Assignment 6

Student Performance

This data approach student achievement in secondary education of two Portuguese schools. The data attributes include student grades, demographic, social and school related features) and it was collected by using school reports and questionnaires. Two datasets are provided regarding the performance in two distinct subjects: Mathematics (mat) and Portuguese language (por). In [Cortez and Silva, 2008], the two datasets were modeled under binary/five-level classification and regression tasks. Important note: the target attribute G3 has a strong correlation with attributes G2 and G1. This occurs because G3 is the final year grade (issued at the 3rd period), while G1 and G2 correspond to the 1st and 2nd period grades. It is more difficult to predict G3 without G2 and G1, but such prediction is much more useful (see paper source for more details).

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

In [ ]:
```
df = pd.read_csv('C:/Users/Dell/OneDrive/Desktop/student-mat.csv', sep=';')
df.head()
```

Out[ ]:

	school	sex	age	address	famsize	Pstatus	Medu	Fedu	Mjob	Fjob	...	fam
0	GP	F	18	U	GT3	A	4	4	at_home	teacher	...	
1	GP	F	17	U	GT3	T	1	1	at_home	other	...	
2	GP	F	15	U	LE3	T	1	1	at_home	other	...	
3	GP	F	15	U	GT3	T	4	2	health	services	...	
4	GP	F	16	U	GT3	T	3	3	other	other	...	

5 rows × 33 columns

In [ ]:
```
df.dtypes
```

Out[ ]:
```
school        object
sex           object
age            int64
address       object
famsize       object
Pstatus       object
Medu           int64
Fedu           int64
Mjob          object
Fjob          object
reason        object
guardian      object
traveltime     int64
studytime      int64
failures       int64
schoolsup     object
famsup        object
paid          object
activities    object
nursery       object
higher        object
internet      object
romantic      object
famrel         int64
freetime       int64
goout          int64
Dalc           int64
Walc           int64
health         int64
absences       int64
G1             int64
G2             int64
G3             int64
dtype: object
```

In [ ]:
```
df.describe()
```

Out[ ]:

	age	Medu	Fedu	traveltime	studytime	failures	fam
count	408.000000	408.000000	408.000000	408.000000	408.000000	408.000000	408.0000
mean	16.666667	2.737745	2.536765	1.448529	2.034314	0.330882	3.9534
std	1.274072	1.098289	1.073981	0.702609	0.825752	0.735767	0.8868
min	15.000000	0.000000	0.000000	1.000000	1.000000	0.000000	1.0000
25%	16.000000	2.000000	2.000000	1.000000	1.000000	0.000000	4.0000
50%	17.000000	3.000000	3.000000	1.000000	2.000000	0.000000	4.0000
75%	18.000000	4.000000	3.000000	2.000000	2.000000	0.000000	5.0000
max	22.000000	4.000000	4.000000	4.000000	4.000000	3.000000	5.0000

In [ ]:
```
df.shape
```

Out[ ]:
```
(408, 33)
```

In [ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 408 entries, 0 to 407
Data columns (total 33 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   school      408 non-null    object
 1   sex         408 non-null    object
 2   age         408 non-null    int64 
 3   address     408 non-null    object
 4   famsize     408 non-null    object
 5   Pstatus     408 non-null    object
 6   Medu        408 non-null    int64 
 7   Fedu        408 non-null    int64 
 8   Mjob        408 non-null    object
 9   Fjob        408 non-null    object
 10  reason      408 non-null    object
 11  guardian    408 non-null    object
 12  traveltime  408 non-null    int64 
 13  studytime   408 non-null    int64 
 14  failures    408 non-null    int64 
 15  schoolsup   408 non-null    object
 16  famsup      408 non-null    object
 17  paid        408 non-null    object
 18  activities  408 non-null    object
 19  nursery     408 non-null    object
 20  higher      408 non-null    object
 21  internet    408 non-null    object
 22  romantic    408 non-null    object
 23  famrel      408 non-null    int64 
 24  freetime    408 non-null    int64 
 25  goout       408 non-null    int64 
 26  Dalc        408 non-null    int64 
 27  Walc        408 non-null    int64 
 28  health      408 non-null    int64 
 29  absences    408 non-null    int64 
 30  G1          408 non-null    int64 
 31  G2          408 non-null    int64 
 32  G3          408 non-null    int64 
dtypes: int64(16), object(17)
memory usage: 105.3+ KB
```

In [ ]:
```
df.nunique()
```

Out[ ]:
```
school         2
sex            2
age            8
address        2
famsize        4
Pstatus        2
Medu           5
Fedu           5
Mjob           5
Fjob           5
reason         4
guardian       3
traveltime     4
studytime      4
failures       4
schoolsup      2
famsup         2
paid           2
activities     2
nursery        2
higher         2
internet       2
romantic       2
famrel         5
freetime       5
goout          5
Dalc           5
Walc           5
health         5
absences      34
G1            17
G2            17
G3            18
dtype: int64
```

Null Values

In [ ]:
```
df.isnull().sum()
```

Out[ ]:
```
school        0
sex           0
age           0
address       0
famsize       0
Pstatus       0
Medu          0
Fedu          0
Mjob          0
Fjob          0
reason        0
guardian      0
traveltime    0
studytime     0
failures      0
schoolsup     0
famsup        0
paid          0
activities    0
nursery       0
higher        0
internet      0
romantic      0
famrel        0
freetime      0
goout         0
Dalc          0
Walc          0
health        0
absences      0
G1            0
G2            0
G3            0
dtype: int64
```

Error Correction

In [ ]:
```
df['famsize'].unique()
```

Out[ ]:
```
array(['GT3', 'LE3', 'GT4', 'LE2'], dtype=object)
```

In [ ]:
```
df.famsize.value_counts()
```

Out[ ]:
```
famsize
GT3    292
LE3    112
GT4      2
LE2      2
Name: count, dtype: int64
```

In the data description it is given that 'famsize' can have only 2 values either 'GT3' or 'LE3'

In [ ]:
```
df[df['famsize']=='LE2']
```

Out[ ]:

	school	sex	age	address	famsize	Pstatus	Medu	Fedu	Mjob	Fjob	...	famrel
51	GP	F	15	U	LE2	T	4	2	health	other	...	4
92	GP	F	16	U	LE2	T	3	1	other	other	...	3

2 rows × 33 columns

In [ ]:
```
df.loc[df['famsize']=='LE2', 'famsize'] = 'LE3'
```

In [ ]:
```
df.famsize.value_counts()
```

Out[ ]:
```
famsize
GT3    292
LE3    114
GT4      2
Name: count, dtype: int64
```

In [ ]:
```
df[df['famsize']=='GT4']
```

Out[ ]:

	school	sex	age	address	famsize	Pstatus	Medu	Fedu	Mjob	Fjob	...	f
7	GP	F	17	U	GT4	A	4	4	other	teacher	...	
123	GP	F	15	U	GT4	T	1	2	at_home	services	...	

2 rows × 33 columns

In [ ]:
```
df.loc[df['famsize']=='GT4', 'famsize'] = 'GT3'
```

In [ ]:
```
df.famsize.value_counts()
```

Out[ ]:
```
famsize
GT3    294
LE3    114
Name: count, dtype: int64
```

Removing Duplicates

In [ ]:
```
df[df.duplicated()]
```

Out[ ]:

	school	sex	age	address	famsize	Pstatus	Medu	Fedu	Mjob	Fjob	...	f
119	GP	M	17	R	GT3	T	1	3	other	other	...	
120	GP	M	17	R	GT3	T	1	3	other	other	...	
121	GP	M	17	R	GT3	T	1	3	other	other	...	
159	GP	M	15	R	GT3	T	2	3	at_home	services	...	
160	GP	M	15	R	GT3	T	2	3	at_home	services	...	
161	GP	M	15	R	GT3	T	2	3	at_home	services	...	
162	GP	M	15	R	GT3	T	2	3	at_home	services	...	
163	GP	M	15	R	GT3	T	2	3	at_home	services	...	
164	GP	M	15	R	GT3	T	2	3	at_home	services	...	
210	GP	F	16	U	GT3	T	4	3	health	other	...	
211	GP	F	16	U	GT3	T	4	3	health	other	...	
212	GP	F	16	U	GT3	T	4	3	health	other	...	
213	GP	F	16	U	GT3	T	4	3	health	other	...	

13 rows × 33 columns

In [ ]:
```
no_of_duplicated_rows = df.duplicated().sum()
print(f"Number of duplicated rows = {no_of_duplicated_rows}") if no_of_duplicate
```

```
Number of duplicated rows = 13
```

In [ ]:
```
duplicate_df = df[df.duplicated(keep=False)]
duplicate_df.head()
```

Out[ ]:

	school	sex	age	address	famsize	Pstatus	Medu	Fedu	Mjob	Fjob	...	f
118	GP	M	17	R	GT3	T	1	3	other	other	...	
119	GP	M	17	R	GT3	T	1	3	other	other	...	
120	GP	M	17	R	GT3	T	1	3	other	other	...	
121	GP	M	17	R	GT3	T	1	3	other	other	...	
158	GP	M	15	R	GT3	T	2	3	at_home	services	...	

5 rows × 33 columns

In [ ]:
```
df = df.drop_duplicates()
```

In [ ]:
```
df.shape
```

Out[ ]:
```
(395, 33)
```

In [ ]:
```
df.describe()
```

Out[ ]:

	age	traveltime	studytime	failures	freetime	goout	D
count	395.000000	395.000000	395.000000	395.000000	395.000000	395.000000	395.000(
mean	16.696203	1.448101	2.035443	0.334177	3.235443	3.108861	1.481(
std	1.276043	0.697505	0.839240	0.743651	0.998862	1.113278	0.890
min	15.000000	1.000000	1.000000	0.000000	1.000000	1.000000	1.000(
25%	16.000000	1.000000	1.000000	0.000000	3.000000	2.000000	1.000(
50%	17.000000	1.000000	2.000000	0.000000	3.000000	3.000000	1.000(
75%	18.000000	2.000000	2.000000	0.000000	4.000000	4.000000	2.000(
max	22.000000	4.000000	4.000000	3.000000	5.000000	5.000000	5.000(

In [ ]:
```
df.head()
```

Out[ ]:

	school	sex	age	address	famsize	Pstatus	Medu	Fedu	Mjob	Fjob
0	GP	F	18	U	GT3	A	Higher Education	Higher Education	at_home	teacher
1	GP	F	17	U	GT3	T	Primary Education	Primary Education	at_home	other
2	GP	F	15	U	LE3	T	Primary Education	Primary Education	at_home	other
3	GP	F	15	U	GT3	T	Higher Education	Pre Secondary Education	health	services
4	GP	F	16	U	GT3	T	Secondary Education	Secondary Education	other	other

5 rows × 33 columns

In [ ]:
```
df['Medu'].unique()
```

Out[ ]:
```
array([4, 1, 3, 2, 0], dtype=int64)
```

In [ ]:
```
df['Medu'] = df['Medu'].replace({0: "No Education",
                    1: "Primary Education",
                    2: "Pre Secondary Education",
                    3: "Secondary Education",
                    4: "Higher Education"
                    })
```

In [ ]:
```
df['Fedu'] = df['Fedu'].replace({0: "No Education",
                    1: "Primary Education",
                    2: "Pre Secondary Education",
```

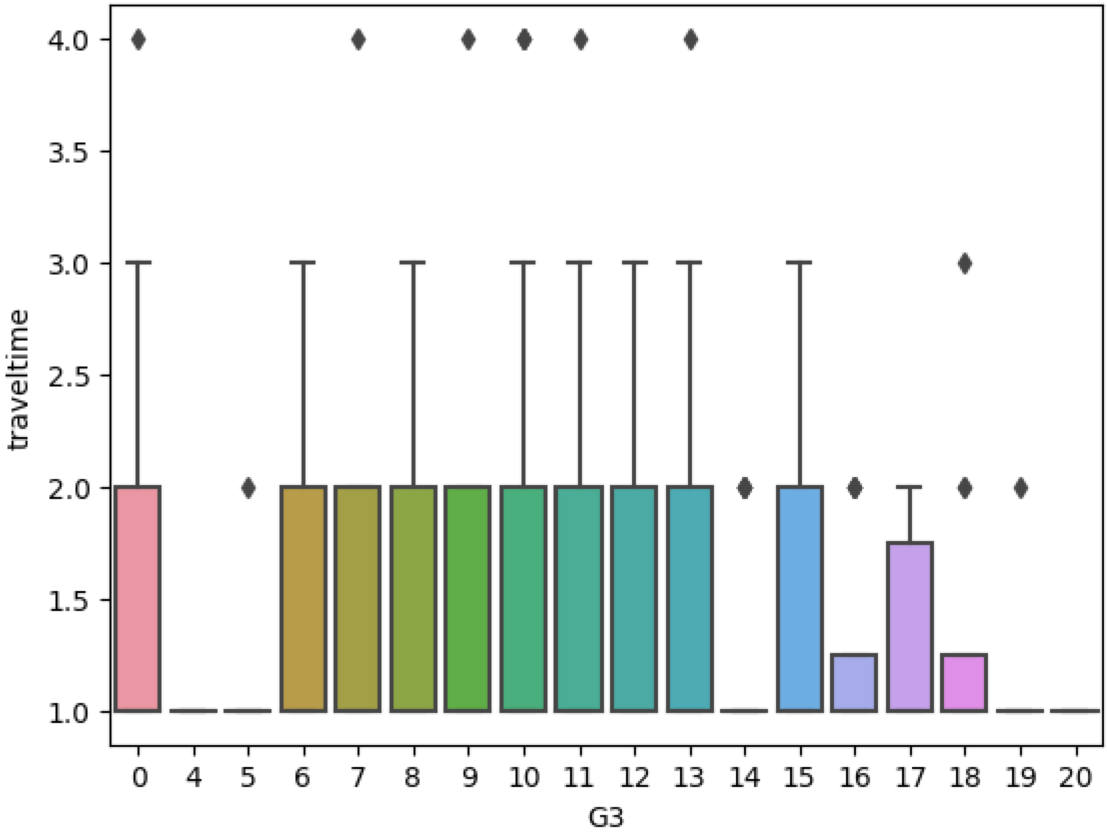
```
                    3: "Secondary Education",
                    4: "Higher Education"
                    })
```

In [ ]:
```
df['famrel'] = df['famrel'].replace({   1: "very bad",
                                         2 : "bad",
                                         3 : "normal",
                                         4 : "good",
                                         5 : "excellent"})
```

Identifying Outliers

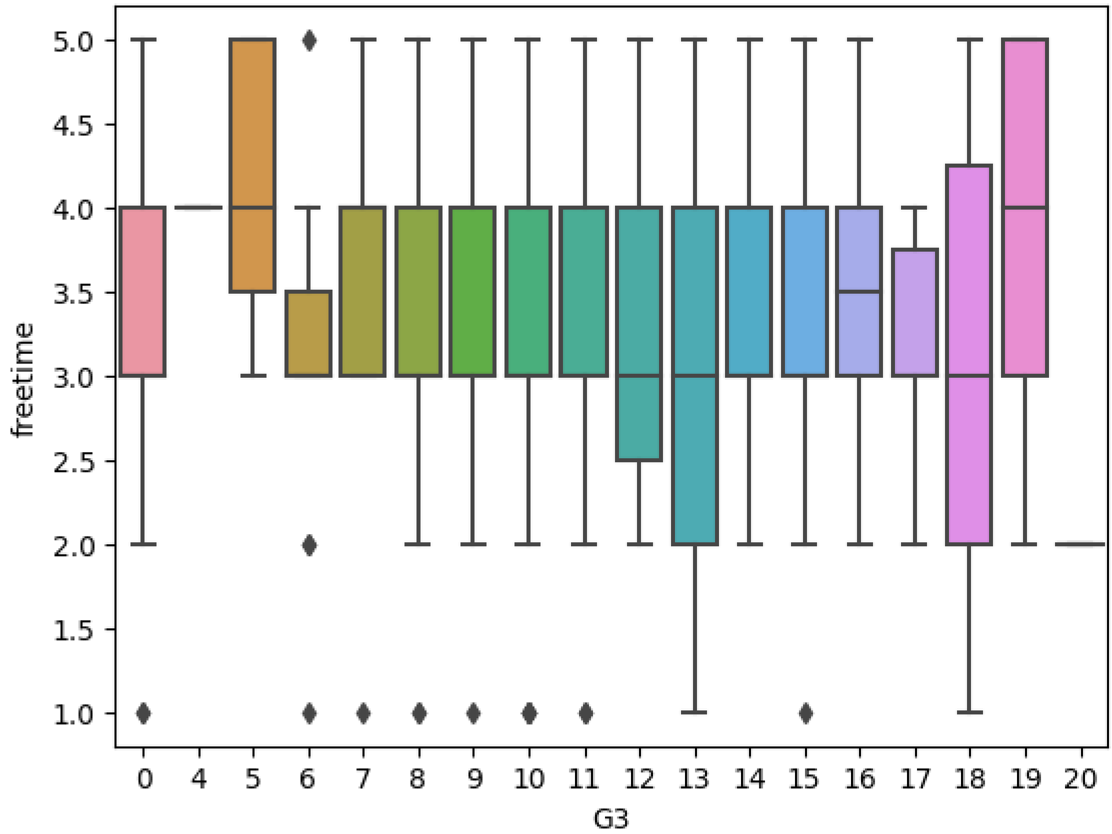
In [ ]:
```
g3_traveltime_boxplot = sns.boxplot(x="G3", y="traveltime", data=df)
plt.show()
```

```
C:\Users\Dell\AppData\Roaming\Python\Python311\site-packages\seaborn\_oldcore.py:
1498: FutureWarning: is_categorical_dtype is deprecated and will be removed in a
future version. Use isinstance(dtype, CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
C:\Users\Dell\AppData\Roaming\Python\Python311\site-packages\seaborn\_oldcore.py:
1498: FutureWarning: is_categorical_dtype is deprecated and will be removed in a
future version. Use isinstance(dtype, CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
C:\Users\Dell\AppData\Roaming\Python\Python311\site-packages\seaborn\_oldcore.py:
1498: FutureWarning: is_categorical_dtype is deprecated and will be removed in a
future version. Use isinstance(dtype, CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
```



In [ ]:
```
g3_freetime_boxplot = sns.boxplot(x="G3", y="freetime", data=df)
plt.show()
```

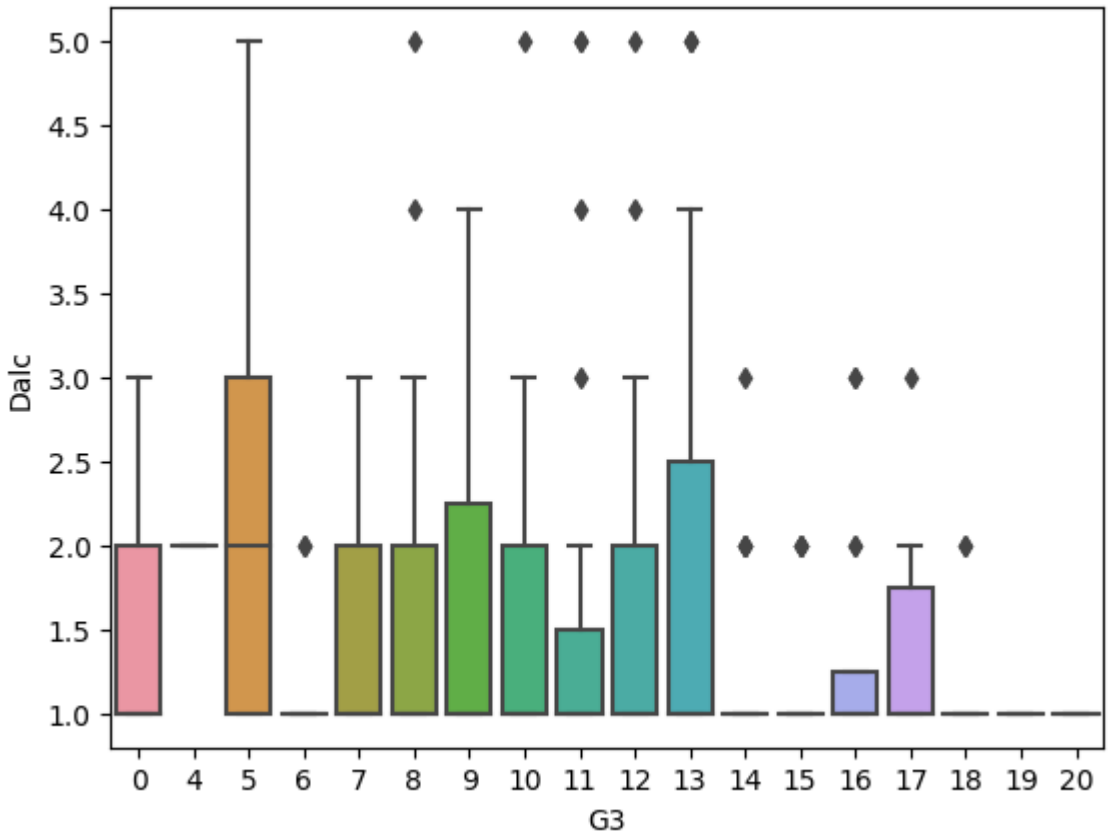
```
C:\Users\Dell\AppData\Roaming\Python\Python311\site-packages\seaborn\_oldcore.py:
1498: FutureWarning: is_categorical_dtype is deprecated and will be removed in a
future version. Use isinstance(dtype, CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
C:\Users\Dell\AppData\Roaming\Python\Python311\site-packages\seaborn\_oldcore.py:
1498: FutureWarning: is_categorical_dtype is deprecated and will be removed in a
future version. Use isinstance(dtype, CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
C:\Users\Dell\AppData\Roaming\Python\Python311\site-packages\seaborn\_oldcore.py:
1498: FutureWarning: is_categorical_dtype is deprecated and will be removed in a
future version. Use isinstance(dtype, CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
```



In [ ]:

```
g3_Dalc_boxplot = sns.boxplot(x="G3", y="Dalc", data=df)
plt.show()
```

```
C:\Users\Dell\AppData\Roaming\Python\Python311\site-packages\seaborn\_oldcore.py:
1498: FutureWarning: is_categorical_dtype is deprecated and will be removed in a
future version. Use isinstance(dtype, CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
C:\Users\Dell\AppData\Roaming\Python\Python311\site-packages\seaborn\_oldcore.py:
1498: FutureWarning: is_categorical_dtype is deprecated and will be removed in a
future version. Use isinstance(dtype, CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
C:\Users\Dell\AppData\Roaming\Python\Python311\site-packages\seaborn\_oldcore.py:
1498: FutureWarning: is_categorical_dtype is deprecated and will be removed in a
future version. Use isinstance(dtype, CategoricalDtype) instead
  if pd.api.types.is_categorical_dtype(vector):
```



Dropping Outliers

In [ ]:
```
features = ['traveltime', 'freetime', 'Dalc']
```

In [ ]:
```
def outliers_handling(df_of_features, drop = False):
    for each_feature in df_of_features.columns:
        feature_data = df_of_features[each_feature]
        Q1 = np.percentile(feature_data, 25.)
        Q3 = np.percentile(feature_data, 75.)
        IQR = Q3-Q1
        lower_limit = Q1 - (1.5*IQR)
        upper_limit = Q3 + (1.5*IQR)
        upper_outliers = feature_data[feature_data > upper_limit].index.tolist()
        lower_outliers = feature_data[feature_data < lower_limit].index.tolist()
        bad_indices = list(set(upper_outliers + lower_outliers))
        if not drop:
            print(f'For the feature {each_feature}, No of Outliers is {len(bad_i
        if drop:
            df.drop(outliers, inplace = True, errors = 'ignore')
            print('Outliers from {} feature removed'.format(each_feature))
```

In [ ]:
```
outliers_handling(df[features])
```

```
For the feature traveltime, No of Outliers is 8
For the feature freetime, No of Outliers is 19
For the feature Dalc, No of Outliers is 18
```

In [ ]:
```
outliers_handling(df[features], drop=True)
```

```
Outliers from traveltime feature removed
Outliers from freetime feature removed
Outliers from Dalc feature removed
```