DA_C3

November 3, 2020

[1]:
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn import metrics

# import lightgbm as lgb

pd.set_option('display.max_columns',15)
pd.set_option('display.max_rows', 500)
pd.set_option('display.width', 1000)
```

[6]:
```python
df_train = pd.read_csv('Train.csv')
df_test = pd.read_csv('Test.csv')
```

[8]:
```python
df_train.head()
```

[8]:
```
  Item_Identifier  Item_Weight Item_Fat_Content  Item_Visibility
Item_Type  Item_MRP Outlet_Identifier  Outlet_Establishment_Year Outlet_Size
Outlet_Location_Type        Outlet_Type  Item_Outlet_Sales
0           FDA15         9.30          Low Fat         0.016047
Dairy  249.8092            OUT049                         1999      Medium
Tier 1  Supermarket Type1          3735.1380
1           DRC01         5.92          Regular         0.019278            Soft
Drinks   48.2692            OUT018                         2009      Medium
Tier 3  Supermarket Type2           443.4228
2           FDN15        17.50          Low Fat         0.016760
Meat  141.6180            OUT049                         1999      Medium
Tier 1  Supermarket Type1          2097.2700
3           FDX07        19.20          Regular         0.000000  Fruits and
Vegetables  182.0950            OUT010                         1998         NaN
Tier 3      Grocery Store           732.3800
4           NCD19         8.93          Low Fat         0.000000
```

```
Household   53.8614            OUT013                           1987         High
Tier 3  Supermarket Type1          994.7052
```

[9]:
```
df_test.head()
```

[9]:
```
  Item_Identifier  Item_Weight Item_Fat_Content  Item_Visibility    Item_Type
Item_MRP Outlet_Identifier  Outlet_Establishment_Year Outlet_Size
Outlet_Location_Type        Outlet_Type
0           FDW58       20.750          Low Fat         0.007565  Snack Foods
107.8622           OUT049                        1999      Medium
Tier 1  Supermarket Type1
1           FDW14        8.300              reg         0.038428        Dairy
87.3198           OUT017                        2007          NaN
Tier 2  Supermarket Type1
2           NCN55       14.600          Low Fat         0.099575       Others
241.7538           OUT010                        1998          NaN
Tier 3      Grocery Store
3           FDQ58        7.315          Low Fat         0.015388  Snack Foods
155.0340           OUT017                        2007          NaN
Tier 2  Supermarket Type1
4           FDY38          NaN          Regular         0.118599        Dairy
234.2300           OUT027                        1985      Medium
Tier 3  Supermarket Type3
```

[10]:
```
df_train.shape, df_test.shape
```

[10]:
```
((8523, 12), (5681, 11))
```

[12]:
```
df_train.isnull().sum()
```

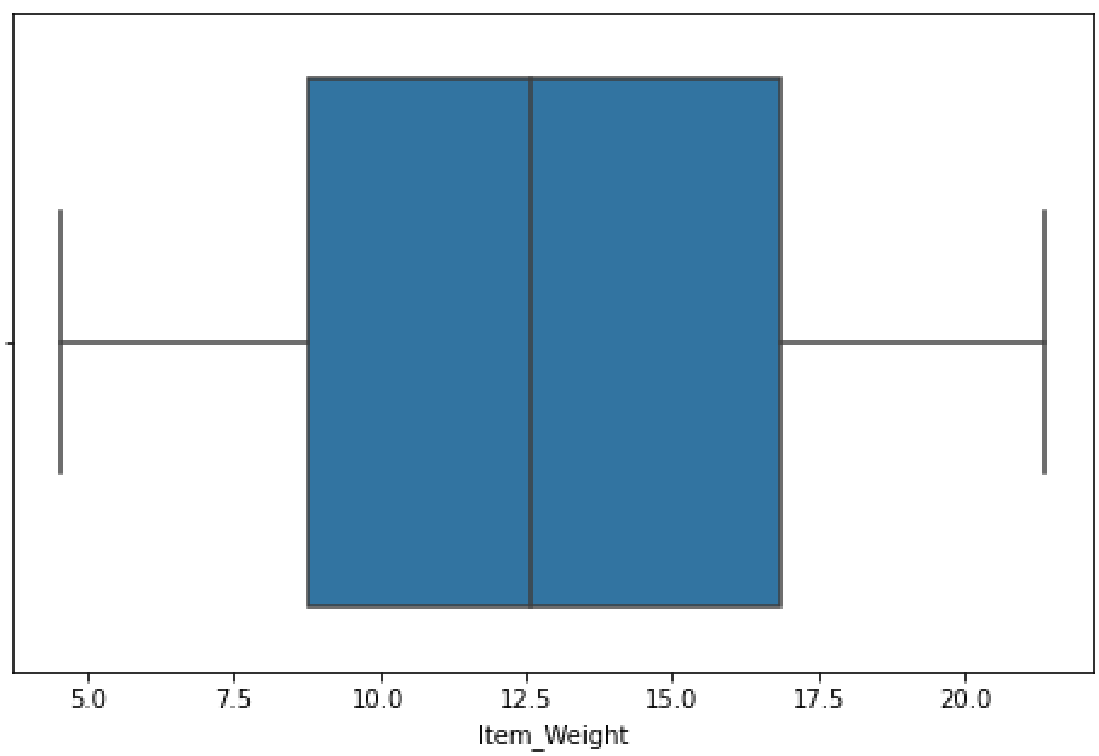
[12]:
```
Item_Identifier                 0
Item_Weight                  1463
Item_Fat_Content                0
Item_Visibility                 0
Item_Type                       0
Item_MRP                        0
Outlet_Identifier               0
Outlet_Establishment_Year       0
Outlet_Size                  2410
Outlet_Location_Type            0
Outlet_Type                     0
Item_Outlet_Sales               0
dtype: int64
```

[13]:
```
df_test.isnull().sum()
```

[13]:
```
Item_Identifier                 0
Item_Weight                   976
Item_Fat_Content                0
Item_Visibility                 0
Item_Type                       0
Item_MRP                        0
Outlet_Identifier               0
Outlet_Establishment_Year       0
Outlet_Size                  1606
Outlet_Location_Type            0
Outlet_Type                     0
dtype: int64
```

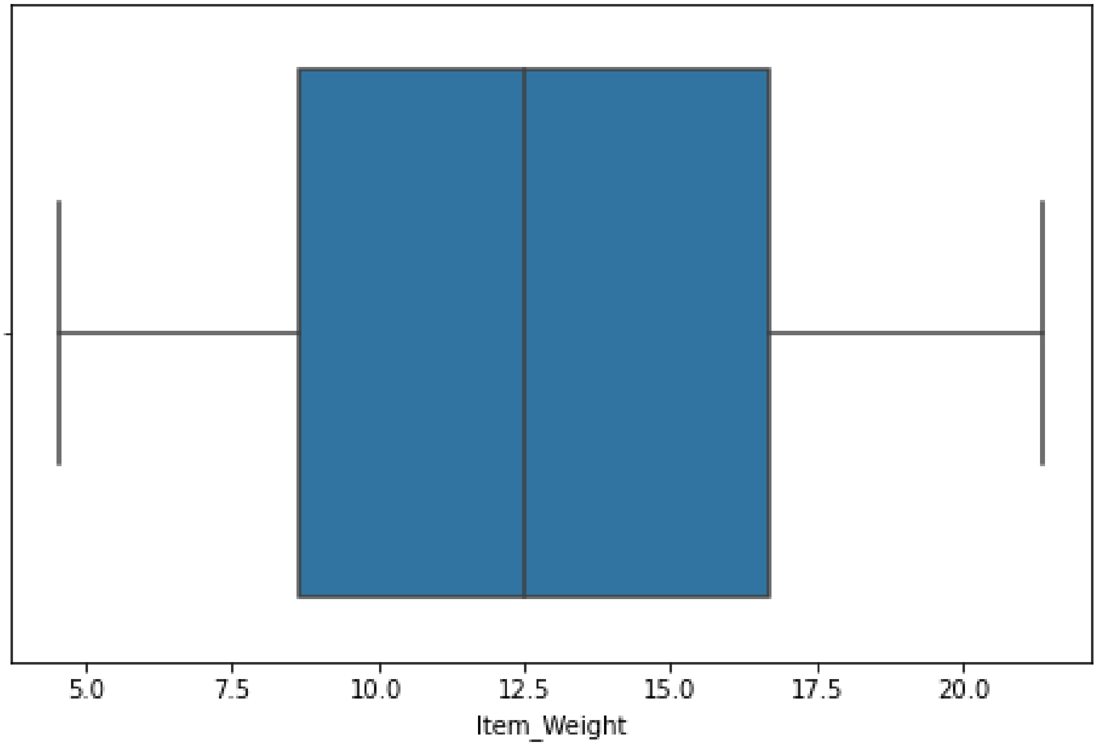
[20]:
```
plt.figure(figsize=(8,5))
sns.boxplot('Item_Weight',data=df_train)
```

[20]: <AxesSubplot:xlabel='Item_Weight'>



[21]:
```
plt.figure(figsize=(8,5))
sns.boxplot('Item_Weight',data=df_test)
```

[21]: <AxesSubplot:xlabel='Item_Weight'>



[22]:
```
df_train['Item_Weight'] = df_train['Item_Weight'].
    ↪fillna(df_train['Item_Weight'].mean())
df_test['Item_Weight'] = df_test['Item_Weight'].fillna(df_test['Item_Weight'].
    ↪mean())
```

[25]:
```
df_train['Item_Weight'].isnull().sum(), df_test['Item_Weight'].isnull().sum()
```

[25]:
```
(0, 0)
```

[28]:
```
df_train['Outlet_Size'].value_counts(), df_test['Outlet_Size'].value_counts()
```

[28]:
```
(Medium    2793
 Small     2388
 High       932
 Name: Outlet_Size, dtype: int64,
 Medium    1862
 Small     1592
 High       621
 Name: Outlet_Size, dtype: int64)
```

[29]:
```
df_train['Outlet_Size'] = df_train['Outlet_Size'].
    ↪fillna(df_train['Outlet_Size'].mode()[0])
```

```
df_test['Outlet_Size'] = df_test['Outlet_Size'].fillna(df_test['Outlet_Size'].
 ↪mode()[0])
```

[30]:
```
df_train['Outlet_Size'].isnull().sum(), df_test['Outlet_Size'].isnull().sum()
```

[30]:
```
(0, 0)
```

[32]:
```
df_train['Item_Fat_Content'].value_counts(), df_test['Item_Fat_Content'].
 ↪value_counts()
```

[32]:
```
(Low Fat    5089
 Regular    2889
 LF          316
 reg         117
 low fat     112
 Name: Item_Fat_Content, dtype: int64,
 Low Fat    3396
 Regular    1935
 LF          206
 reg          78
 low fat      66
 Name: Item_Fat_Content, dtype: int64)
```

[33]:
```
df_train['Item_Fat_Content'].replace(['low fat','LF','reg'],['Low Fat','Low␣
 ↪Fat','Regular'],inplace = True)
df_test['Item_Fat_Content'].replace(['low fat','LF','reg'],['Low Fat','Low␣
 ↪Fat','Regular'],inplace = True)
```

[34]:
```
df_train['Item_Fat_Content'].value_counts(), df_test['Item_Fat_Content'].
 ↪value_counts()
```

[34]:
```
(Low Fat    5517
 Regular    3006
 Name: Item_Fat_Content, dtype: int64,
 Low Fat    3668
 Regular    2013
 Name: Item_Fat_Content, dtype: int64)
```

[35]:
```
df_train['Years_Established'] = df_train['Outlet_Establishment_Year'].
 ↪apply(lambda x: 2020 - x)
df_test['Years_Established'] = df_test['Outlet_Establishment_Year'].
 ↪apply(lambda x: 2020 - x)
```

[36]:
```
df_train.head()
```

[36]:
```
  Item_Identifier  Item_Weight Item_Fat_Content  Item_Visibility
Item_Type  Item_MRP Outlet_Identifier  Outlet_Establishment_Year Outlet_Size
```

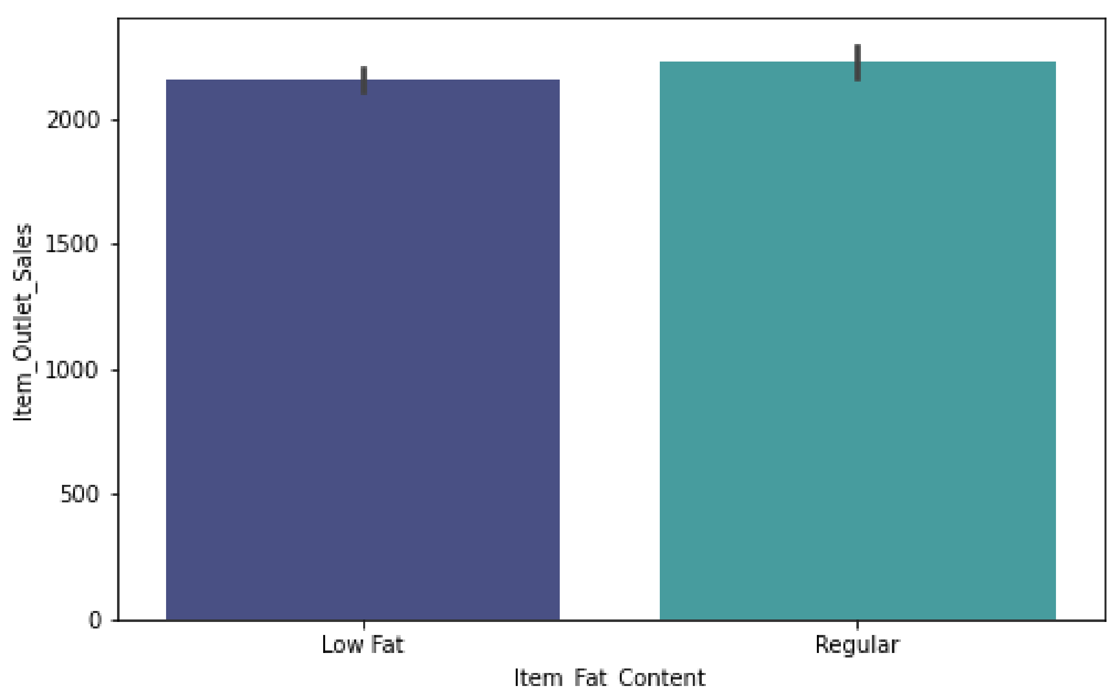
```
Outlet_Location_Type        Outlet_Type  Item_Outlet_Sales  Years_Established
0           FDA15         9.30          Low Fat         0.016047
Dairy  249.8092            OUT049                       1999      Medium
Tier 1  Supermarket Type1          3735.1380              21
1           DRC01         5.92          Regular         0.019278          Soft
Drinks   48.2692            OUT018                       2009      Medium
Tier 3  Supermarket Type2           443.4228              11
2           FDN15        17.50          Low Fat         0.016760
Meat  141.6180            OUT049                       1999      Medium
Tier 1  Supermarket Type1          2097.2700              21
3           FDX07        19.20          Regular         0.000000  Fruits and
Vegetables  182.0950            OUT010                       1998      Medium
Tier 3      Grocery Store           732.3800              22
4           NCD19         8.93          Low Fat         0.000000
Household   53.8614             OUT013                       1987        High
Tier 3  Supermarket Type1           994.7052              33
```

[37]:
```python
df_train['Item_Fat_Content'] = df_train['Item_Fat_Content'].astype(str)
```

[38]:
```python
df_test['Item_Fat_Content'] = df_test['Item_Fat_Content'].astype(str)
```

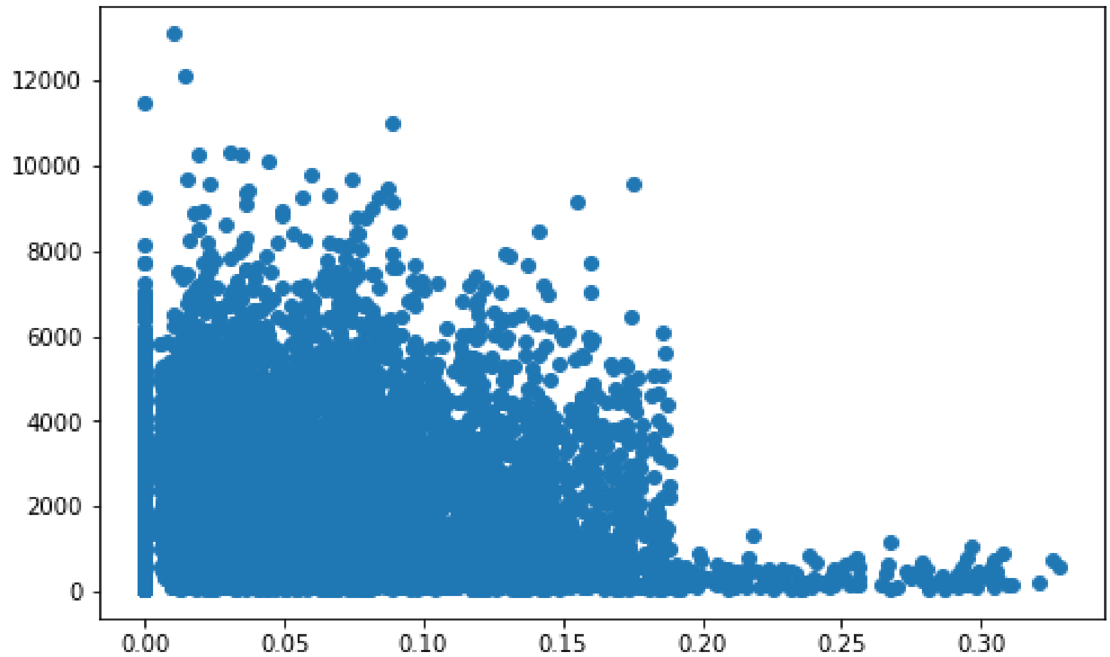
[39]:
```python
plt.figure(figsize=(8,5))
sns.barplot('Item_Fat_Content','Item_Outlet_Sales',data=df_train,palette='mako')
```

[39]: <AxesSubplot:xlabel='Item_Fat_Content', ylabel='Item_Outlet_Sales'>



[40]:
```
plt.figure(figsize=(8,5))
plt.scatter('Item_Visibility','Item_Outlet_Sales',data=df_train)
```

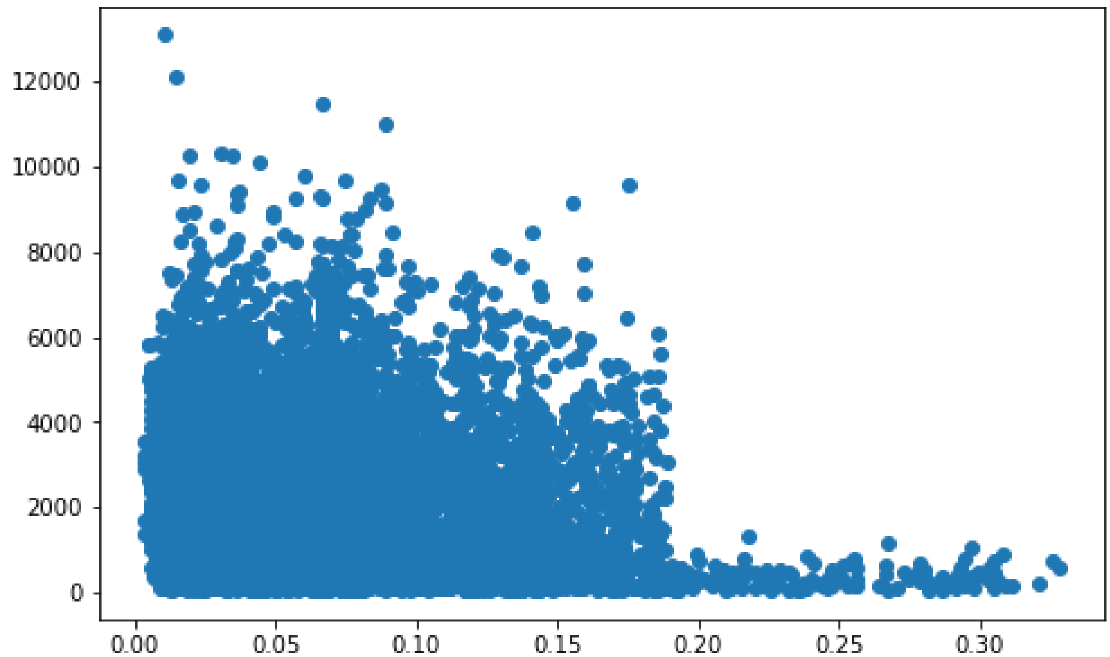
[40]: <matplotlib.collections.PathCollection at 0x7f74a588ef70>



[41]:
```
df_train['Item_Visibility'] = df_train['Item_Visibility'].
  ↪replace(0,df_train['Item_Visibility'].mean())
df_test['Item_Visibility']= df_test['Item_Visibility'].
  ↪replace(0,df_test['Item_Visibility'].mean())
```

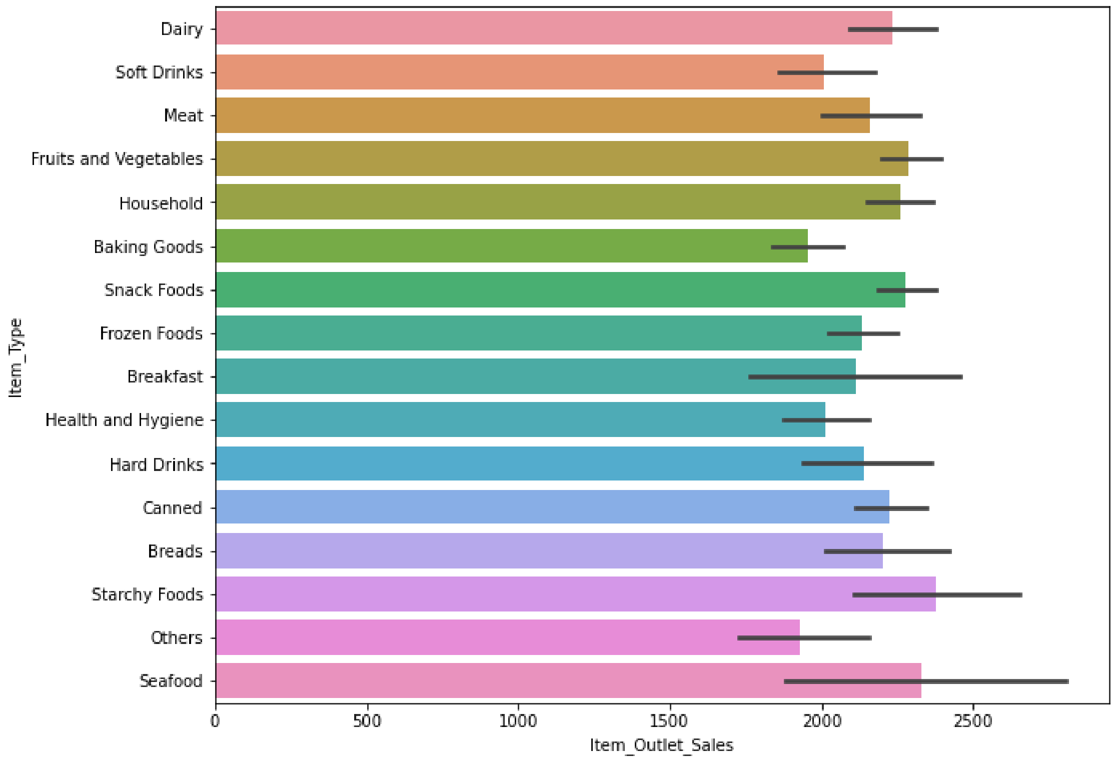
[42]:
```
plt.figure(figsize=(8,5))
plt.scatter('Item_Visibility','Item_Outlet_Sales',data=df_train)
```

[42]: <matplotlib.collections.PathCollection at 0x7f74a57fc100>



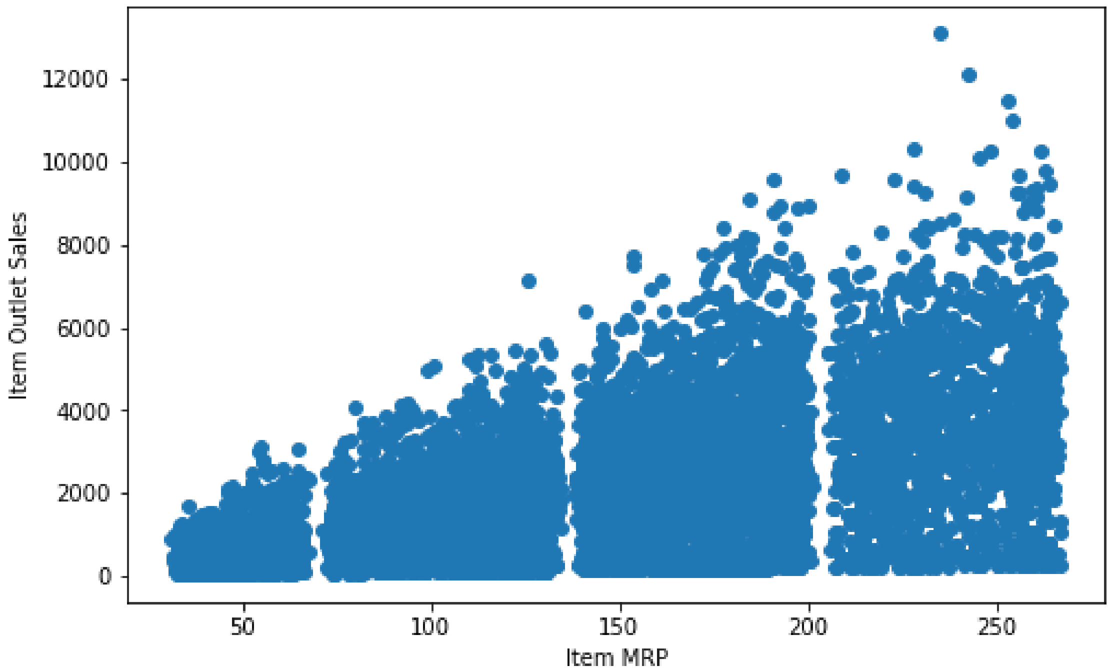
[44]:
```
plt.figure(figsize=(10,8))
sns.barplot(y='Item_Type',x='Item_Outlet_Sales',data=df_train)
```

[44]: <AxesSubplot:xlabel='Item_Outlet_Sales', ylabel='Item_Type'>



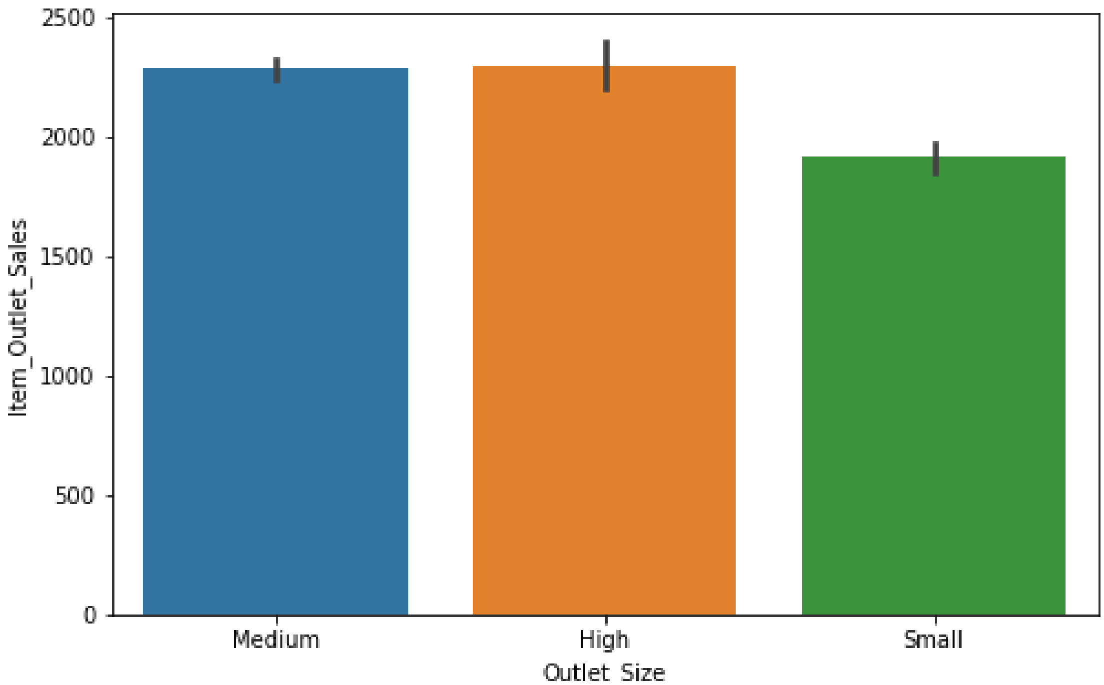
[45]:
```
plt.figure(figsize=(8,5))
plt.scatter(y='Item_Outlet_Sales',x='Item_MRP',data=df_train)
plt.xlabel('Item MRP')
plt.ylabel('Item Outlet Sales')
```

[45]: Text(0, 0.5, 'Item Outlet Sales')



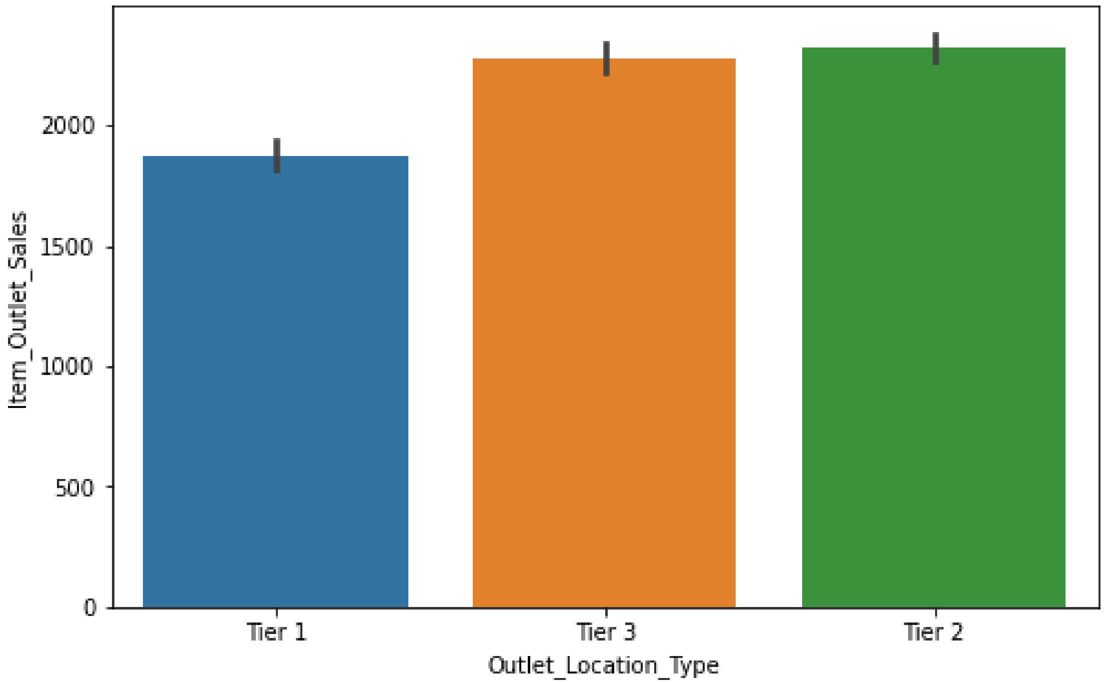
[47]:
```
plt.figure(figsize=(8,5))
sns.barplot(x='Outlet_Size',y='Item_Outlet_Sales',data=df_train)
```

[47]: <AxesSubplot:xlabel='Outlet_Size', ylabel='Item_Outlet_Sales'>



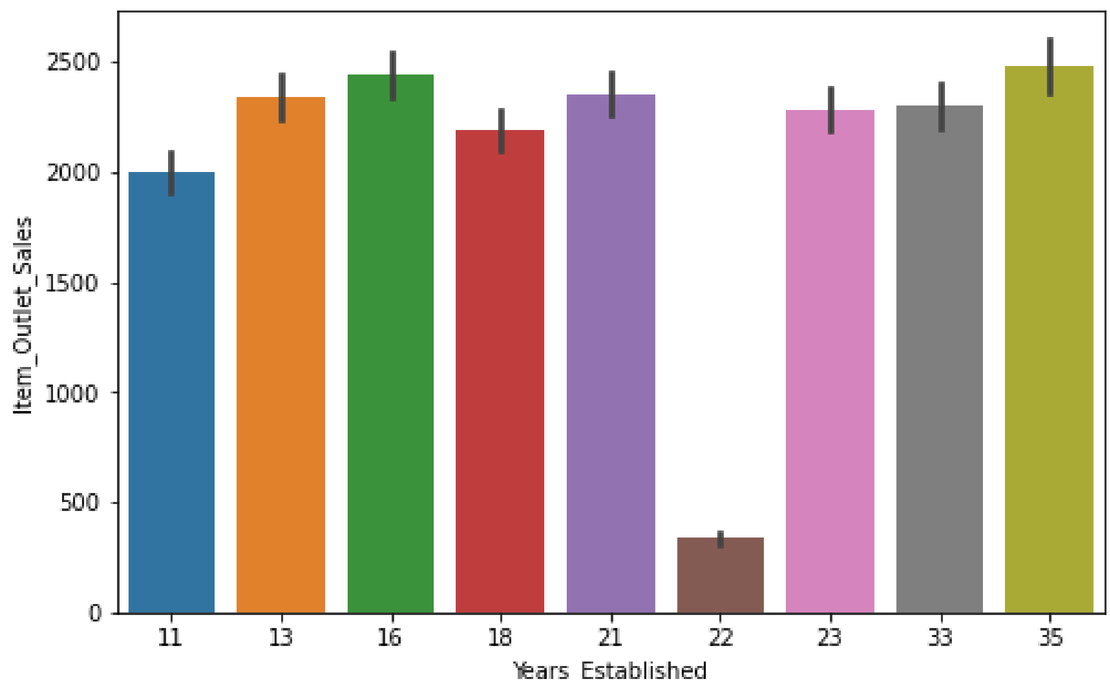
[48]:
```
plt.figure(figsize=(8,5))
sns.barplot(x='Outlet_Location_Type',y='Item_Outlet_Sales',data=df_train)
```

[48]: <AxesSubplot:xlabel='Outlet_Location_Type', ylabel='Item_Outlet_Sales'>



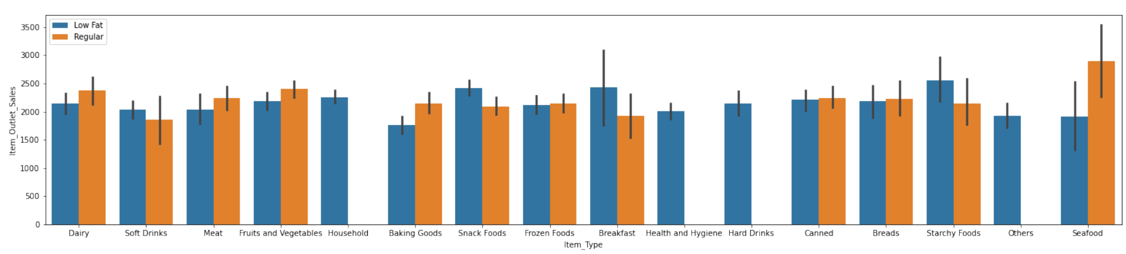
[49]:
```
plt.figure(figsize=(8,5))
sns.barplot(x='Years_Established',y='Item_Outlet_Sales',data=df_train)
```

[49]: <AxesSubplot:xlabel='Years_Established', ylabel='Item_Outlet_Sales'>



[50]:
```
plt.figure(figsize=(25,5))
sns.barplot('Item_Type','Item_Outlet_Sales',hue='Item_Fat_Content',data=df_train)
plt.legend()
```

[50]: <matplotlib.legend.Legend at 0x7f74a5396df0>



[51]:
```
le = LabelEncoder()
var_mod = ['Item_Fat_Content','Outlet_Location_Type','Outlet_Size','Outlet_Type','Item_Type']

for i in var_mod:
    df_train[i] = le.fit_transform(df_train[i])
```

```
for i in var_mod:
    df_test[i] = le.fit_transform(df_test[i])
```

[53]:
```
df_train[:10]
```

[53]:
```
  Item_Identifier  Item_Weight  Item_Fat_Content  Item_Visibility  Item_Type
Item_MRP Outlet_Identifier  Outlet_Establishment_Year  Outlet_Size
Outlet_Location_Type  Outlet_Type  Item_Outlet_Sales  Years_Established
0            FDA15     9.300000                 0         0.016047          4
249.8092            OUT049                        1999                1
0            1          3735.1380                21
1            DRC01     5.920000                 1         0.019278         14
48.2692             OUT018                        2009                1
2            2           443.4228                11
2            FDN15    17.500000                 0         0.016760         10
141.6180            OUT049                        1999                1
0            1          2097.2700                21
3            FDX07    19.200000                 1         0.066132          6
182.0950            OUT010                        1998                1
2            0           732.3800                22
4            NCD19     8.930000                 0         0.066132          9
53.8614             OUT013                        1987                0
2            1           994.7052                33
5            FDP36    10.395000                 1         0.066132          0
51.4008             OUT018                        2009                1
2            2           556.6088                11
6            FDO10    13.650000                 1         0.012741         13
57.6588             OUT013                        1987                0
2            1           343.5528                33
7            FDP10    12.857645                 0         0.127470         13
107.7622            OUT027                        1985                1
2            3          4022.7636                35
8            FDH17    16.200000                 1         0.016687          5
96.9726             OUT045                        2002                1
1            1          1076.5986                18
9            FDU28    19.200000                 1         0.094450          5
187.8214            OUT017                        2007                1
1            1          4710.5350                13
```

[55]:
```
df_train = df_train.
 ↪drop(['Item_Identifier','Outlet_Identifier','Outlet_Establishment_Year'],axis=1)
df_test= df_test.
 ↪drop(['Item_Identifier','Outlet_Identifier','Outlet_Establishment_Year'],axis=1)
```

[58]:
```
df_train[:10]
```

[58]:
```
   Item_Weight  Item_Fat_Content  Item_Visibility  Item_Type  Item_MRP
Outlet_Size  Outlet_Location_Type  Outlet_Type  Item_Outlet_Sales
Years_Established
0     9.300000                 0         0.016047          4  249.8092
1                      0            1         3735.1380                 21
1     5.920000                 1         0.019278         14   48.2692
1                      2            2          443.4228                 11
2    17.500000                 0         0.016760         10  141.6180
1                      0            1         2097.2700                 21
3    19.200000                 1         0.066132          6  182.0950
1                      2            0          732.3800                 22
4     8.930000                 0         0.066132          9   53.8614
0                      2            1          994.7052                 33
5    10.395000                 1         0.066132          0   51.4008
1                      2            2          556.6088                 11
6    13.650000                 1         0.012741         13   57.6588
0                      2            1          343.5528                 33
7    12.857645                 0         0.127470         13  107.7622
1                      2            3         4022.7636                 35
8    16.200000                 1         0.016687          5   96.9726
1                      1            1         1076.5986                 18
9    19.200000                 1         0.094450          5  187.8214
1                      1            1         4710.5350                 13
```

[59]:
```python
df_test.shape[0]
```

[59]:
```
5681
```

[152]:
```python
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import AdaBoostRegressor

Y = df_train['Item_Outlet_Sales']
feats =␣
 ↪['Item_Weight','Item_Fat_Content','Item_Visibility','Item_Type','Item_MRP','Outlet_Size','O
X = df_train[feats]
```

[176]:
```python
# sub_preds = np.zeros(df_test.shape[0])

trn_x, val_x, trn_y, val_y = train_test_split(X, Y, test_size=0.1,␣
 ↪random_state=42)
feature_importance_df = pd.DataFrame()

dtr = DecisionTreeRegressor(max_depth=9,min_samples_leaf=150, random_state=22)

# clf = LGBMClassifier(n_estimators=10000,learning_rate=0.
 ↪10,num_leaves=30,subsample=.9,max_depth=7,reg_alpha=.1,reg_lambda=.
 ↪1,min_split_gain=.01,min_child_weight=2,silent=-1,verbose=-1,)
```

```
dtr.fit(trn_x,trn_y)

sub_preds = dtr.predict(val_x)

fold_importance_df = pd.DataFrame()
fold_importance_df["feature"] = feats
fold_importance_df["importance"] = dtr.feature_importances_
feature_importance_df = pd.concat([feature_importance_df, fold_importance_df],␣
 ↪axis=0)
```

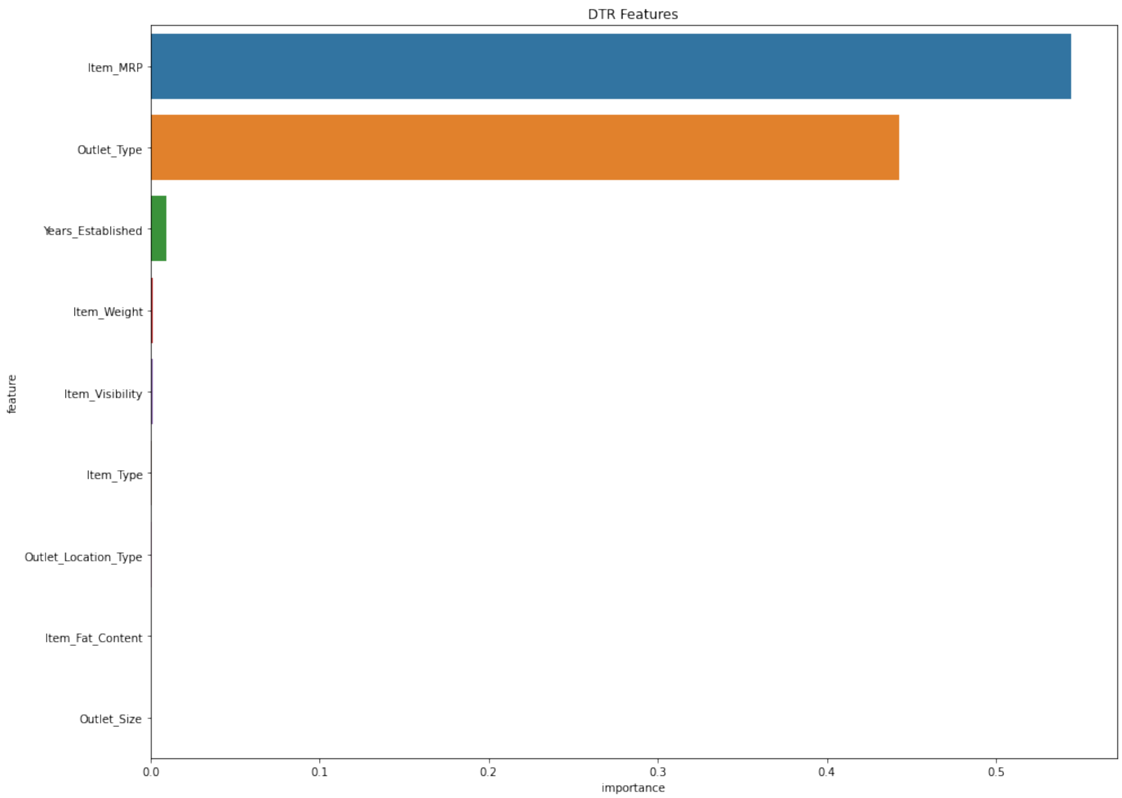
[177]:
```
dtr.score(val_x,val_y)
```

[177]: 0.6155057880241049

[178]:
```
cols = feature_importance_df[["feature", "importance"]].groupby("feature").
 ↪mean().sort_values(by="importance", ascending=False)[:50].index

best_features = feature_importance_df.loc[feature_importance_df.feature.
 ↪isin(cols)]

plt.figure(figsize=(14,10))
sns.barplot(x="importance", y="feature", data=best_features.
 ↪sort_values(by="importance", ascending=False))
plt.title('DTR Features')
plt.tight_layout()
```



[236]:
```
from sklearn.model_selection  import cross_val_score
def cross_val(model_name,model,X,y,cv):

    scores = cross_val_score(model, X, y, cv=cv)
    print(f'{model_name} Scores:')
    for i in scores:
        print(round(i,2))
    print(f'Average {model_name} score: {round(scores.mean(),2)}')
```

[241]:
```
cross_val(dtr,DecisionTreeRegressor(),X,Y,5)
```

```
DecisionTreeRegressor(max_depth=9, min_samples_leaf=150, random_state=22)
Scores:
0.23
0.13
0.07
0.17
0.18
Average DecisionTreeRegressor(max_depth=9, min_samples_leaf=150,
random_state=22) score: 0.15
```

[204]:

```
ada = AdaBoostRegressor(DecisionTreeRegressor(max_depth=5),n_estimators=500,␣
↪learning_rate=0.001, random_state=22)
ada.fit(trn_x,trn_y)
sub_preds1 = ada.predict(val_x)
feature_importance_df1 = pd.DataFrame()
fold_importance_df1 = pd.DataFrame()
fold_importance_df1["feature"] = feats
fold_importance_df1["importance"] = ada.feature_importances_
feature_importance_df1 = pd.concat([feature_importance_df1,␣
↪fold_importance_df1], axis=0)
```

[205]:

```
ada.score(val_x,val_y)
```

[205]: 0.6171924629651433

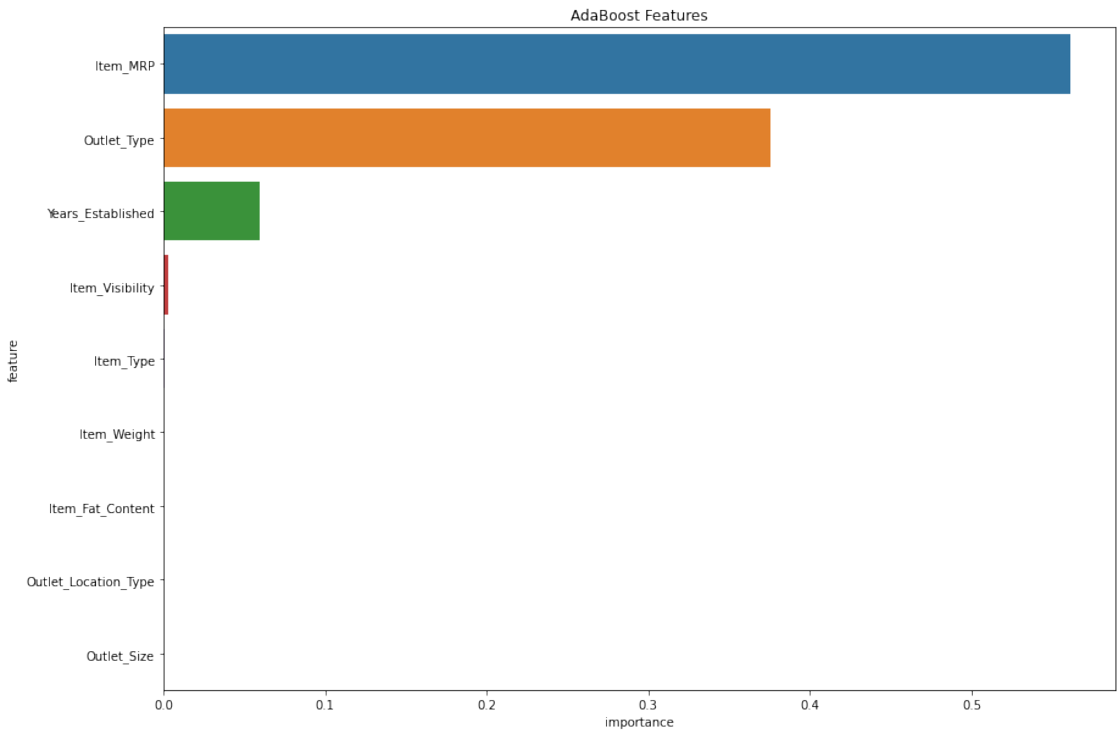
[207]:

```
cols = feature_importance_df1[["feature", "importance"]].groupby("feature").
↪mean().sort_values(by="importance", ascending=False)[:50].index

best_features = feature_importance_df1.loc[feature_importance_df1.feature.
↪isin(cols)]

plt.figure(figsize=(14,10))
sns.barplot(x="importance", y="feature", data=best_features.
↪sort_values(by="importance", ascending=False))
plt.title('AdaBoost Features')
```

[207]: Text(0.5, 1.0, 'AdaBoost Features')



[242]:

```
cross_val(ada,AdaBoostRegressor(),X,Y,10)
```

```
AdaBoostRegressor(base_estimator=DecisionTreeRegressor(max_depth=5),
                  learning_rate=0.001, n_estimators=500, random_state=22)
Scores:
0.5
0.49
0.45
0.51
0.43
0.5
0.56
0.52
0.55
0.5
Average AdaBoostRegressor(base_estimator=DecisionTreeRegressor(max_depth=5),
                  learning_rate=0.001, n_estimators=500, random_state=22) score:
0.5
```

[224]:

```
from sklearn.ensemble import RandomForestRegressor
RF= RandomForestRegressor(n_estimators=300,max_depth=10,␣
↪min_samples_leaf=100,n_jobs=4,random_state=22, verbose=-1)

RF.fit(trn_x,trn_y)
```

```
sub_preds2 = RF.predict(val_x)
feature_importance_df2 = pd.DataFrame()
fold_importance_df2 = pd.DataFrame()
fold_importance_df2["feature"] = feats
fold_importance_df2["importance"] = RF.feature_importances_
feature_importance_df2 = pd.concat([feature_importance_df2,␣
↪fold_importance_df2], axis=0)
```

```
[Parallel(n_jobs=4)]: Using backend ThreadingBackend with 4 concurrent workers.
[Parallel(n_jobs=4)]: Done  64 tasks      | elapsed:    0.1s
[Parallel(n_jobs=4)]: Done 280 tasks      | elapsed:    0.6s
[Parallel(n_jobs=4)]: Done 300 out of 300 | elapsed:    0.7s finished
[Parallel(n_jobs=4)]: Using backend ThreadingBackend with 4 concurrent workers.
[Parallel(n_jobs=4)]: Done  64 tasks      | elapsed:    0.0s
[Parallel(n_jobs=4)]: Done 280 tasks      | elapsed:    0.0s
[Parallel(n_jobs=4)]: Done 300 out of 300 | elapsed:    0.0s finished
```

[225]:
```
RF.score(val_x,val_y)
```

```
[Parallel(n_jobs=4)]: Using backend ThreadingBackend with 4 concurrent workers.
[Parallel(n_jobs=4)]: Done  64 tasks      | elapsed:    0.0s
[Parallel(n_jobs=4)]: Done 280 tasks      | elapsed:    0.1s
[Parallel(n_jobs=4)]: Done 300 out of 300 | elapsed:    0.1s finished
```

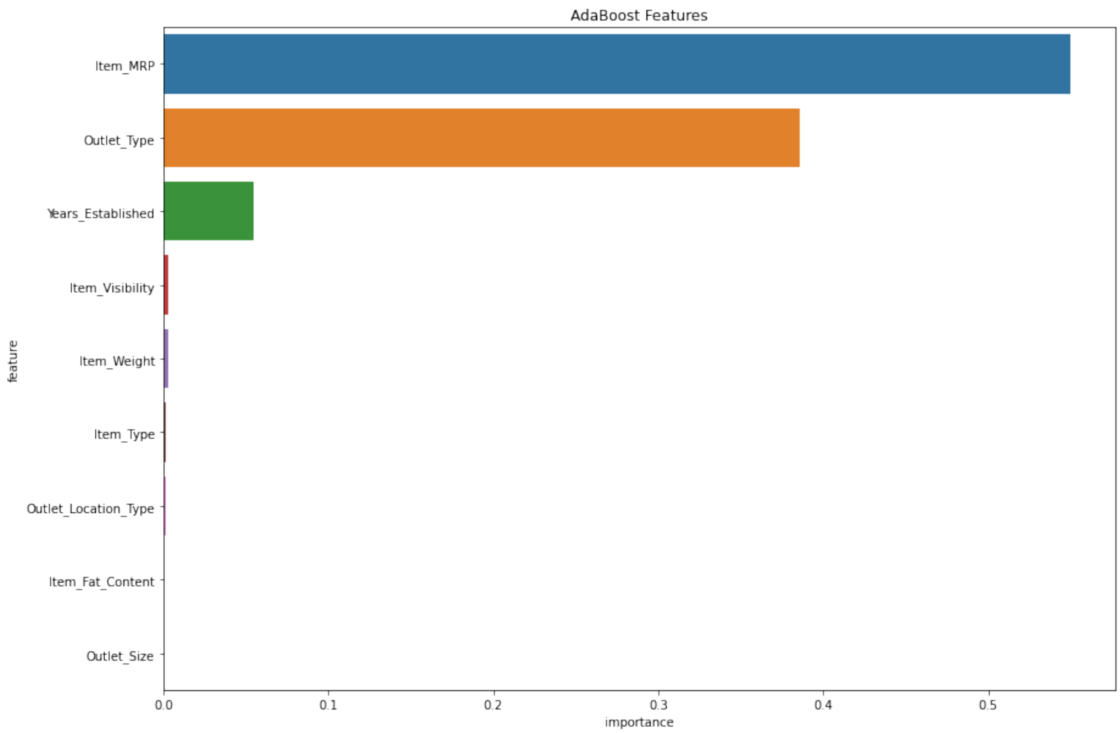
[225]:
```
0.6253330302688165
```

[226]:
```
cols = feature_importance_df2[["feature", "importance"]].groupby("feature").
↪mean().sort_values(by="importance", ascending=False)[:50].index

best_features = feature_importance_df2.loc[feature_importance_df2.feature.
↪isin(cols)]

plt.figure(figsize=(14,10))
sns.barplot(x="importance", y="feature", data=best_features.
↪sort_values(by="importance", ascending=False))
plt.title('AdaBoost Features')
```

[226]:
```
Text(0.5, 1.0, 'AdaBoost Features')
```



[244]:
```
cross_val(RF,RandomForestRegressor(),X,Y,5)
```

```
RandomForestRegressor(max_depth=10, min_samples_leaf=100, n_estimators=300,
                      n_jobs=4, random_state=22, verbose=-1) Scores:
0.57
0.52
0.52
0.55
0.57
Average RandomForestRegressor(max_depth=10, min_samples_leaf=100,
n_estimators=300,
                      n_jobs=4, random_state=22, verbose=-1) score: 0.55
```

[231]:
```
LR = LinearRegression(normalize=True)
LR.fit(trn_x,trn_y)
sub_preds3 = LR.predict(val_x)
feature_importance_df3 = pd.DataFrame()
fold_importance_df3 = pd.DataFrame()
fold_importance_df3["feature"] = feats
fold_importance_df3["importance"] = RF.feature_importances_
feature_importance_df3 = pd.concat([feature_importance_df3,␣
↪fold_importance_df3], axis=0)
```

[233]:
```
LR.score(val_x,val_y)
```

[233]: 0.5309791442288767

[246]:
```
cross_val(LR,LinearRegression(),X,Y,5)
```

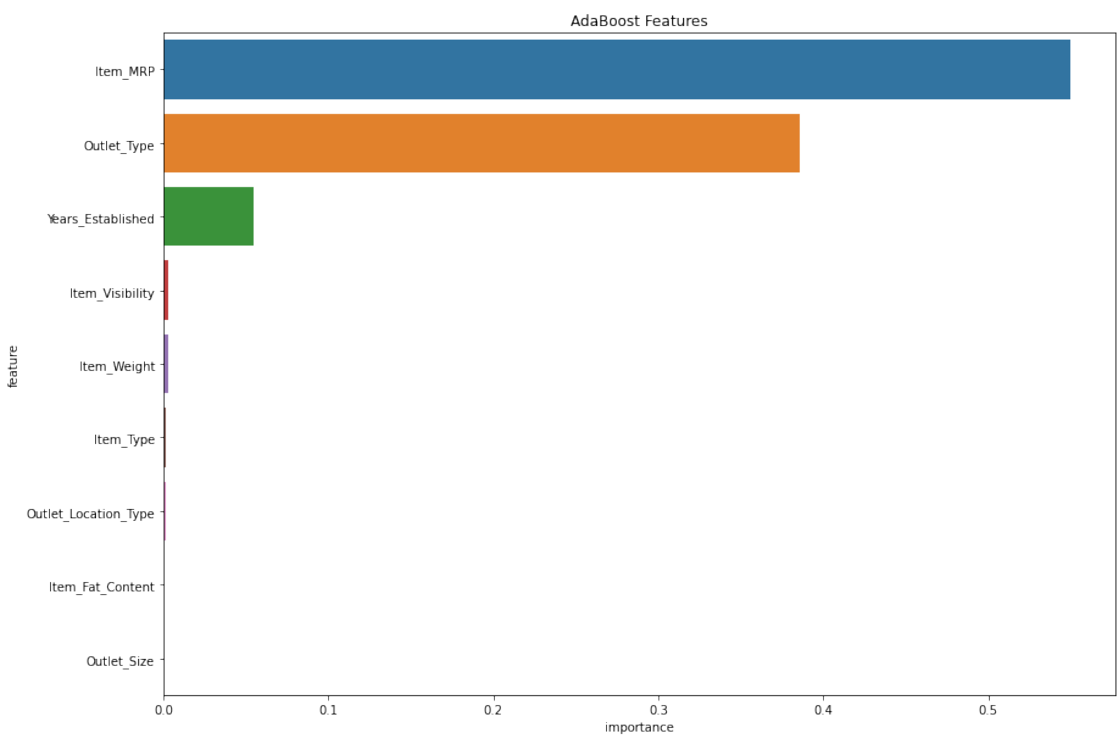
```
LinearRegression(normalize=True) Scores:
0.53
0.5
0.49
0.51
0.51
Average LinearRegression(normalize=True) score: 0.51
```

[248]:
```
cols = feature_importance_df3[["feature", "importance"]].groupby("feature").
↪mean().sort_values(by="importance", ascending=False)[:50].index

best_features = feature_importance_df3.loc[feature_importance_df3.feature.
↪isin(cols)]

plt.figure(figsize=(14,10))
sns.barplot(x="importance", y="feature", data=best_features.
↪sort_values(by="importance", ascending=False))
plt.title('AdaBoost Features')
```

[248]: Text(0.5, 1.0, 'AdaBoost Features')



```
[ ]:
```