda_str        object
year                  object
month                 object
day                   object
dias_da_semana        object
media_movel_7        float64
```

```
media_movel_21       float64
dtype: object
```

[ ]:
```
_forecast_com_exo.columns
```

[ ]:
```
Index(['data_venda', 'canal_de_venda', 'local_de_venda', 'pax',
       'monetário_vendido', 'rpk', 'usd_rate', 'km', 'aceleracao_pax',
       'aumento_pax', 'aceleracao_rpk', 'aumento_rpk', 'aceleracao_km',
       'aumento_km', 'data_venda_str', 'year', 'month', 'day',
       'dias_da_semana', 'media_movel_7', 'media_movel_21'],
      dtype='object')
```

[ ]:
```
_forecast_com_exo = _forecast_com_exo[[ 'pax','monetário_vendido', 'rpk',␣
↪'usd_rate', 'km']]
_forecast_com_exo.head(2), _forecast_com_exo.dtypes
```

[ ]:
```
(    pax  monetário_vendido     rpk  usd_rate          km
 0  30.0        2188.109487  3476.0  3.217581  115.866667
 1  52.0        3302.375951  8197.0  3.217581  157.634615,
 pax                 float64
 monetário_vendido   float64
 rpk                 float64
 usd_rate            float64
 km                  float64
 dtype: object)
```

[ ]:
```
x = _forecast_com_exo
y = _forecast_com_exo['pax']
```

[ ]:
```
x_train, x_val, y_train, y_val = train_test_split(x,y, test_size=0.3,␣
↪random_state=0)
print(x_train.shape, x_val.shape, y_train.shape, y_val.shape)

# Normalizando os dados
scaler = StandardScaler()
x_train_scaled = scaler.fit_transform(x_train)
x_val_scaled = scaler.transform(x_val)

modelo = LinearRegression(fit_intercept=False , normalize=False)
modelo.fit(x_train_scaled, y_train)
prediction = modelo.predict(x_val_scaled)
mse = np.sqrt(mean_squared_error(y_val, p))
cof = modelo.coef_

print(f"Predictions  {prediction[:5]}")
print(f"Predictions len  {len(prediction)}")
print(f"Coeficient  {cof}")
```

```
print(f"Target       {y[:5].values}")
print(f"Error        {y[:5].values - prediction[:5]}")
print(f"MAE        {abs(y[:5].values - prediction[:5])}")
```

```
(1712, 5) (734, 5) (1712,) (734,)
Predictions  [653.47897196 -19.52102804 518.47897196 233.47897196 719.47897196]
Predictions len  734
Coeficient  [ 7.46019674e+02 -2.09780999e-13 -1.16196261e-12 -2.39341569e-12
  9.45674240e-13]
Target       [ 30.  52.  19. 496.  46.]
Error        [-623.47897196   71.52102804 -499.47897196  262.52102804
-673.47897196]
MAE        [623.47897196  71.52102804 499.47897196 262.52102804 673.47897196]

C:\Users\conta\AppData\Local\Programs\Python\Python39\lib\site-
packages\sklearn\linear_model\_base.py:148: FutureWarning: 'normalize' was
deprecated in version 1.0 and will be removed in 1.2. Please leave the normalize
parameter to its default value to silence this warning. The default behavior of
this estimator is to not do any normalization. If normalization is needed please
use sklearn.preprocessing.StandardScaler instead.
  warnings.warn(
```