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PROJECT-02(Income Qualification in Latin America)

OBJECTIVE-Identify the level of income qualification needed for the families in Latin America.

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
import warnings
warnings.filterwarnings("ignore")
```

In [2]:
```
train=pd.read_csv("train.csv",index_col=0)
test=pd.read_csv("test.csv",index_col=0)
```

In [3]:
```
train.shape,test.shape
```

Out[3]:
```
((9557, 142), (23856, 141))
```

In [4]:
```
train.head()
```

Out[4]:

Id	v2a1	hacdor	rooms	hacapo	v14a	refrig	v18q	v18q1	r4h1	r4h2	...	SQBescolari	SQBage	SQBhogar_total	SQBedjefe	SQBhogar_nin	SQBovercrowding	SQBdependency	SC
ID_279628684	190000.0	0	3	0	1	1	0	NaN	0	1	...	100	1849	1	100	0	1.000000	0.0	
ID_f29eb3ddd	135000.0	0	4	0	1	1	1	1.0	0	1	...	144	4489	1	144	0	1.000000	64.0	
ID_68de51c94	NaN	0	8	0	1	1	0	NaN	0	0	...	121	8464	1	0	0	0.250000	64.0	
ID_d671db89c	180000.0	0	5	0	1	1	1	1.0	0	2	...	81	289	16	121	4	1.777778	1.0	
ID_d56d6f5f5	180000.0	0	5	0	1	1	1	1.0	0	2	...	121	1369	16	121	4	1.777778	1.0	

5 rows × 142 columns

In [5]:
```
test.head()
```

Out[5]:

Id	v2a1	hacdor	rooms	hacapo	v14a	refrig	v18q	v18q1	r4h1	r4h2	...	age	SQBescolari	SQBage	SQBhogar_total	SQBedjefe	SQBhogar_nin	SQBovercrowding	SQBdependenc
ID_2f6873615	NaN	0	5	0	1	1	0	NaN	1	1	...	4	0	16	9	0	1	2.25	0.2
ID_1c78846d2	NaN	0	5	0	1	1	0	NaN	1	1	...	41	256	1681	9	0	1	2.25	0.2
ID_e5442cf6a	NaN	0	5	0	1	1	0	NaN	1	1	...	41	289	1681	9	0	1	2.25	0.2
ID_a8db26a79	NaN	0	14	0	1	1	1	1.0	0	1	...	59	256	3481	1	256	0	1.00	0.0
ID_a62966799	175000.0	0	4	0	1	1	1	1.0	0	0	...	18	121	324	1	0	1	0.25	64.0

5 rows × 141 columns

From the above,it's clear that Target column is the output variable.

In [6]:
```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 9557 entries, ID_279628684 to ID_a38c64491
Columns: 142 entries, v2a1 to Target
dtypes: float64(8), int64(130), object(4)
memory usage: 10.4+ MB
```

In [7]:
```
test.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 23856 entries, ID_2f6873615 to ID_34754556f
Columns: 141 entries, v2a1 to agesq
dtypes: float64(8), int64(129), object(4)
memory usage: 25.8+ MB
```

Understand the type of data

In [8]:
```
train.describe(include="object")
```

Out[8]:

	idhogar	dependency	edjefe	edjefa
count	9557	9557	9557	9557
unique	2988	31	22	22
top	fd8a6d014	yes	no	no
freq	13	2192	3762	6230

In [9]:
```
test.describe(include="object")
```

Out[9]:

	idhogar	dependency	edjefe	edjefa
count	23856	23856	23856	23856
unique	7352	35	22	22
top	8e9159699	yes	no	no
freq	13	5388	9056	15845

In [10]:
```
train["idhogar"].unique()
```

Out[10]:
```
array(['21eb7fcc1', '0e5d7a658', '2c7317ea8', ..., 'a8eeafc29',
       '212db6f6c', 'd6c086aa3'], dtype=object)
```

In [11]:
```
train["dependency"].value_counts()[:10]
```

Out[11]:
```
yes          2192
no           1747
.5           1497
2             730
1.5           713
.33333334     598
.66666669     487
8             378
.25           260
3             236
Name: dependency, dtype: int64
```

In [12]:
```
train["dependency"][train["dependency"].isin(["yes","no"])==False].value_counts().head(1)
```

Out[12]:
```
.5    1497
Name: dependency, dtype: int64
```

In [13]:
```
train.dependency[train.dependency.isin(["yes","no"])==False].mode()
```

Out[13]:
```
0    .5
dtype: object
```

In [14]:
```
train["dependency"]=train["dependency"].replace("yes",0.5).replace("no",0).astype("float")
test["dependency"]=test["dependency"].replace("yes",0.5).replace("no",0).astype("float")
```

changed object datatype to float of dependency column

In [15]:
```
train.edjefe[train.edjefe.isin(["yes","no"])==False].astype("float")
```

Out[15]:
```
Id
ID_279628684    10.0
ID_f29eb3ddd    12.0
ID_d671db89c    11.0
ID_d56d6f5f5    11.0
ID_ec05b1a7b    11.0
                ... 
ID_d45ae367d     9.0
ID_c94744e07     9.0
ID_85fc658f8     9.0
ID_ced540c61     9.0
ID_a38c64491     9.0
Name: edjefe, Length: 5672, dtype: float64
```

In [16]:
```
train.edjefe[train.edjefe.isin(["yes","no"])==False].astype("float").median()
```

Out[16]:
```
7.0
```

In [17]:
```
np.median(train.edjefe[train.edjefe.isin(["yes","no"])==False].astype("float"))
```

Out[17]:
```
7.0
```

In [18]:
```
med=np.median(train.edjefe[train.edjefe.isin(["yes","no"])==False].astype("float"))
train["edjefe"]=train["edjefe"].replace("yes",med).replace("no",0).astype("float")
test["edjefe"]=test["edjefe"].replace("yes",med).replace("no",0).astype("float")
```

changed object datatype to float of edjefe column

In [19]:
```
med=np.median(train.edjefa[train.edjefa.isin(["yes","no"])==False].astype("float"))
train["edjefa"]=train["edjefa"].replace("yes",med).replace("no",0).astype("float")
test["edjefa"]=test["edjefa"].replace("yes",med).replace("no",0).astype("float")
```

changed object datatype to float of edjefa column

In [20]:
```
train.describe(include="object")
```

Out[20]:

	idhogar
count	9557
unique	2988
top	fd8a6d014
freq	13

Count how many null values are existing in columns

In [21]:
```
train.isna().sum().sort_values(ascending=False)[:10]
```

Out[21]:
```
rez_esc         7928
v18q1           7342
v2a1            6860
SQBmeaned          5
meaneduc           5
hogar_adul         0
parentesco10       0
parentesco11       0
parentesco12       0
idhogar            0
dtype: int64
```

In [22]:
```
test.isna().sum().sort_values(ascending=False)[:10]
```

Out[22]:
```
rez_esc         19653
v18q1           18126
v2a1            17403
SQBmeaned          31
meaneduc           31
hogar_adul          0
parentesco10        0
parentesco11        0
parentesco12        0
idhogar             0
dtype: int64
```

Training dataset

In [23]:
```
print("The percentage of missing values in rez_esc is ",(train["rez_esc"].isna().sum()/train.shape[0]))
print("The percentage of missing values in v18q1 is ",(train["v18q1"].isna().sum()/train.shape[0]))
print("The percentage of missing values in v2a1 is ",(train["v2a1"].isna().sum()/train.shape[0]))
```

```
The percentage of missing values in rez_esc is  0.8295490216595166
The percentage of missing values in v18q1 is  0.7682327090091032
The percentage of missing values in v2a1 is  0.717798472323951
```

Testing dataset

In [24]:
```
print("The percentage of missing values in rez_esc is ",(test["rez_esc"].isna().sum()/test.shape[0]))
print("The percentage of missing values in v18q1 is ",(test["v18q1"].isna().sum()/test.shape[0]))
print("The percentage of missing values in v2a1 is ",(test["v2a1"].isna().sum()/test.shape[0]))
```

```
The percentage of missing values in rez_esc is  0.823817907444668
The percentage of missing values in v18q1 is  0.7598088531187123
The percentage of missing values in v2a1 is  0.7295020120724346
```

In [25]:
```
train.shape,test.shape
```

Out[25]:
```
((9557, 142), (23856, 141))
```

In [26]:
```
train.drop(columns=["rez_esc","v18q1","v2a1"],inplace=True)
test.drop(columns=["rez_esc","v18q1","v2a1"],inplace=True)
```

In [27]:
```
train.shape,test.shape
```

Out[27]:
```
((9557, 139), (23856, 138))
```

In [28]:
```
train.isna().sum().sort_values(ascending=False)
```

Out[28]:
```
SQBmeaned          5
meaneduc           5
hacdor             0
hogar_total        0
parentesco11       0
                  ..
abastaguano        0
abastaguafuera     0
abastaguadentro    0
cielorazo          0
Target             0
Length: 139, dtype: int64
```

In [29]:
```
train.columns[train.isna().any()]
```

Out[29]:
```
Index(['meaneduc', 'SQBmeaned'], dtype='object')
```

In [30]:
```
null=train.columns[train.isna().any()]
train[null].isna().sum()
```

Out[30]:
```
meaneduc     5
SQBmeaned    5
dtype: int64
```

In [31]:
```
test.isna().sum().sort_values(ascending=False)
```

Out[31]:
```
SQBmeaned          31
meaneduc           31
hacdor              0
hogar_mayor         0
parentesco10        0
                   ..
abastaguano         0
abastaguafuera      0
abastaguadentro     0
cielorazo           0
agesq               0
Length: 138, dtype: int64
```

In [32]:
```
from sklearn.impute import SimpleImputer
```

In [33]:
```
imputer=SimpleImputer(missing_values=np.nan,strategy="median")
imputer.fit(train[["SQBmeaned","meaneduc"]])
```

Out[33]:
```
SimpleImputer(strategy='median')
```

In [34]:
```
train[["SQBmeaned","meaneduc"]]=imputer.transform(train[["SQBmeaned","meaneduc"]])
test[["SQBmeaned","meaneduc"]]=imputer.transform(test[["SQBmeaned","meaneduc"]])
```

In [35]:
```
train.isna().sum().sort_values(ascending=False)
```

Out[35]:
```
hacdor             0
hogar_total        0
parentesco11       0
parentesco12       0
idhogar            0
                  ..
abastaguano        0
abastaguafuera     0
abastaguadentro    0
cielorazo          0
Target             0
Length: 139, dtype: int64
```

In [36]:
```
train.isna().any().sum()
```

Out[36]:
```
0
```

In [37]:
```
test.isna().any().sum()
```

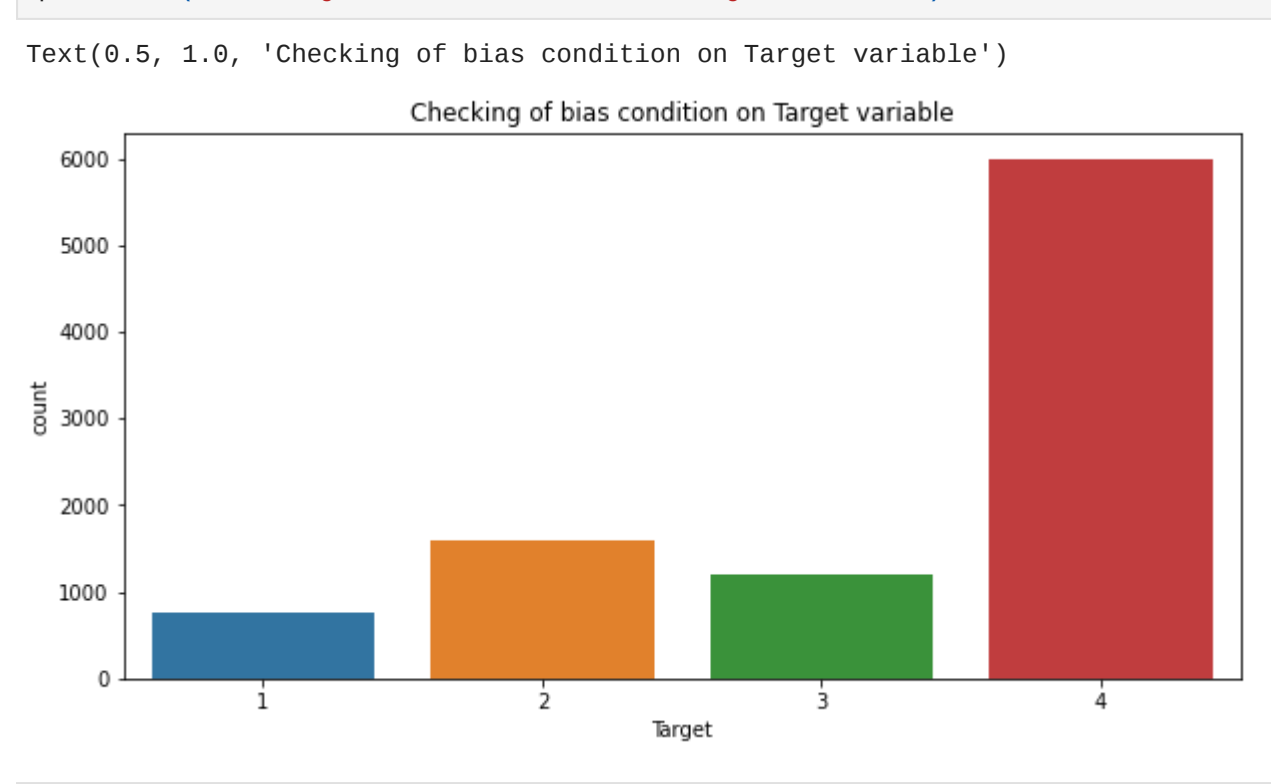
Out[37]:
```
0
```

Removed null values from the dataset in the above.

Check if there are any biases in your dataset.

In [38]:
```
plt.figure(figsize=(10,5))
sns.countplot(x="Target",data=train)
plt.title("Checking of bias condition on Target variable")
```

Out[38]:
```
Text(0.5, 1.0, 'Checking of bias condition on Target variable')
```



In [39]:
```
train["Target"].value_counts()
```

Out[39]:
```
4    5996
2    1597
3    1209
1     755
Name: Target, dtype: int64
```

Since,the 4 has highest value as compared to others.So,there are biases in the dataset.

Check whether all members of the house have the same poverty level.

In [40]:
```
train.groupby(["idhogar"])["Target"].nunique()>1
```

Out[40]:
```
idhogar
001ff74ca    False
003123ec2    False
004616164    False
004983866    False
005905417    False
             ...
ff9343a35    False
ff9d5ab17    False
ffae4a097    False
ffe90d46f    False
fff7d6be1    False
Name: Target, Length: 2988, dtype: bool
```

In [41]:
```
print("House id with different poverty level: ")
(train.groupby(["idhogar"])["Target"].nunique()>1).index
```

```
House id with different poverty level:
```

Out[41]:
```
Index(['001ff74ca', '003123ec2', '004616164', '004983866', '005905417',
       '006031de3', '006555fe2', '00693f597', '006b64543', '00941f1f4',
       ...
       'ff250fd6c', 'ff31b984b', 'ff38ddef1', 'ff6d16fd0', 'ff703eed4',
       'ff9343a35', 'ff9d5ab17', 'ffae4a097', 'ffe90d46f', 'fff7d6be1'],
      dtype='object', name='idhogar', length=2988)
```

Check if there is a house without a family head.

In [42]:
```
train.groupby(["idhogar"])["parentesco1"].sum()==0
```

Out[42]:
```
idhogar
001ff74ca    False
003123ec2    False
004616164    False
004983866    False
005905417    False
             ...
ff9343a35    False
ff9d5ab17    False
ffae4a097    False
ffe90d46f    False
fff7d6be1    False
Name: parentesco1, Length: 2988, dtype: bool
```

In [43]:
```
print("House id without a family head:")
(train.groupby(["idhogar"])["parentesco1"].sum()==0).index
```

```
House id without a family head:
```

Out[43]:
```
Index(['001ff74ca', '003123ec2', '004616164', '004983866', '005905417',
       '006031de3', '006555fe2', '00693f597', '006b64543', '00941f1f4',
       ...
       'ff250fd6c', 'ff31b984b', 'ff38ddef1', 'ff6d16fd0', 'ff703eed4',
       'ff9343a35', 'ff9d5ab17', 'ffae4a097', 'ffe90d46f', 'fff7d6be1'],
      dtype='object', name='idhogar', length=2988)
```

Set poverty level of the members and the head of the house within a family.

In [44]:
```
Target_mean=train.groupby("idhogar")["Target"].mean().astype("int64").reset_index().rename(columns={"Target":"Target_mean"})
Target_mean
```

Out[44]:

	idhogar	Target_mean
0	001ff74ca	4
1	003123ec2	2
2	004616164	2
3	004983866	3
4	005905417	2
...	...	...
2983	ff9343a35	4
2984	ff9d5ab17	4
2985	ffae4a097	4
2986	ffe90d46f	1
2987	fff7d6be1	4

2988 rows × 2 columns

In [45]:
```
train=train.merge(Target_mean,on="idhogar",how="left")
train.head()
```

Out[45]:

	hacdor	rooms	hacapo	v14a	refrig	v18q	r4h1	r4h2	r4h3	r4m1	...	SQBage	SQBhogar_total	SQBedjefe	SQBhogar_nin	SQBovercrowding	SQBdependency	SQBmeaned	agesq	Target	Targ
0	0	3	0	1	1	0	0	1	1	0	...	1849	1	100	0	1.000000	0.0	100.0	1849	4	
1	0	4	0	1	1	1	0	1	1	0	...	4489	1	144	0	1.000000	64.0	144.0	4489	4	
2	0	8	0	1	1	0	0	0	0	0	...	8464	1	0	0	0.250000	64.0	121.0	8464	4	
3	0	5	0	1	1	1	0	2	2	1	...	289	16	121	4	1.777778	1.0	121.0	289	4	
4	0	5	0	1	1	1	0	2	2	1	...	1369	16	121	4	1.777778	1.0	121.0	1369	4	

5 rows × 140 columns

In [46]:
```
train.Target=train.Target_mean
train.head()
```

Out[46]:

	hacdor	rooms	hacapo	v14a	refrig	v18q	r4h1	r4h2	r4h3	r4m1	...	SQBage	SQBhogar_total	SQBedjefe	SQBhogar_nin	SQBovercrowding	SQBdependency	SQBmeaned	agesq	Target	Targ
0	0	3	0	1	1	0	0	1	1	0	...	1849	1	100	0	1.000000	0.0	100.0	1849	4	
1	0	4	0	1	1	1	0	1	1	0	...	4489	1	144	0	1.000000	64.0	144.0	4489	4	
2	0	8	0	1	1	0	0	0	0	0	...	8464	1	0	0	0.250000	64.0	121.0	8464	4	
3	0	5	0	1	1	1	0	2	2	1	...	289	16	121	4	1.777778	1.0	121.0	289	4	
4	0	5	0	1	1	1	0	2	2	1	...	1369	16	121	4	1.777778	1.0	121.0	1369	4	

5 rows × 140 columns

In [47]:
```
train.drop("Target_mean",axis=1,inplace=True)
train.head()
```

Out[47]:

	hacdor	rooms	hacapo	v14a	refrig	v18q	r4h1	r4h2	r4h3	r4m1	...	SQBescolari	SQBage	SQBhogar_total	SQBedjefe	SQBhogar_nin	SQBovercrowding	SQBdependency	SQBmeaned	agesq
0	0	3	0	1	1	0	0	1	1	0	...	100	1849	1	100	0	1.000000	0.0	100.0	1849
1	0	4	0	1	1	1	0	1	1	0	...	144	4489	1	144	0	1.000000	64.0	144.0	4489
2	0	8	0	1	1	0	0	0	0	0	...	121	8464	1	0	0	0.250000	64.0	121.0	8464
3	0	5	0	1	1	1	0	2	2	1	...	81	289	16	121	4	1.777778	1.0	121.0	289
4	0	5	0	1	1	1	0	2	2	1	...	121	1369	16	121	4	1.777778	1.0	121.0	1369

5 rows × 139 columns

Prediction model for machine learning

In [48]:
```
print("Shape of train dataset: ",(train.shape))
train.drop("idhogar",axis=1,inplace=True)
print("Shape of train dataset: ",(train.shape))
```

```
Shape of train dataset:  (9557, 139)
Shape of train dataset:  (9557, 138)
```

In [49]:
```
print("Shape of test dataset: ",(test.shape))
test.drop("idhogar",axis=1,inplace=True)
print("Shape of test.csv dataset: ",(test.shape))
```

```
Shape of test dataset:  (23856, 138)
Shape of test.csv dataset:  (23856, 137)
```

In [50]:
```
x=train.drop(["Target"],axis=1)
y=train[["Target"]]
```

In [51]:
```
x.head()
```

Out[51]:

	hacdor	rooms	hacapo	v14a	refrig	v18q	r4h1	r4h2	r4h3	r4m1	...	age	SQBescolari	SQBage	SQBhogar_total	SQBedjefe	SQBhogar_nin	SQBovercrowding	SQBdependency	SQBmeaned
0	0	3	0	1	1	0	0	1	1	0	...	43	100	1849	1	100	0	1.000000	0.0	100.0
1	0	4	0	1	1	1	0	1	1	0	...	67	144	4489	1	144	0	1.000000	64.0	144.0
2	0	8	0	1	1	0	0	0	0	0	...	92	121	8464	1	0	0	0.250000	64.0	121.0
3	0	5	0	1	1	1	0	2	2	1	...	17	81	289	16	121	4	1.777778	1.0	121.0
4	0	5	0	1	1	1	0	2	2	1	...	37	121	1369	16	121	4	1.777778	1.0	121.0

5 rows × 137 columns

In [52]:
```
y.head()
```

Out[52]:

	Target
0	4
1	4
2	4
3	4
4	4

Predict the accuracy using random forest classifier

In [53]:
```
from sklearn.ensemble import RandomForestClassifier
```

In [54]:
```
rf_model=RandomForestClassifier(min_samples_leaf=10,min_samples_split=10,random_state=25)
rf_model.fit(x,y)
```

Out[54]:
```
RandomForestClassifier(min_samples_leaf=10, min_samples_split=10,
                       random_state=25)
```

In [55]:
```
pred=rf_model.predict(x)
pred
```

Out[55]:
```
array([4, 4, 4, ..., 4, 4, 4], dtype=int64)
```

In [56]:
```
from sklearn.metrics import confusion_matrix,accuracy_score,classification_report
```

In [57]:
```
confusion_matrix(y_pred=pred,y_true=y)
```

Out[57]:
```
array([[ 546,   14,    0,  298],
       [   3, 1075,    1,  496],
       [   9,   39,  522,  584],
       [   8,    6,    1, 5955]], dtype=int64)
```

In [58]:
```
accuracy_score(y_pred=pred,y_true=y)
```

Out[58]:
```
0.8473370304488856
```

In [59]:
```
classification_report(y_pred=pred,y_true=y)
```

Out[59]:
```
'              precision    recall  f1-score   support\n\n           1       0.96      0.64      0.77       858\n           2       0.95      0.68      0.79
1575\n           3       1.00      0.45      0.62      1154\n           4       0.81      1.00      0.90      5970\n\n    accuracy
0.85      9557\n   macro avg       0.93      0.69      0.77      9557\nweighted avg       0.87      0.85      0.83      9557\n'
```

Check the accuracy using random forest with cross validation

In [60]:
```
from sklearn.model_selection import cross_val_score
```

In [61]:
```
cv=cross_val_score(rf_model,x,y,scoring="accuracy",cv=10)
cv
```

Out[61]:
```
array([0.63807531, 0.64958159, 0.64435146, 0.63598326, 0.66108787,
       0.66004184, 0.62970711, 0.62094241, 0.60837696, 0.61361257])
```

In [62]:
```
min(cv)
```

Out[62]:
```
0.6083769633507854
```

In [63]:
```
np.mean(cv)
```

Out[63]:
```
0.636176038905562
```

In [64]:
```
max(cv)
```

Out[64]:
```
0.6610878661087866
```

Thank you!!!