m03_v01_store_sales_prediction

September 12, 2021

1 0.0. IMPORTS

[1]:
```
import math
import numpy  as np
import pandas as pd
import inflection

import seaborn as sns

from matplotlib import pyplot as plt
from IPython.core.display import HTML
from IPython.display import Image
```

1.1 0.1. Helper Functions

[2]:
```
def jupyter_settings():
    %matplotlib inline
    %pylab inline

    plt.style.use( 'bmh' )
    plt.rcParams['figure.figsize'] = [25, 12]
    plt.rcParams['font.size'] = 24

    display( HTML( '<style>.container { width:100% !important; }</style>') )
    pd.options.display.max_columns = None
    pd.options.display.max_rows = None
    pd.set_option( 'display.expand_frame_repr', False )

    sns.set()
```

[3]:
```
jupyter_settings()
```

```
Populating the interactive namespace from numpy and matplotlib
```

```
<IPython.core.display.HTML object>
```

1.2 0.2. Loading data

[4]:
```
df_sales_raw = pd.read_csv( '../data/train.csv', low_memory=False )
df_store_raw = pd.read_csv( '../data/store.csv', low_memory=False )

# merge
df_raw = pd.merge( df_sales_raw, df_store_raw, how='left', on='Store' )
```

2 1.0. PASSO 01 - DESCRICAO DOS DADOS

[5]:
```
df1 = df_raw.copy()
```

2.1 1.1. Rename Columns

[6]:
```
cols_old = ['Store', 'DayOfWeek', 'Date', 'Sales', 'Customers', 'Open',␣
 ↪'Promo', 'StateHoliday', 'SchoolHoliday',
            'StoreType', 'Assortment', 'CompetitionDistance',␣
 ↪'CompetitionOpenSinceMonth',
            'CompetitionOpenSinceYear', 'Promo2', 'Promo2SinceWeek',␣
 ↪'Promo2SinceYear', 'PromoInterval']

snakecase = lambda x: inflection.underscore( x )

cols_new = list( map( snakecase, cols_old ) )

# rename
df1.columns = cols_new
```

2.2 1.2. Data Dimensions

[7]:
```
print( 'Number of Rows: {}'.format( df1.shape[0] ) )
print( 'Number of Cols: {}'.format( df1.shape[1] ) )
```

```
Number of Rows: 1017209
Number of Cols: 18
```

2.3 1.3. Data Types

[8]:
```
df1['date'] = pd.to_datetime( df1['date'] )
df1.dtypes
```

[8]:
```
store                    int64
day_of_week              int64
date            datetime64[ns]
sales                    int64
customers                int64
open                     int64
```

```
promo                                  int64
state_holiday                         object
school_holiday                         int64
store_type                            object
assortment                            object
competition_distance                 float64
competition_open_since_month         float64
competition_open_since_year          float64
promo2                                 int64
promo2_since_week                    float64
promo2_since_year                    float64
promo_interval                        object
dtype: object
```

2.4 1.4. Check NA

[9]:
```
df1.isna().sum()
```

[9]:
```
store                             0
day_of_week                       0
date                              0
sales                             0
customers                         0
open                              0
promo                             0
state_holiday                     0
school_holiday                    0
store_type                        0
assortment                        0
competition_distance           2642
competition_open_since_month  323348
competition_open_since_year   323348
promo2                            0
promo2_since_week             508031
promo2_since_year             508031
promo_interval                508031
dtype: int64
```

2.5 1.5. Fillout NA

[10]:
```
df1.sample()
```

[10]:
```
        store  day_of_week       date  sales  customers  open  promo
state_holiday  school_holiday store_type assortment  competition_distance
competition_open_since_month  competition_open_since_year  promo2
promo2_since_week  promo2_since_year    promo_interval
575825    156             5 2014-01-31   6454        714     1      0
```

```
0                0          a          a                2020.0
2.0                         2011.0      1               14.0              2011.0
Mar,Jun,Sept,Dec
```

[11]:
```
#competition_distance
df1['competition_distance'] = df1['competition_distance'].apply( lambda x:␣
↪200000.0 if math.isnan( x ) else x )

#competition_open_since_month
df1['competition_open_since_month'] = df1.apply( lambda x: x['date'].month if␣
↪math.isnan( x['competition_open_since_month'] ) else␣
↪x['competition_open_since_month'], axis=1 )

#competition_open_since_year
df1['competition_open_since_year'] = df1.apply( lambda x: x['date'].year if␣
↪math.isnan( x['competition_open_since_year'] ) else␣
↪x['competition_open_since_year'], axis=1 )

#promo2_since_week
df1['promo2_since_week'] = df1.apply( lambda x: x['date'].week if math.isnan(␣
↪x['promo2_since_week'] ) else x['promo2_since_week'], axis=1 )

#promo2_since_year
df1['promo2_since_year'] = df1.apply( lambda x: x['date'].year if math.isnan(␣
↪x['promo2_since_year'] ) else x['promo2_since_year'], axis=1 )

#promo_interval
month_map = {1: 'Jan',  2: 'Fev',  3: 'Mar',  4: 'Apr',  5: 'May',  6: 'Jun', ␣
↪7: 'Jul',  8: 'Aug',  9: 'Sep',  10: 'Oct', 11: 'Nov', 12: 'Dec'}

df1['promo_interval'].fillna(0, inplace=True )

df1['month_map'] = df1['date'].dt.month.map( month_map )

df1['is_promo'] = df1[['promo_interval', 'month_map']].apply( lambda x: 0 if␣
↪x['promo_interval'] == 0 else 1 if x['month_map'] in x['promo_interval'].
↪split( ',' ) else 0, axis=1 )
```

[12]:
```
df1.isna().sum()
```

[12]:
```
store                         0
day_of_week                   0
date                          0
sales                         0
customers                     0
open                          0
promo                         0
```

```
state_holiday                   0
school_holiday                  0
store_type                      0
assortment                      0
competition_distance            0
competition_open_since_month    0
competition_open_since_year     0
promo2                          0
promo2_since_week               0
promo2_since_year               0
promo_interval                  0
month_map                       0
is_promo                        0
dtype: int64
```

2.6 1.6. Change Data Types

[13]:
```
# competiton
df1['competition_open_since_month'] = df1['competition_open_since_month'].
 ↪astype( int )
df1['competition_open_since_year'] = df1['competition_open_since_year'].astype(␣
 ↪int )

# promo2
df1['promo2_since_week'] = df1['promo2_since_week'].astype( int )
df1['promo2_since_year'] = df1['promo2_since_year'].astype( int )
```

2.7 1.7. Descriptive Statistics

[14]:
```
num_attributes = df1.select_dtypes( include=['int64', 'float64'] )
cat_attributes = df1.select_dtypes( exclude=['int64', 'float64',␣
 ↪'datetime64[ns]'] )
```

2.7.1 1.7.1. Numerical Atributes

[15]:
```
# Central Tendency - mean, meadina
ct1 = pd.DataFrame( num_attributes.apply( np.mean ) ).T
ct2 = pd.DataFrame( num_attributes.apply( np.median ) ).T

# dispersion - std, min, max, range, skew, kurtosis
d1 = pd.DataFrame( num_attributes.apply( np.std ) ).T
d2 = pd.DataFrame( num_attributes.apply( min ) ).T
d3 = pd.DataFrame( num_attributes.apply( max ) ).T
d4 = pd.DataFrame( num_attributes.apply( lambda x: x.max() - x.min() ) ).T
d5 = pd.DataFrame( num_attributes.apply( lambda x: x.skew() ) ).T
d6 = pd.DataFrame( num_attributes.apply( lambda x: x.kurtosis() ) ).T
```

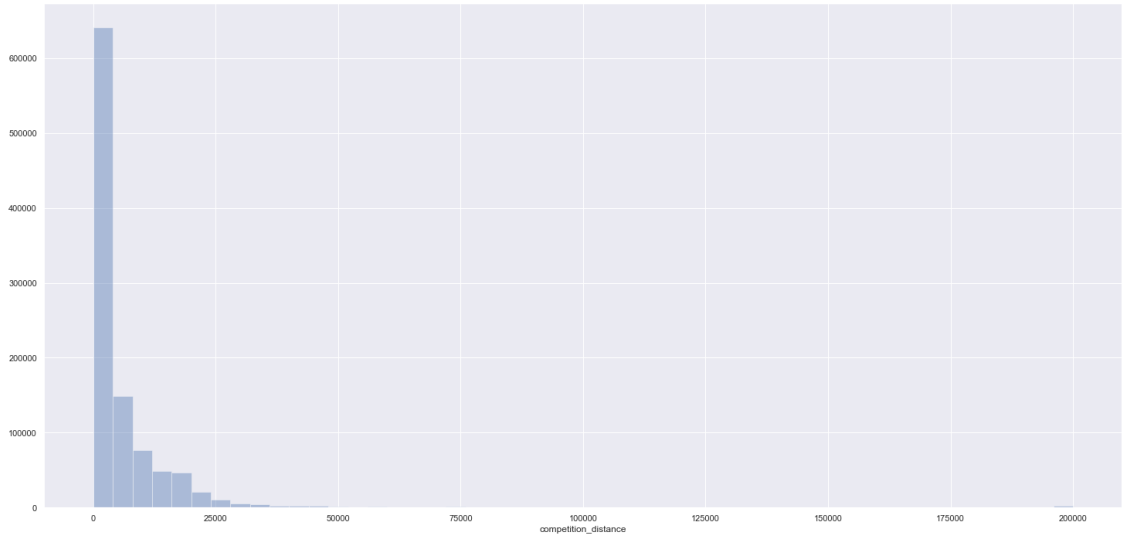
```
# concatenar
m = pd.concat( [d2, d3, d4, ct1, ct2, d1, d5, d6] ).T.reset_index()
m.columns = ['attributes', 'min', 'max', 'range', 'mean', 'median', 'std',␣
 ↪'skew', 'kurtosis']
m
```

[15]:

	attributes	min	max	range	mean	median	std	skew	kurtosis
0	store	1.0	1115.0	1114.0	558.429727	558.0	321.908493	-0.000955	-1.200524
1	day_of_week	1.0	7.0	6.0	3.998341	4.0	1.997390	0.001593	-1.246873
2	sales	0.0	41551.0	41551.0	5773.818972	5744.0	3849.924283	0.641460	1.778375
3	customers	0.0	7388.0	7388.0	633.145946	609.0	464.411506	1.598650	7.091773
4	open	0.0	1.0	1.0	0.830107	1.0	0.375539	-1.758045	1.090723
5	promo	0.0	1.0	1.0	0.381515	0.0	0.485758	0.487838	-1.762018
6	school_holiday	0.0	1.0	1.0	0.178647	0.0	0.383056	1.677842	0.815154
7	competition_distance	20.0	200000.0	199980.0	5935.442677	2330.0	12547.646829	10.242344	147.789712
8	competition_open_since_month	1.0	12.0	11.0	6.786849	7.0	3.311085	-0.042076	-1.232607
9	competition_open_since_year	1900.0	2015.0	115.0	2010.324840	2012.0	5.515591	-7.235657	124.071304
10	promo2	0.0	1.0	1.0	0.500564	1.0	0.500000	-0.002255	-1.999999
11	promo2_since_week	1.0	52.0	51.0	23.619033	22.0	14.310057	0.178723	-1.184046
12	promo2_since_year	2009.0	2015.0	6.0	2012.793297	2013.0	1.662657	-0.784436	-0.210075
13	is_promo	0.0	1.0	1.0	0.155231	0.0	0.362124	1.904152	1.625796

[16]:
```
sns.distplot( df1['competition_distance'], kde=False )
```

[16]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x162de2370>
```



2.7.2 1.7.2. Categorical Atributes

[17]:
```
cat_attributes.apply( lambda x: x.unique().shape[0] )
```

[17]:
```
state_holiday      4
store_type         4
assortment         3
promo_interval     4
month_map         12
dtype: int64
```

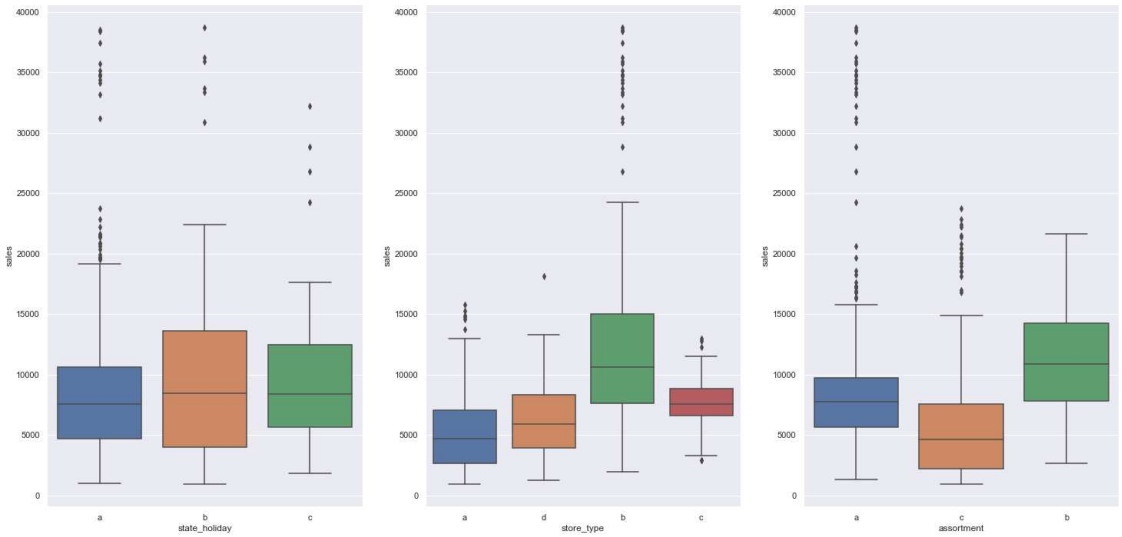
[18]:
```
aux = df1[(df1['state_holiday'] != '0') & (df1['sales'] > 0)]

plt.subplot( 1, 3, 1 )
sns.boxplot( x='state_holiday', y='sales', data=aux )

plt.subplot( 1, 3, 2 )
sns.boxplot( x='store_type', y='sales', data=aux )

plt.subplot( 1, 3, 3 )
sns.boxplot( x='assortment', y='sales', data=aux )
```

[18]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x106f06dc0>
```



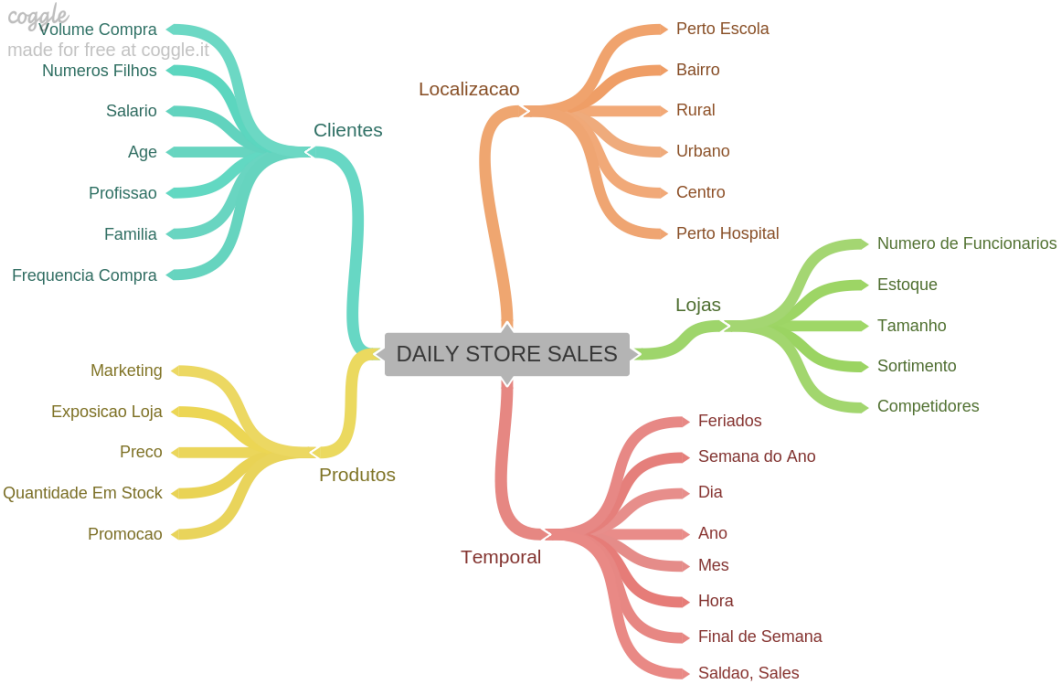
3 2.0. PASSO 02 - FEATURE ENGINEERING

[19]:
```
df2 = df1.copy()
```

3.1 2.1. Mapa Mental de Hipoteses

[20]:
```
Image( 'img/MindMapHypothesis.png' )
```

[20]:



3.2 2.2. Criacao das Hipoteses

3.2.1 2.2.1. Hipoteses Loja

1. Lojas com número maior de funcionários deveriam vender mais.

2. Lojas com maior capacidade de estoque deveriam vender mais.

3. Lojas com maior porte deveriam vender mais.

4. Lojas com maior sortimentos deveriam vender mais.

5. Lojas com competidores mais próximos deveriam vender menos.

6. Lojas com competidores à mais tempo deveriam vendem mais.

3.2.2 2.2.2. Hipoteses Produto

1. Lojas que investem mais em Marketing deveriam vender mais.

2. Lojas com maior exposição de produto deveriam vender mais.

3. Lojas com produtos com preço menor deveriam vender mais.

5. Lojas com promoções mais agressivas (descontos maiores), deveriam vender mais.

6. Lojas com promoções ativas por mais tempo deveriam vender mais.

7. Lojas com mais dias de promoção deveriam vender mais.

8. Lojas com mais promoções consecutivas deveriam vender mais.

3.2.3 2.2.3. Hipoteses Tempo

1. Lojas abertas durante o feriado de Natal deveriam vender mais.

2. Lojas deveriam vender mais ao longo dos anos.

3. Lojas deveriam vender mais no segundo semestre do ano.

4. Lojas deveriam vender mais depois do dia 10 de cada mês.

5. Lojas deveriam vender menos aos finais de semana.

6. Lojas deveriam vender menos durante os feriados escolares.

3.3 2.3. Lista Final de Hipóteses

1. Lojas com maior sortimentos deveriam vender mais.

2. Lojas com competidores mais próximos deveriam vender menos.

3. Lojas com competidores à mais tempo deveriam vendem mais.

4. Lojas com promoções ativas por mais tempo deveriam vender mais.

5. Lojas com mais dias de promoção deveriam vender mais.

7. Lojas com mais promoções consecutivas deveriam vender mais.

8. Lojas abertas durante o feriado de Natal deveriam vender mais.

9. Lojas deveriam vender mais ao longo dos anos.

10. Lojas deveriam vender mais no segundo semestre do ano.

11. Lojas deveriam vender mais depois do dia 10 de cada mês.

12. Lojas deveriam vender menos aos finais de semana.

13. Lojas deveriam vender menos durante os feriados escolares.

3.4 2.4. Feature Engineering

[21]:
```
# year
df2['year'] = df2['date'].dt.year

# month
df2['month'] = df2['date'].dt.month

# day
df2['day'] = df2['date'].dt.day

# week of year
df2['week_of_year'] = df2['date'].dt.weekofyear

# year week
df2['year_week'] = df2['date'].dt.strftime( '%Y-%W' )

# competition since
df2['competition_since'] = df2.apply( lambda x: datetime.datetime(␣
 ↪year=x['competition_open_since_year'],␣
 ↪month=x['competition_open_since_month'],day=1 ), axis=1 )
df2['competition_time_month'] = ( ( df2['date'] - df2['competition_since'] )/30␣
 ↪).apply( lambda x: x.days ).astype( int )

# promo since
df2['promo_since'] = df2['promo2_since_year'].astype( str ) + '-' +␣
 ↪df2['promo2_since_week'].astype( str )
df2['promo_since'] = df2['promo_since'].apply( lambda x: datetime.datetime.
 ↪strptime( x + '-1', '%Y-%W-%w' ) - datetime.timedelta( days=7 ) )
df2['promo_time_week'] = ( ( df2['date'] - df2['promo_since'] )/7 ).apply(␣
 ↪lambda x: x.days ).astype( int )

# assortment
```

```
df2['assortment'] = df2['assortment'].apply( lambda x: 'basic' if x == 'a' else␣
 ↪'extra' if x == 'b' else 'extended' )

# state holiday
df2['state_holiday'] = df2['state_holiday'].apply( lambda x: 'public_holiday'␣
 ↪if x == 'a' else 'easter_holiday' if x == 'b' else 'christmas' if x == 'c'␣
 ↪else 'regular_day' )
```

4 3.0. PASSO 03 - FILTRAGEM DE VARIÁVEIS

[22]:
```
df3 = df2.copy()
```

4.1 3.1. Filtragem das Linhas

[23]:
```
df3 = df3[(df3['open'] != 0) & (df3['sales'] > 0)]
```

4.2 3.2. Selecao das Colunas

[24]:
```
cols_drop = ['customers', 'open', 'promo_interval', 'month_map']
df3 = df3.drop( cols_drop, axis=1 )
```