```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
Path = 'drive/My Drive/Dataset'
```

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import plotly.graph_objects as go
import plotly.express as px
import seaborn as sns

import xgboost as xgb
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.model_selection import cross_val_score

import pickle

import warnings
warnings.filterwarnings('ignore')

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

```
import pandas as pd
student_data= pd.read_csv(Path+'/student_list.csv')
```

```
student_data
```

	Marital status	Application mode	Application order	Course	Daytime/evening attendance	Previous qualification	Nacionality	Mothers qualification	Fathe qualificat
0	1	8	5	2	1	1	1	13	
1	1	6	1	11	1	1	1	1	
2	1	1	5	5	1	1	1	22	
3	1	8	2	15	1	1	1	23	
4	2	12	1	3	0	1	1	22	
...	...	...	...	...	...	...	...	...	
4419	1	1	6	15	1	1	1	1	
4420	1	1	2	15	1	1	19	1	
4421	1	1	1	12	1	1	1	22	

```
student_data.shape
```

```
(4424, 35)
```

4424 rows × 35 columns

```
student_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4424 entries, 0 to 4423
Data columns (total 35 columns):
 #   Column                                  Non-Null Count  Dtype
---  ------                                  --------------  -----
 0   Marital status                          4424 non-null   int64
 1   Application mode                        4424 non-null   int64
 2   Application order                       4424 non-null   int64
 3   Course                                  4424 non-null   int64
 4   Daytime/evening attendance              4424 non-null   int64
 5   Previous qualification                  4424 non-null   int64
 6   Nacionality                             4424 non-null   int64
 7   Mothers qualification                   4424 non-null   int64
 8   Fathers qualification                   4424 non-null   int64
 9   Mothers occupation                      4424 non-null   int64
 10  Fathers occupation                      4424 non-null   int64
 11  Displaced                               4424 non-null   int64
 12  Educational special needs               4424 non-null   int64
 13  Debtor                                  4424 non-null   int64
 14  Tuition fees up to date                 4424 non-null   int64
 15  Gender                                  4424 non-null   int64
```

```
 16  Scholarship holder                              4424 non-null   int64
 17  Age at enrollment                               4424 non-null   int64
 18  International                                   4424 non-null   int64
 19  Curricular units 1st sem (credited)             4424 non-null   int64
 20  Curricular units 1st sem (enrolled)             4424 non-null   int64
 21  Curricular units 1st sem (evaluations)          4424 non-null   int64
 22  Curricular units 1st sem (approved)             4424 non-null   int64
 23  Curricular units 1st sem (grade)                4424 non-null   float64
 24  Curricular units 1st sem (without evaluations)  4424 non-null   int64
 25  Curricular units 2nd sem (credited)             4424 non-null   int64
 26  Curricular units 2nd sem (enrolled)             4424 non-null   int64
 27  Curricular units 2nd sem (evaluations)          4424 non-null   int64
 28  Curricular units 2nd sem (approved)             4424 non-null   int64
 29  Curricular units 2nd sem (grade)                4424 non-null   float64
 30  Curricular units 2nd sem (without evaluations)  4424 non-null   int64
 31  Unemployment rate                               4424 non-null   float64
 32  Inflation rate                                  4424 non-null   float64
 33  GDP                                             4424 non-null   float64
 34  Target                                          4424 non-null   object
dtypes: float64(5), int64(29), object(1)
memory usage: 1.2+ MB
```

```
student_data.isna().sum()
```

```
Marital status                                  0
Application mode                                0
Application order                               0
Course                                          0
Daytime/evening attendance                      0
Previous qualification                          0
Nacionality                                     0
Mothers qualification                           0
Fathers qualification                           0
Mothers occupation                              0
Fathers occupation                              0
Displaced                                       0
Educational special needs                       0
Debtor                                          0
Tuition fees up to date                         0
Gender                                          0
Scholarship holder                              0
Age at enrollment                               0
International                                   0
Curricular units 1st sem (credited)             0
Curricular units 1st sem (enrolled)             0
Curricular units 1st sem (evaluations)          0
Curricular units 1st sem (approved)             0
Curricular units 1st sem (grade)                0
Curricular units 1st sem (without evaluations)  0
```

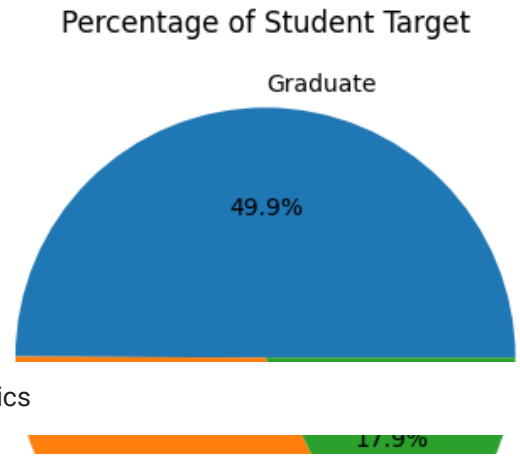
```
Curricular units 2nd sem (credited)              0
Curricular units 2nd sem (enrolled)              0
Curricular units 2nd sem (evaluations)           0
Curricular units 2nd sem (approved)              0
Curricular units 2nd sem (grade)                 0
Curricular units 2nd sem (without evaluations)   0
Unemployment rate                                0
Inflation rate                                   0
GDP                                              0
Target                                           0
dtype: int64
```

```
student_data.duplicated()
```

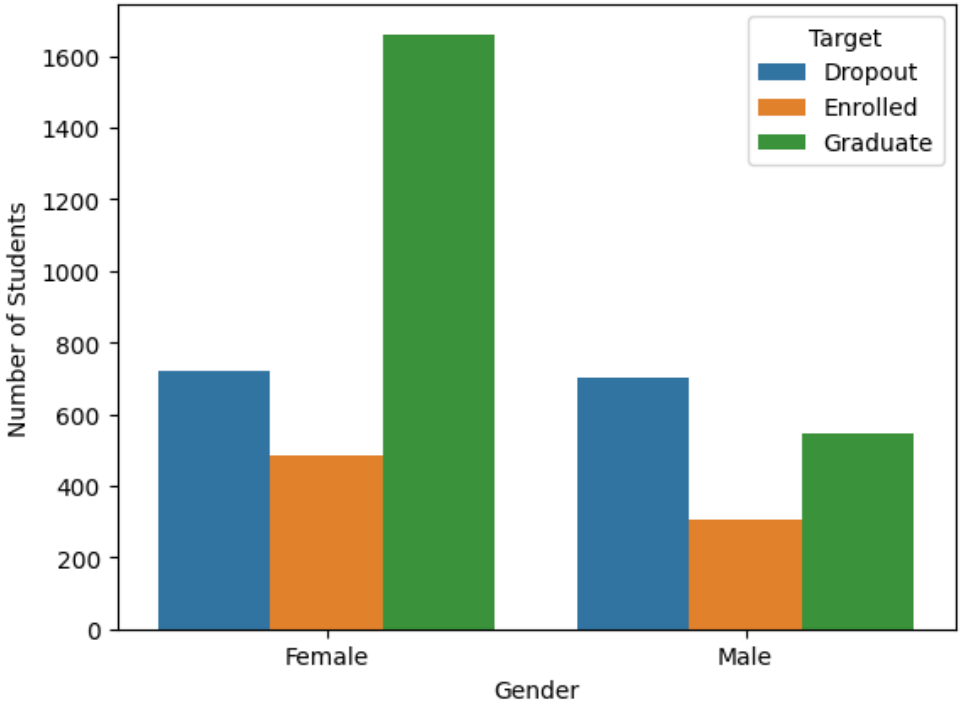
```
0       False
1       False
2       False
3       False
4       False
        ...
4419    False
4420    False
4421    False
4422    False
4423    False
Length: 4424, dtype: bool
```

data cleaning

```
student_target·=·student_data['Target'].value_counts()

plt.pie(student_target,·labels=student_target.index,·autopct='%1.1f%%')
plt.title('Percentage·of·Student·Target')
plt.show()
```

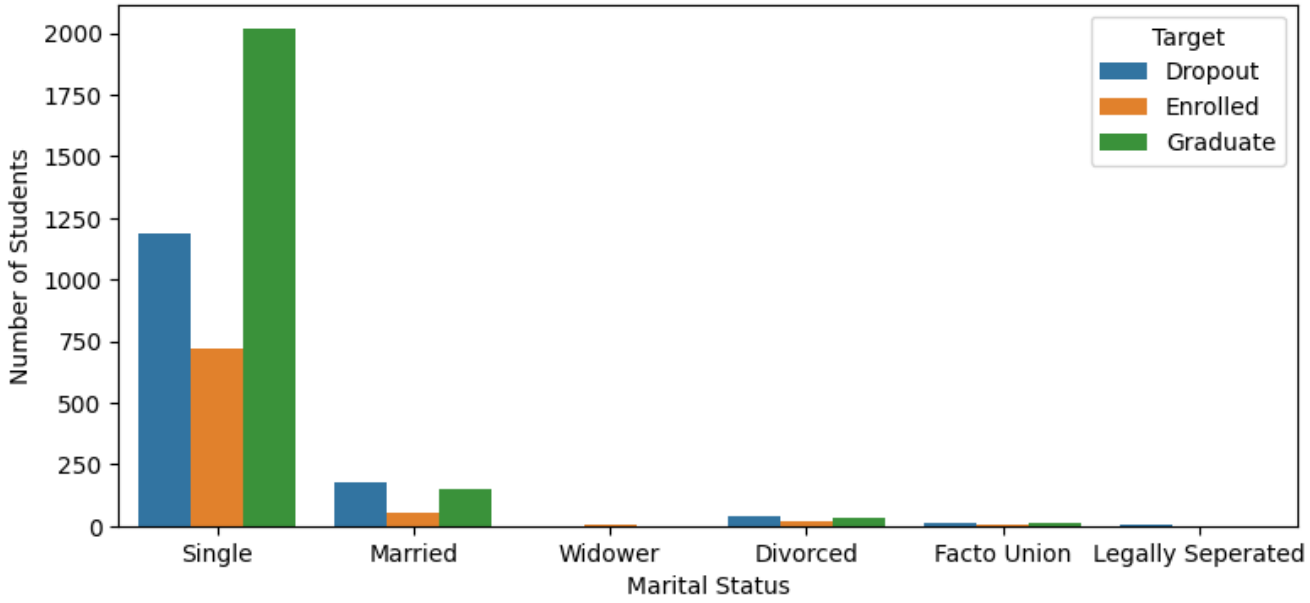



```
sns.countplot(data=student_data,·x='Gender',·hue='Target',·hue_order=['Dropout',·'Enrolled',·'Graduate'])

plt.xticks(ticks=[0,1],·labels=['Female','Male'])
plt.ylabel('Number·of·Students')
plt.show()
```




```
plt.figure(figsize=(9,4))
```

```
plt.figure(figsize=(9,4))

sns.countplot(data=student_data,·x='Marital·status',·hue='Target',·hue_order=['Dropout',·'Enrolled',·'Graduate'])

plt.xticks(ticks=[0,1,2,3,4,5],·labels=['Single','Married','Widower','Divorced','Facto·Union','Legally·Seperated'])
plt.xlabel('Marital·Status')
plt.ylabel('Number·of·Students')
plt.show()
```




```
student_data['Marital status'].value_counts()
```

```
1    3919
2     379
4      91
5      25
6       6
3       4
Name: Marital status, dtype: int64
```

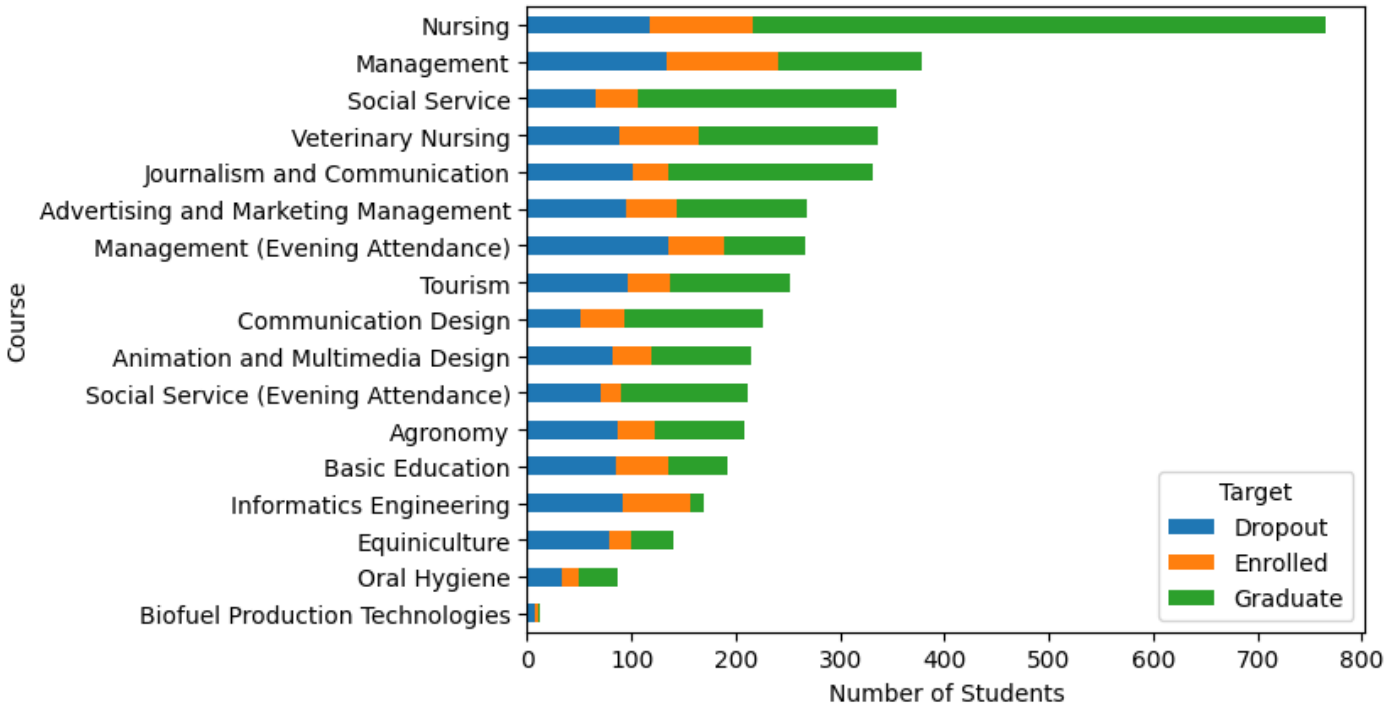
```
student_data = student_data[student_data['Marital status'].isin([1, 2, 4, 5])]
student_data.shape
```

```
(4414, 35)
```

```
student_data.drop(['Marital status'], axis = 1, inplace = True)
student_data.shape
```

```
(4414, 34)
```

```
student_course·=·student_data.groupby(['Course',·'Target']).size().reset_index().pivot(columns='Target',·index='Course',·values=0)

#·Rename·the·index·of·the·DataFrame
student_course·=·student_course.rename(index={1:'Biofuel·Production·Technologies',2:'Animation·and·Multimedia·Design',3:'Social·Service·(Evening·Att

student_course_total·=·student_course.sum(axis=1)
student_course_sorted·=·student_course_total.sort_values(ascending=True)
student_course.loc[student_course_sorted.index].plot(kind='barh',·stacked=True)

plt.xlabel('Number·of·Students')
plt.show()
```




```
student_data['Course'].value_counts()
```

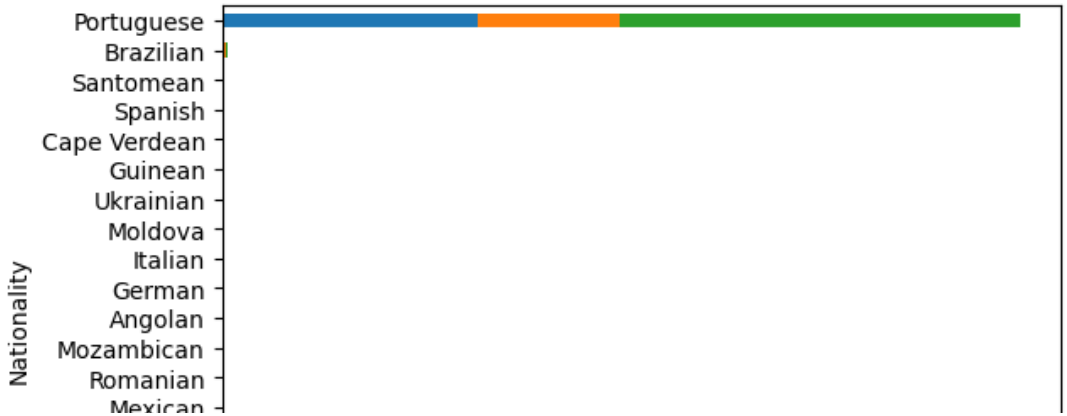
```
12     765
9      379
```

```
10    354
6     336
15    331
14    268
17    266
11    252
5     226
2     215
3     212
4     209
16    192
7     170
8     141
13     86
1      12
Name: Course, dtype: int64
```

```
student_data·=·student_data[(student_data['Course']·!=·1)]
student_data.shape
```

```
(4402, 34)
```

```
student_nationality·=·student_data.groupby(['Nacionality',·'Target']).size().reset_index().pivot(columns='Target',·index='Nacionality',·values=0)

#·Rename·the·index·of·the·DataFrame
student_nationality·=·student_nationality.rename(index={1:'Portuguese',·2:'German',·3:'Spanish',·4:'Italian',·5:'Dutch',·6:'English',·7:'Lithuanian'

student_nationality_total·=·student_nationality.sum(axis=1)
student_nationality_sorted·=·student_nationality_total.sort_values(ascending=True)
student_nationality.loc[student_nationality_sorted.index].plot(kind='barh',·stacked=True)

plt.xlabel('Number·of·Students')
plt.ylabel('Nationality')
plt.show()
```




```
student_data['Nacionality'].value_counts()
```

```
1     4294
14      36
12      14
9       13
3       13
10       5
16       3
4        3
18       3
8        2
17       2
15       2
11       2
2        2
19       2
13       1
5        1
21       1
20       1
6        1
7        1
Name: Nacionality, dtype: int64
```

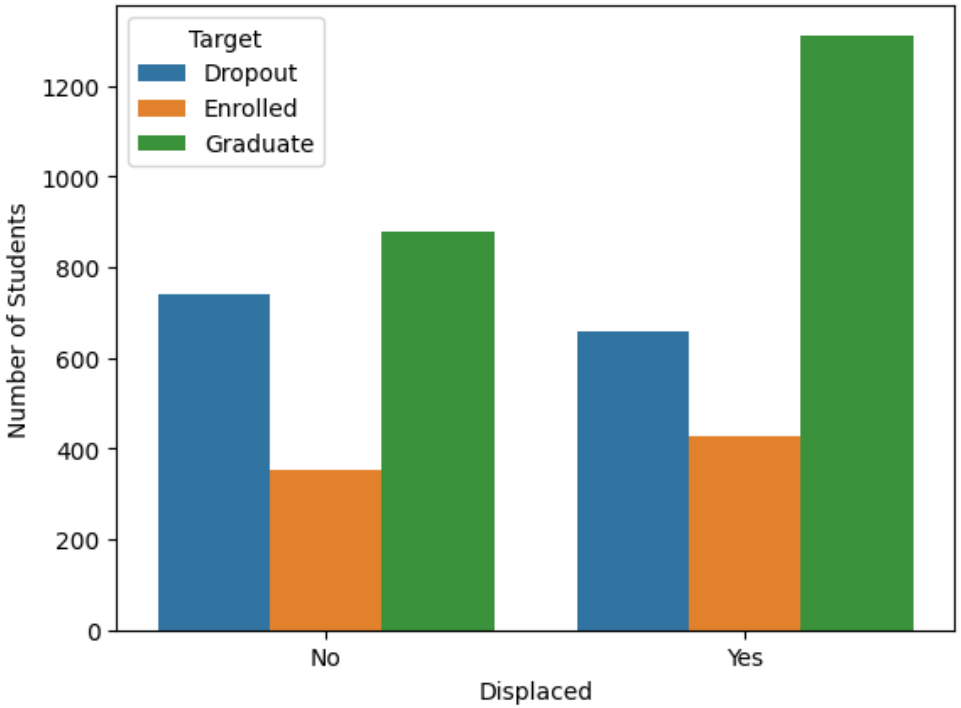
```
student_data = student_data[student_data['Nacionality'].isin([1, 14, 9, 12, 3])]
student_data.shape
```

```
(4370, 34)
```

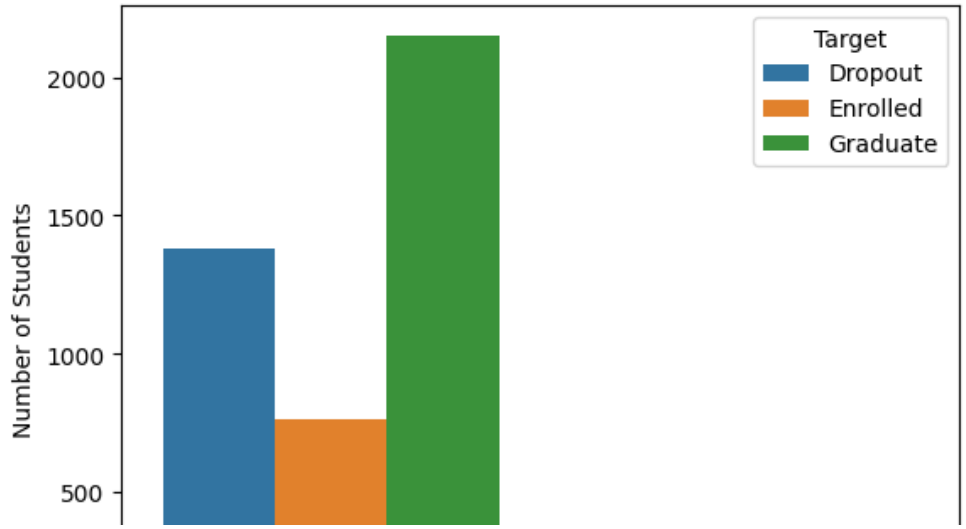
```
student_data.drop(['Nacionality'], axis = 1, inplace = True)
student_data.shape
```

```
(4370, 33)
```

```
sns.countplot(data=student_data,·x='Displaced',·hue='Target',·hue_order=['Dropout',·'Enrolled',·'Graduate'])

plt.xticks(ticks=[0,1],·labels=['No','Yes'])
plt.ylabel('Number·of·Students')
plt.show()
```




```
sns.countplot(data=student_data,·x='International',·hue='Target',·hue_order=['Dropout',·'Enrolled',·'Graduate'])

plt.xticks(ticks=[0,1],·labels=['No','Yes'])
plt.ylabel('Number·of·Students')
plt.show()
```




```
student_data['International'].value_counts()
```

```
0    4294
1      76
Name: International, dtype: int64
```

```
student_data = student_data[student_data['International'].isin([0])]
student_data.shape
```

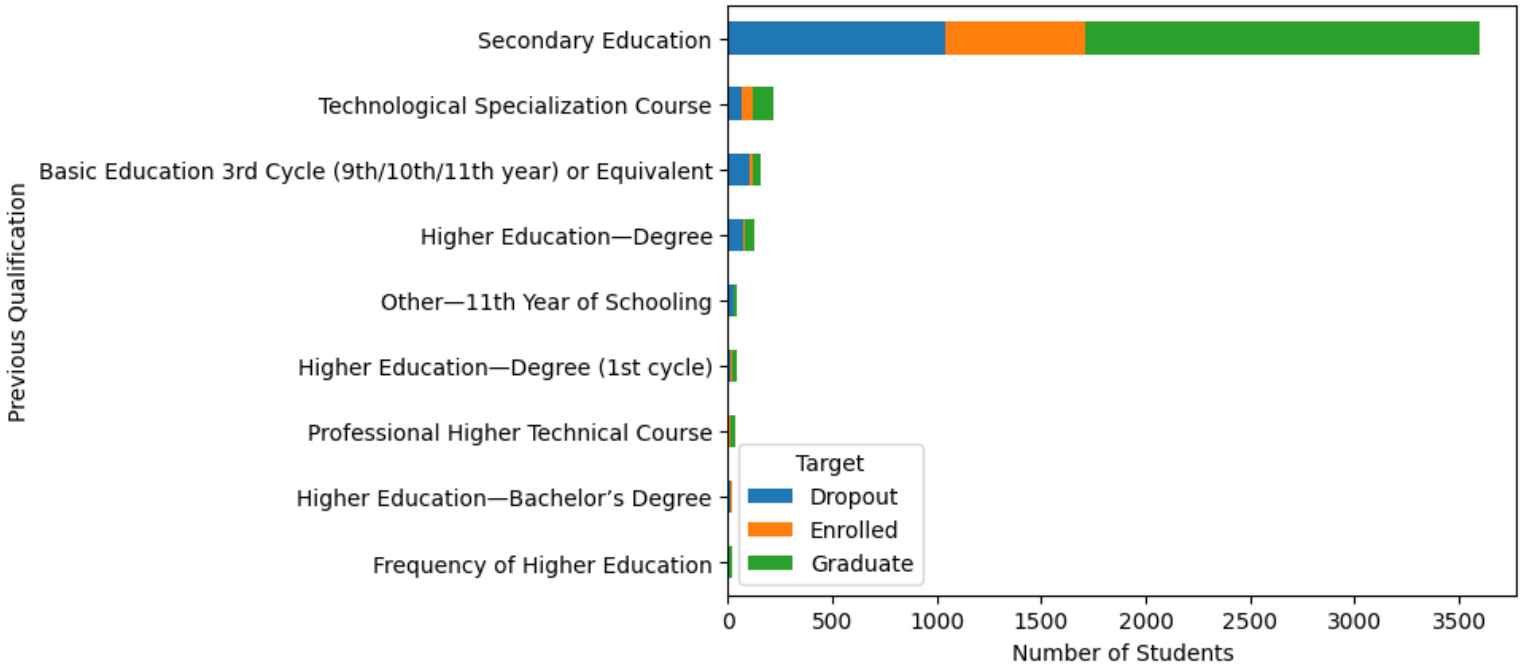
```
(4294, 33)
```

```
student_data.drop(['International'], axis = 1, inplace = True)
student_data.shape
```

```
(4294, 32)
```

```
student_prequal = student_data.groupby(['Previous qualification', 'Target']).size().reset_index().pivot(columns='Target', index='Previous qualificat

# Rename the index of the DataFrame
student_prequal = student_prequal.rename(index={1:'Secondary Education',2:'Higher Education–Bachelor’s Degree',3:'Higher Education–Degree',4:'Higher

student_prequal_total = student_prequal.sum(axis=1)
student_prequal_sorted = student_prequal_total.sort_values(ascending=True)
student_prequal_top = student_prequal_sorted[8:]
student_prequal.loc[student_prequal_top.index].plot(kind='barh', stacked=True)

plt.xlabel('Count')
```

```
plt.xlabel('Number of Students')
plt.ylabel('Previous Qualification')
plt.show()
```




```
student_data['Previous·qualification'].value_counts()
```

```
1     3597
14     214
12     160
3      126
9       44
15      39
16      36
2       22
6       16
7       11
4        8
13       7
17       6
8        4
11       2
5        1
```

```
10       1
Name: Previous qualification, dtype: int64
```

```
student_data = student_data[student_data['Previous qualification'].isin([1, 14, 12, 3, 9, 15, 16, 2, 6, 7])]
student_data.shape
```

```
(4265, 32)
```

```
student_data.drop(['Previous qualification'], axis = 1, inplace = True)
student_data.shape
```

```
(4265, 31)
```

```
sns.displot(data=student_data,·x='Age·at·enrollment',·kde=True)
student_data['Age·at·enrollment'].describe()

plt.xlabel('Age·at·Enrolment')
plt.ylabel('Number·of·Students')
plt.show()
```

```
student_data['Age·at·enrollment'].value_counts()
```

```
18    1017
19     894
20     577
21     309
22     166
24     126
23     102
27      90
26      86
25      84
28      80
29      63
32      58
34      57
31      53
30      45
35      45
33      41
37      36
39      34
36      33
41      30
38      29
45      22
43      22
44      21
40      21
47      16
50      16
49      13
42      13
46      12
48      10
53       7
51       7
54       6
17       5
55       4
52       4
58       3
60       2
59       2
70       1
61       1
62       1
```

```
57       1
Name: Age at enrollment, dtype: int64
```

```
student_data = student_data[student_data['Age at enrollment'].isin([18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37,
student_data.shape
```

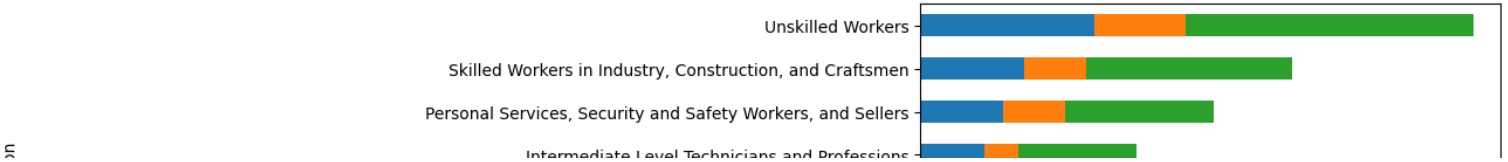
```
(4221, 31)
```

```
student_data.drop(['Age·at·enrollment'],·axis·=·1,·inplace·=·True)
student_data.shape
```

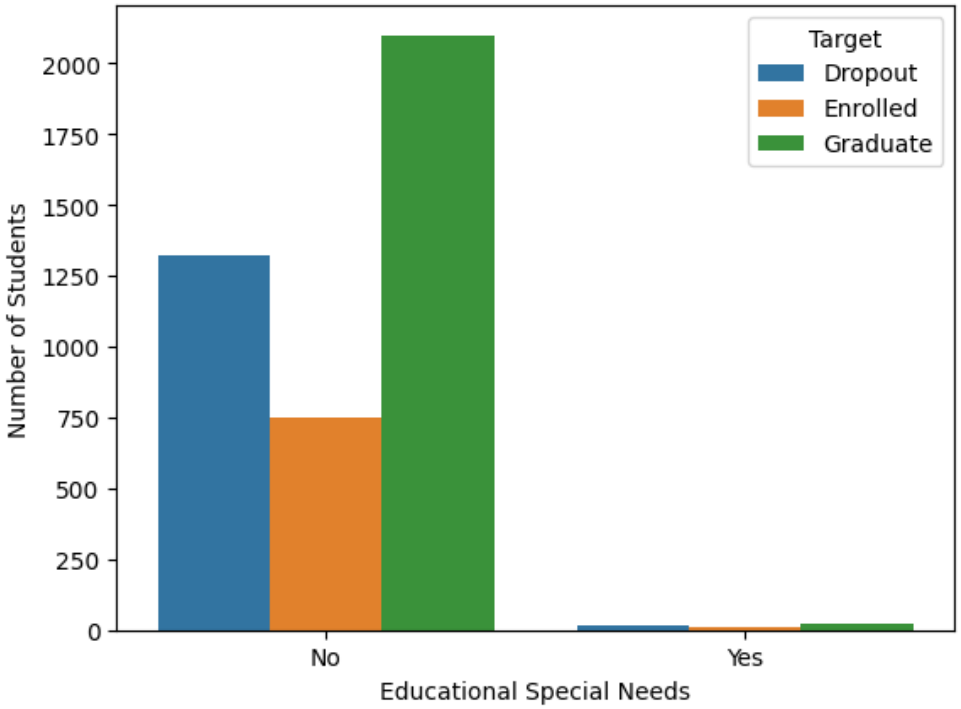
```
(4221, 30)
```

data analysis based on social and economic status of the students

```
student_occupation·=·student_data.groupby(["Fathers·occupation",·'Target']).size().reset_index().pivot(columns='Target',·index="Fathers·occupation",

student_occupation·=·student_occupation.rename(index={1:'Student',2:'Representatives·of·the·Legislative·Power·and·Executive·Bodies,·Directors,·Direc

student_occupation_total·=·student_occupation.sum(axis=1)
student_occupation_sorted·=·student_occupation_total.sort_values(ascending=True)
student_occupation_top10·=·student_occupation_sorted[36:]
student_occupation.loc[student_occupation_top10.index].plot(kind='barh',·stacked=True)

plt.xlabel('Number·of·Students')
plt.ylabel("Fathers·Occupation")
plt.show()
```




```
sns.countplot(data=student_data, x='Educational special needs', hue='Target', hue_order=['Dropout', 'Enrolled', 'Graduate'])

plt.xticks(ticks=[0,1], labels=['No','Yes'])
plt.xlabel('Educational Special Needs')
plt.ylabel('Number of Students')
plt.show()
```




```
student_data['Educational special needs'].value_counts()
```

```
0    4172
1      49
Name: Educational special needs, dtype: int64
```

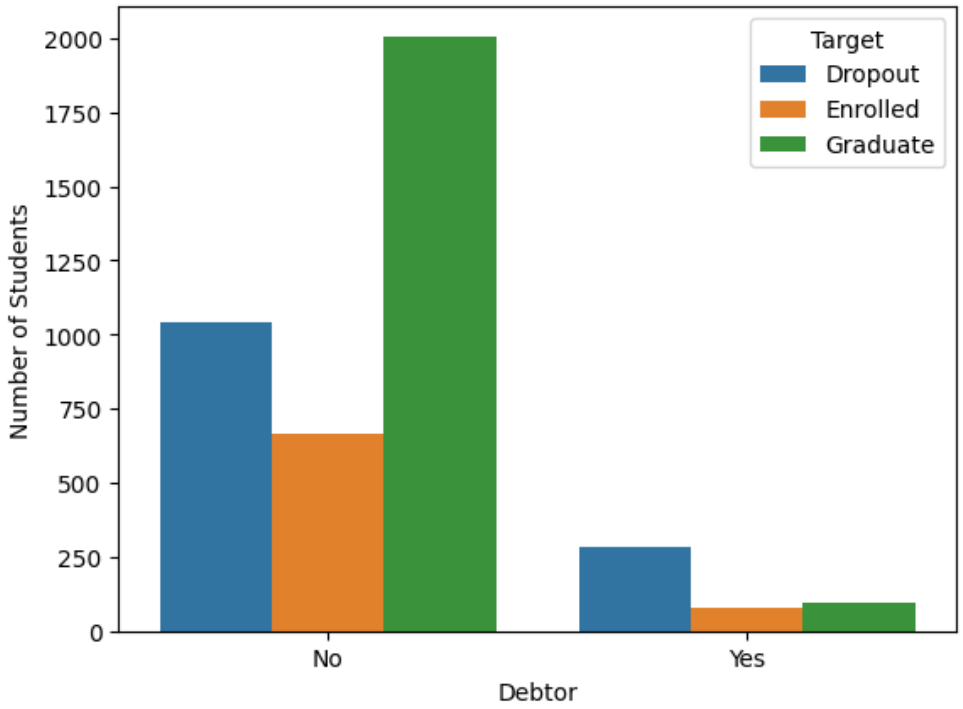
```
student_data = student_data[student_data['Educational special needs'].isin([0])]
student_data.shape
```

```
(4172, 30)
```

```
student_data.drop(['Educational special needs'], axis = 1, inplace = True)
student_data.shape
```

```
(4172, 29)
```

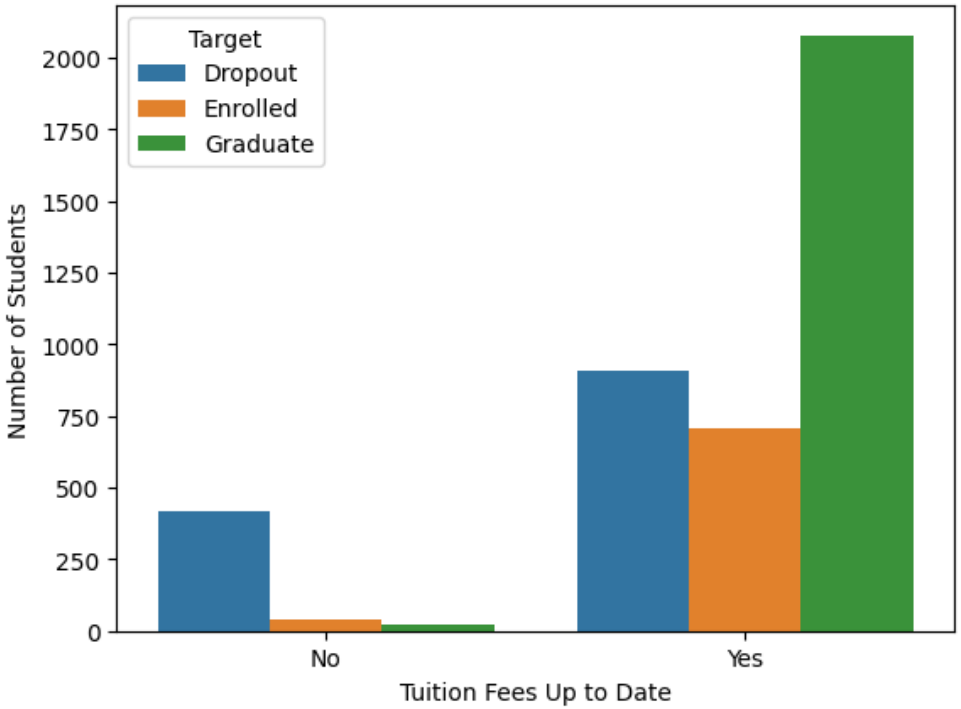
```
sns.countplot(data=student_data, x="Debtor", hue='Target', hue_order=['Dropout', 'Enrolled', 'Graduate'])

plt.xticks(ticks=[0,1], labels=['No','Yes'])
plt.xlabel('Debtor')
plt.ylabel('Number of Students')
plt.show()
```




```
student_data['Debtor'].value_counts()
```

```
0    3714
1     458
Name: Debtor, dtype: int64
```

```
sns.countplot(data=student_data,·x="Tuition·fees·up·to·date",·hue='Target',·hue_order=['Dropout',·'Enrolled',·'Graduate'])

plt.xticks(ticks=[0,1],·labels=['No','Yes'])
plt.xlabel('Tuition·Fees·Up·to·Date')
plt.ylabel('Number·of·Students')
plt.show()
```

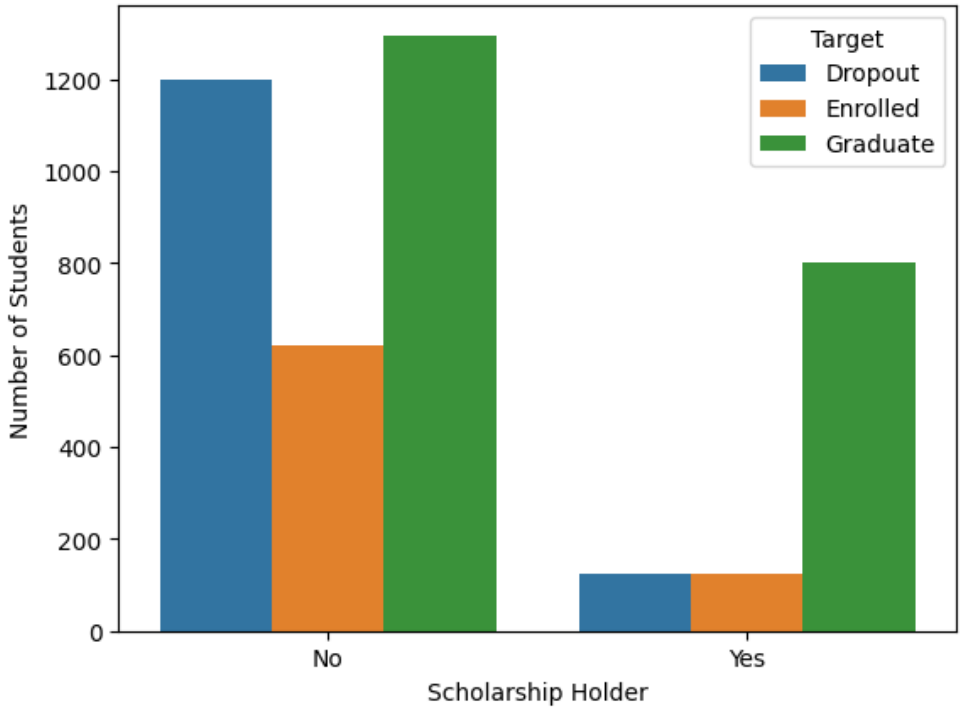



```
student_data['Tuition fees up to date'].value_counts()
```

```
1    3689
0     483
Name: Tuition fees up to date, dtype: int64
```

```
sns.countplot(data=student_data, x="Scholarship holder", hue='Target', hue_order=['Dropout', 'Enrolled', 'Graduate'])

plt.xticks(ticks=[0,1], labels=['No','Yes'])
```

```
plt.xlabel('Scholarship Holder')
plt.ylabel('Number of Students')
plt.show()
```

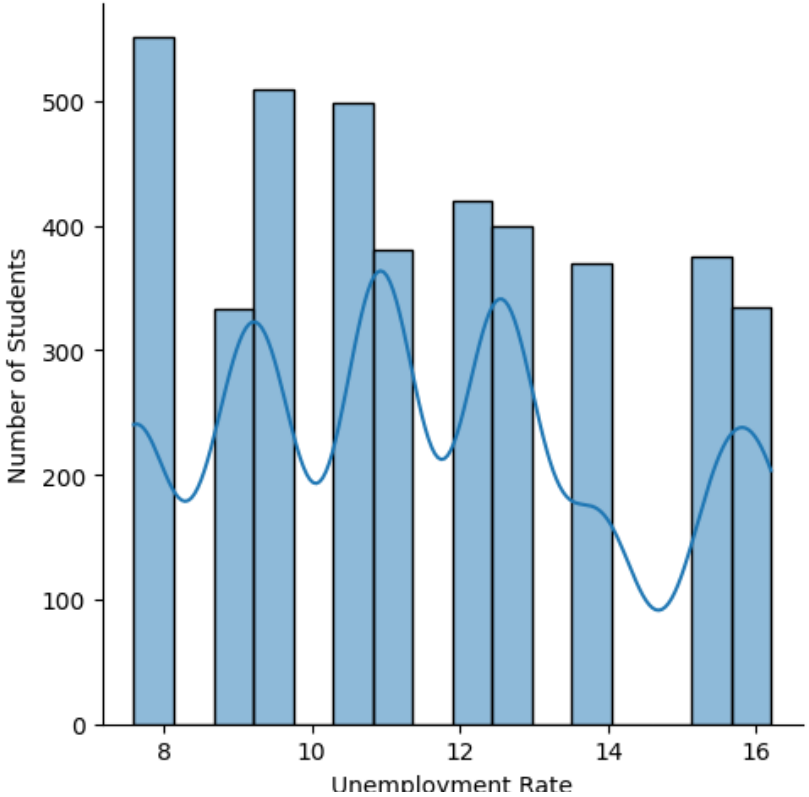



```
student_data['Scholarship holder'].value_counts()
```

```
0    3117
1    1055
Name: Scholarship holder, dtype: int64
```

Macroeconomic Status

```
sns.displot(data=student_data,·x="Unemployment·rate",·kde=True)
student_data['Unemployment·rate'].describe()

plt.xlabel('Unemployment·Rate')
plt.ylabel('Number·of·Students')
plt.show()
```



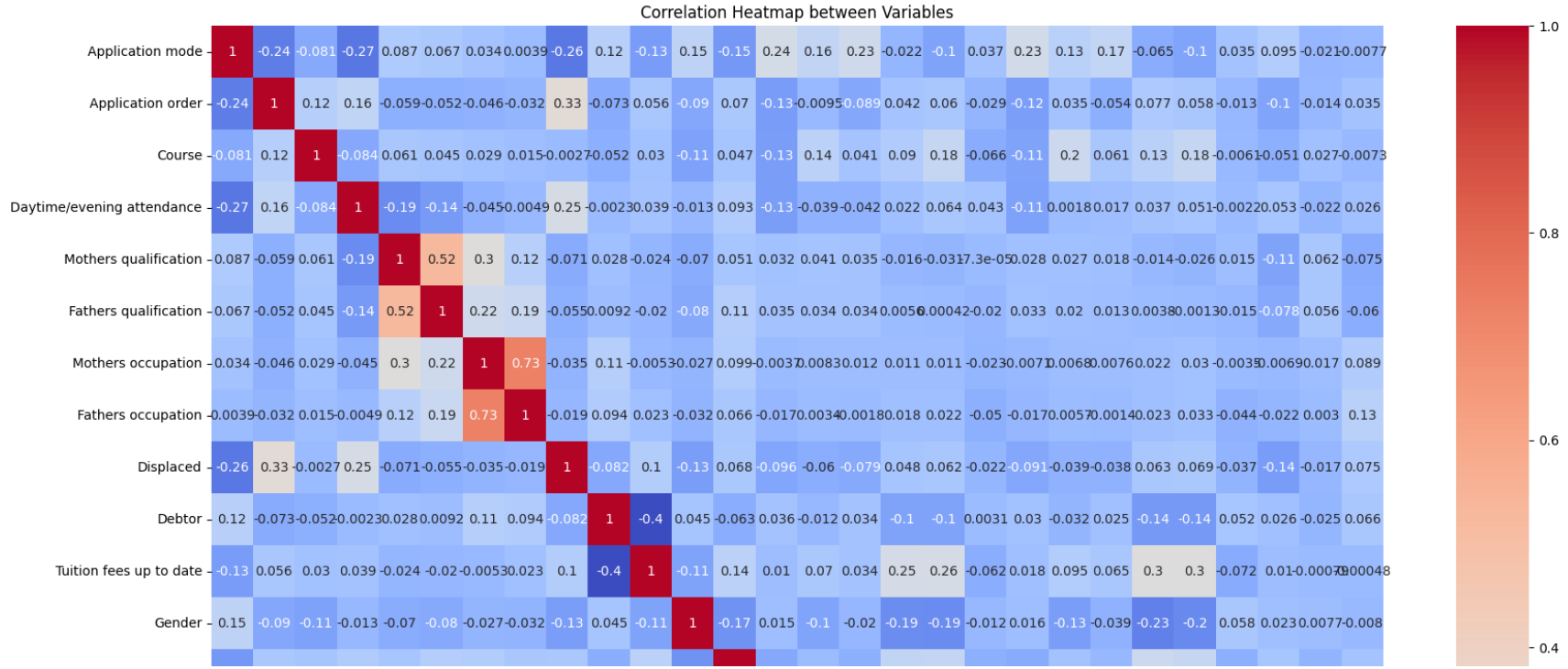

```
student_data['Unemployment rate'].value_counts()
```

```
7.6     551
9.4     510
10.8    499
12.4    420
12.7    399
11.1    380
15.5    375
13.9    370
16.2    335
8.9     333
Name: Unemployment rate, dtype: int64
```

Heatmap

```
plt.figure(figsize=(20,20))

sns.heatmap(student_data.corr(), annot=True, cmap='coolwarm')
```

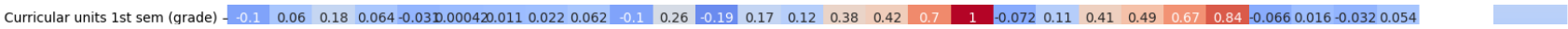
```
    plt.title('Correlation Heatmap between Variables')
    plt.show()
```



Data Modelling Converting Target Variable into Numeric Form

```
# student_data = student_data.drop(student_data[student_data['Target']=='Enrolled'].index)
# student_data.head()
```

```
encoder = LabelEncoder()
```




```
student_data['Target'] = encoder.fit_transform(student_data['Target'])
```

```
student_data.head()
```

	Application mode	Application order	Course	Daytime/evening attendance	Mothers qualification	Fathers qualification	Mothers occupation	Fathers occupation	Displaced	Debtor	...	Curricular units 2nd sem (credited)
0	8	5	2	1	13	10	6	10	1	0	...	0
1	6	1	11	1	1	3	4	4	1	0	...	0
3	8	2	15	1	23	27	6	4	1	0	...	0

Splitting Features and Target Variables into X and Y

```
student_data.columns
```

```
Index(['Application mode', 'Application order', 'Course',
       'Daytime/evening attendance', 'Mothers qualification',
       'Fathers qualification', 'Mothers occupation', 'Fathers occupation',
       'Displaced', 'Debtor', 'Tuition fees up to date', 'Gender',
       'Scholarship holder', 'Curricular units 1st sem (credited)',
       'Curricular units 1st sem (enrolled)',
       'Curricular units 1st sem (evaluations)',
       'Curricular units 1st sem (approved)',
       'Curricular units 1st sem (grade)',
       'Curricular units 1st sem (without evaluations)',
       'Curricular units 2nd sem (credited)',
       'Curricular units 2nd sem (enrolled)',
       'Curricular units 2nd sem (evaluations)',
       'Curricular units 2nd sem (approved)',
       'Curricular units 2nd sem (grade)',
       'Curricular units 2nd sem (without evaluations)', 'Unemployment rate',
       'Inflation rate', 'GDP', 'Target'],
      dtype='object')
```

```
student_data['Unemployment rate'].value_counts()
```

```
7.6     551
9.4     510
10.8    499
12.4    420
12.7    399
11.1    380
15.5    375
13.9    370
16.2    335
8.9     333
Name: Unemployment rate, dtype: int64
```

```
student_data['Inflation rate'].value_counts()
```

```
 1.4    832
 2.6    551
-0.8    510
 0.5    420
 3.7    399
 0.6    380
 2.8    375
-0.3    370
 0.3    335
Name: Inflation rate, dtype: int64
```

```
student_data['GDP'].value_counts()
```

```
 0.32    551
-3.12    510
 1.74    499
 1.79    420
-1.70    399
 2.02    380
-4.06    375
 0.79    370
-0.92    335
 3.51    333
Name: GDP, dtype: int64
```

```
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import PolynomialFeatures
X = student_data[['Unemployment rate', 'Inflation rate', 'GDP']]
scaler = StandardScaler()
scaled = scaler.fit_transform(X)
```

```
student_data.columns
```

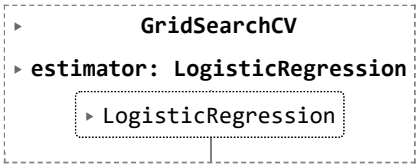
```
Index(['Application mode', 'Application order', 'Course',
       'Daytime/evening attendance', 'Mothers qualification',
       'Fathers qualification', 'Mothers occupation', 'Fathers occupation',
       'Displaced', 'Debtor', 'Tuition fees up to date', 'Gender',
       'Scholarship holder', 'Curricular units 1st sem (credited)',
       'Curricular units 1st sem (enrolled)',
       'Curricular units 1st sem (evaluations)',
       'Curricular units 1st sem (approved)',
       'Curricular units 1st sem (grade)',
       'Curricular units 1st sem (without evaluations)',
       'Curricular units 2nd sem (credited)',
       'Curricular units 2nd sem (enrolled)',
```

```
              'Curricular units 2nd sem (evaluations)',
              'Curricular units 2nd sem (approved)',
              'Curricular units 2nd sem (grade)',
              'Curricular units 2nd sem (without evaluations)', 'Unemployment rate',
              'Inflation rate', 'GDP', 'Target'],
             dtype='object')
```

```
Y = student_data[['Application mode', 'Application order', 'Course',
       'Daytime/evening attendance', 'Mothers qualification',
       'Fathers qualification', 'Mothers occupation', 'Fathers occupation',
       'Displaced', 'Debtor', 'Tuition fees up to date', 'Gender',
       'Scholarship holder', 'Curricular units 1st sem (credited)',
       'Curricular units 1st sem (enrolled)',
       'Curricular units 1st sem (evaluations)',
       'Curricular units 1st sem (approved)',
       'Curricular units 1st sem (grade)',
       'Curricular units 1st sem (without evaluations)',
       'Curricular units 2nd sem (credited)',
       'Curricular units 2nd sem (enrolled)',
       'Curricular units 2nd sem (evaluations)',
       'Curricular units 2nd sem (approved)',
       'Curricular units 2nd sem (grade)',
       'Curricular units 2nd sem (without evaluations)']]
target = student_data['Target']
feature = np.concatenate((scaled, Y), axis = 1)
X_train, X_test, y_train, y_test = train_test_split(feature, target, test_size = 0.20, random_state = 42)
```

Using Logistic regression

```
from sklearn.model_selection import GridSearchCV
from sklearn.linear_model import LogisticRegression
param_grid = {'solver' : ['lbfgs', 'sag', 'saga', 'newton-cg'] , 'C': [0.1, 1, 10, 100, 110, 120]}
grid = GridSearchCV (estimator = LogisticRegression(multi_class = 'multinomial'), param_grid = param_grid , cv = 5)
grid.fit(X_train, y_train)
```




```
grid.best_params_
```

```
{'C': 100, 'solver': 'lbfgs'}
```

```
Softmax_reg = LogisticRegression(multi_class = 'multinomial', solver = 'lbfgs', C = 100)
Softmax_reg.fit(X_train, y_train)
```

```
LogisticRegression
LogisticRegression(C=100, multi_class='multinomial')
```

```
predic = Softmax_reg.predict(X_test)
accuracy_score(y_test, predic)
```

```
0.7604790419161677
```

```
from sklearn.svm import SVC
svm = SVC(probability = True)
svm.fit(X_train, y_train)
```

```
SVC
SVC(probability=True)
```

```
predic3 = svm.predict(X_test)
accuracy_score(y_test, predic3)
```

```
0.732934131736527
```

```
# # SVM (Suport Vector Machine)
# from sklearn.svm import SVC
# from sklearn.model_selection import GridSearchCV, RandomizedSearchCV
# #clf = SVC(gamma='auto')

# svc = SVC()
# parameters = {'kernel':('linear', 'rbf'), 'C':[1, 10]}
# clf = GridSearchCV(svc, parameters)

# clf.fit(X_train,y_train)
# y_pred = clf.predict(X_test)
# print("Without Scaling and without CV: ",accuracy_score(y_test,y_pred))
# scores = cross_val_score(clf, X_train, y_train, cv=10)
# print("Without Scaling and With CV: ",scores.mean())
```

```
# from sklearn import metrics
# from sklearn.metrics import accuracy_score
# from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
# from sklearn.metrics import classification_report
# from sklearn.metrics import precision_score
# from sklearn.metrics import recall_score
# from sklearn.metrics import jaccard_score
# from sklearn.metrics import f1_score
# print('Precision = ', precision_score(y_test, predic))
# print('Recall = ', recall_score(y_test, predic))
# print('F1_Score = ', f1_score(y_test, predic))
# print('Accuracy = ', accuracy_score(y_test, predic))
```