In [ ]:

```
import pandas as pd
import numpy as np
import seaborn as s
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.impute import SimpleImputer
from datascience import *

# These lines do some fancy plotting magic.
import matplotlib
%matplotlib inline
import matplotlib.pyplot as plt
plt.style.use('fivethirtyeight')
import warnings
warnings.simplefilter('ignore', FutureWarning)
```

In [ ]:

```
#reading in the csv file as a dataframe
data=pd.read_csv("Life_Expectancy_Data.csv")
###replacing null cells with the means of that column

for col in data.columns:
    if data[col].isnull().any():
        data[col] = data[col].fillna(data[col].mean())


data.isnull().sum()
```

Out[ ]:

```
Country                            0
Continent                          0
Year                               0
Status                             0
Life_expectancy                    0
Adult_Mortality                    0
infant_deaths                      0
Alcohol                            0
percentage_expenditure             0
Hepatitis_B                        0
Measles                            0
 BMI                               0
under_five_deaths                  0
Polio                              0
Total_expenditure                  0
Diphtheria                         0
 HIV/AIDS                          0
GDP                                0
Population                         0
 thinness  1-19 years              0
 thinness 5-9 years                0
Income_composition_of_resources    0
Schooling                          0
dtype: int64
```

In [ ]:

```
data.groupby('Country').count()
```

Out[ ]:

	Continent	Year	Status	Life_expectancy	Adult_Mortality	infant_deaths	Alcohol	pe
Country								
Afghanistan	16	16	16	16	16	16	16	
Albania	16	16	16	16	16	16	16	
Algeria	16	16	16	16	16	16	16	
Angola	16	16	16	16	16	16	16	
Antigua and Barbuda	16	16	16	16	16	16	16	
...	...	...	...	...	...	...	...	
Uruguay	16	16	16	16	16	16	16	
Uzbekistan	16	16	16	16	16	16	16	
Vanuatu	16	16	16	16	16	16	16	
Zambia	16	16	16	16	16	16	16	
Zimbabwe	16	16	16	16	16	16	16	

156 rows × 22 columns

In [ ]:

```
data['Country'].unique()
```

Out[ ]:

```
array(['Afghanistan', 'Albania', 'Algeria', 'Angola',
       'Antigua and Barbuda', 'Argentina', 'Armenia', 'Australia',
       'Austria', 'Azerbaijan', 'Bahrain', 'Bangladesh', 'Barbados',
       'Belarus', 'Belgium', 'Belize', 'Benin', 'Bhutan',
       'Bosnia and Herzegovina', 'Botswana', 'Brazil', 'Brunei Darussalam',
       'Bulgaria', 'Burkina Faso', 'Burundi', 'Cabo Verde', 'Cambodia',
       'Cameroon', 'Canada', 'Central African Republic', 'Chad', 'Chile',
       'China', 'Colombia', 'Comoros', 'Costa Rica', 'Croatia', 'Cuba',
       'Cyprus', 'Denmark', 'Djibouti', 'Dominican Republic', 'Ecuador',
       'El Salvador', 'Equatorial Guinea', 'Eritrea', 'Estonia',
       'Ethiopia', 'Fiji', 'Finland', 'France', 'Gabon', 'Georgia',
       'Germany', 'Ghana', 'Greece', 'Grenada', 'Guatemala', 'Guinea',
       'Guinea-Bissau', 'Guyana', 'Haiti', 'Honduras', 'Hungary',
       'Iceland', 'India', 'Indonesia', 'Iraq', 'Ireland', 'Israel',
       'Italy', 'Jamaica', 'Japan', 'Jordan', 'Kazakhstan', 'Kenya',
       'Kiribati', 'Kuwait', 'Latvia', 'Lebanon', 'Lesotho', 'Liberia',
       'Libya', 'Lithuania', 'Luxembourg', 'Madagascar', 'Malawi',
       'Malaysia', 'Maldives', 'Mali', 'Malta', 'Mauritania', 'Mauritius',
       'Mexico', 'Mongolia', 'Montenegro', 'Morocco', 'Mozambique',
       'Myanmar', 'Namibia', 'Nepal', 'Netherlands', 'New Zealand',
       'Nicaragua', 'Niger', 'Nigeria', 'Norway', 'Oman', 'Pakistan',
       'Panama', 'Papua New Guinea', 'Paraguay', 'Peru', 'Philippines',
       'Poland', 'Portugal', 'Qatar', 'Romania', 'Russian Federation',
       'Rwanda', 'Samoa', 'Sao Tome and Principe', 'Saudi Arabia',
       'Senegal', 'Serbia', 'Seychelles', 'Sierra Leone', 'Singapore',
       'Slovenia', 'Solomon Islands', 'Somalia', 'South Africa', 'Spain',
       'Sri Lanka', 'Suriname', 'Swaziland', 'Sweden', 'Switzerland',
       'Syrian Arab Republic', 'Tajikistan', 'Thailand', 'Timor-Leste',
       'Togo', 'Tonga', 'Trinidad and Tobago', 'Tunisia', 'Turkey',
       'Turkmenistan', 'Uganda', 'Ukraine', 'United Arab Emirates',
       'Uruguay', 'Uzbekistan', 'Vanuatu', 'Zambia', 'Zimbabwe'], dtype=object)
```

In [ ]:

```
morocco = data[data['Country'] == 'Morocco']

predictVar=morocco[['GDP','Schooling','Income_composition_of_resources']]
target=morocco['Life_expectancy ']
```

In [ ]:

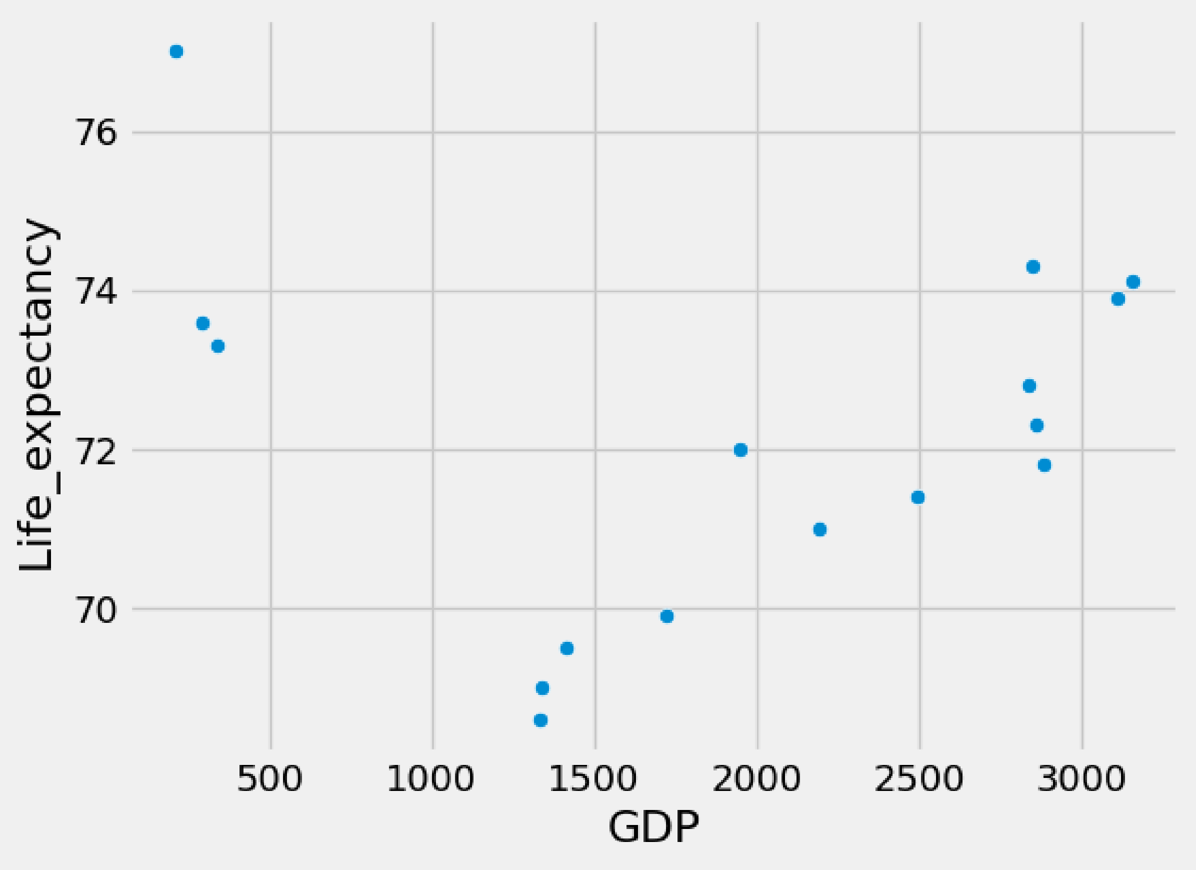
```
predictVar.head(8)
```

Out[ ]:

	GDP	Schooling	Income_composition_of_resources
1524	2847.285569	12.1	0.645
1525	3154.513484	12.1	0.640
1526	3111.762887	12.1	0.634
1527	294.746728	11.6	0.623
1528	339.916160	11.2	0.612
1529	2834.247200	10.7	0.603
1530	2861.554500	10.5	0.596
1531	2884.947760	10.3	0.589

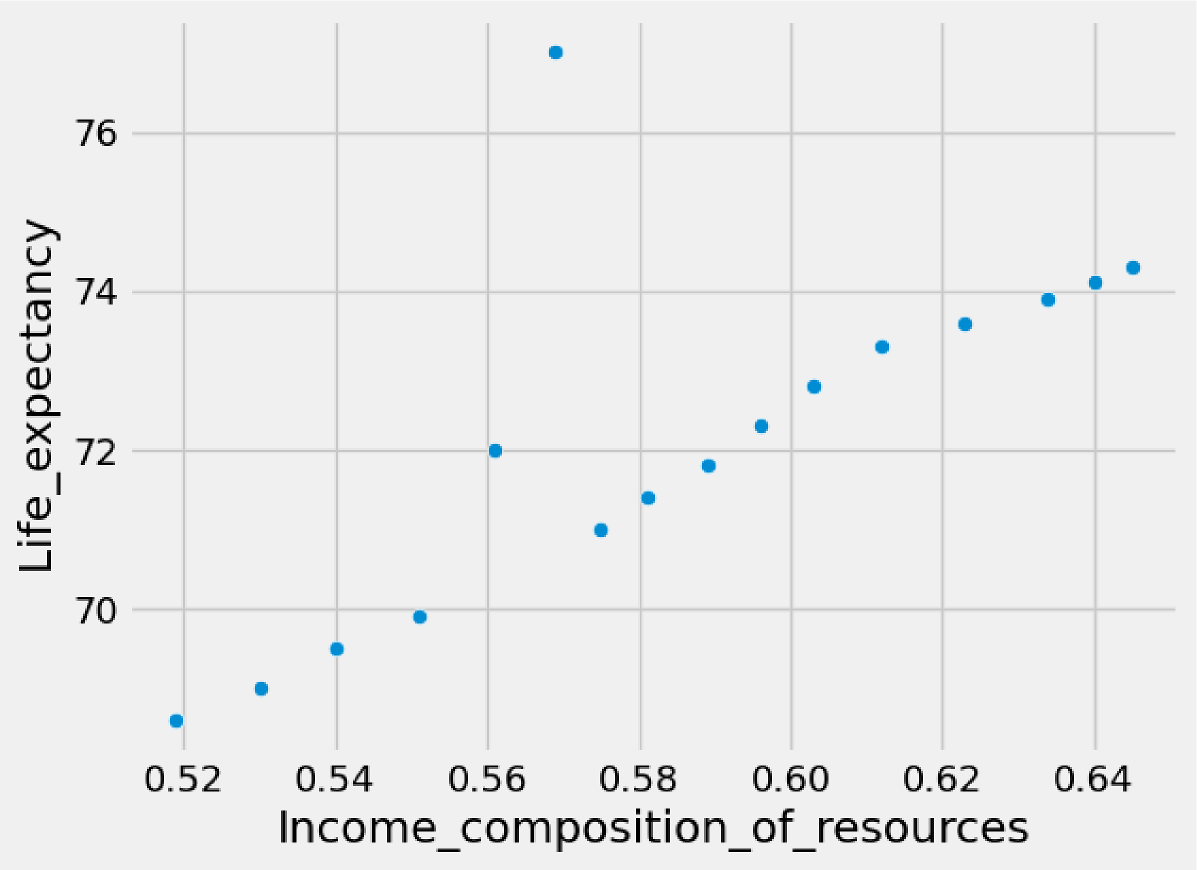
```
In [ ]: s.scatterplot(data=morocco,x='GDP',y='Life_expectancy ')
```

```
Out[ ]: <Axes: xlabel='GDP', ylabel='Life_expectancy '>
```



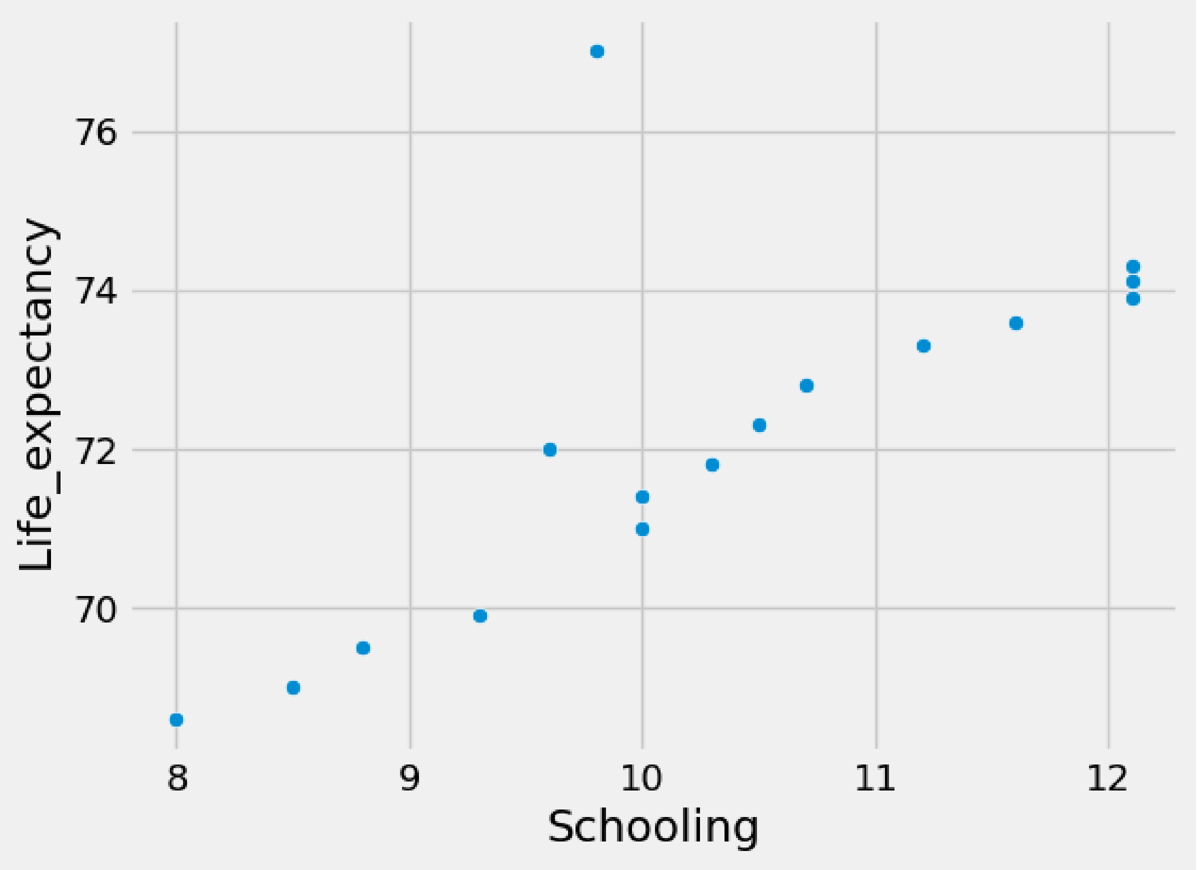
```
In [ ]: s.scatterplot(data=morocco,x='Income_composition_of_resources',y='Life_expectancy '
```

```
Out[ ]: <Axes: xlabel='Income_composition_of_resources', ylabel='Life_expectancy '>
```



In [ ]:
```
s.scatterplot(data=morocco,x='Schooling',y='Life_expectancy ')
```

Out[ ]:
```
<Axes: xlabel='Schooling', ylabel='Life_expectancy '>
```

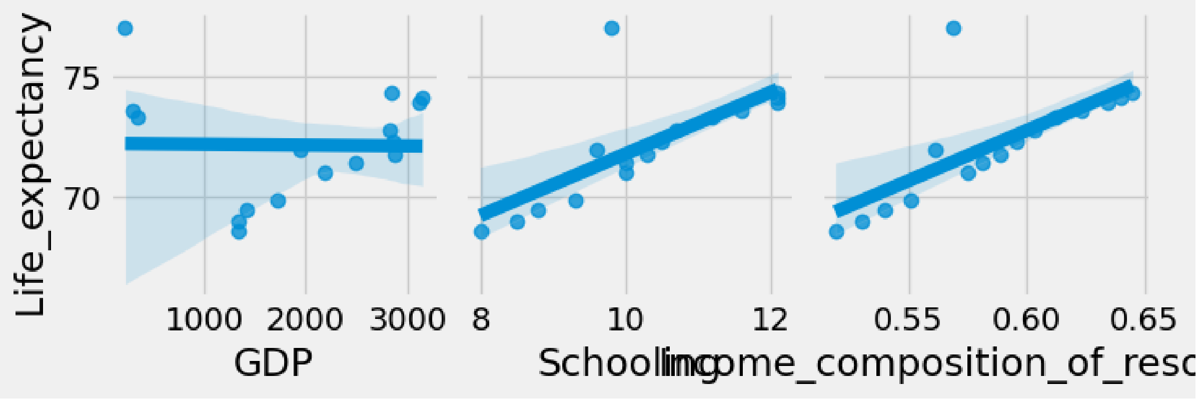


In [ ]:

```
s.pairplot(morocco,x_vars=predictVar,y_vars='Life_expectancy ',kind='reg')
```

Out[ ]:

```
<seaborn.axisgrid.PairGrid at 0x202ef126790>
```



In [ ]:

```
# metrics
from sklearn.metrics import mean_squared_error
from sklearn.metrics import r2_score
```

In [ ]:

```
X = data.drop(["Life_expectancy "],axis=1)
y = data["Life_expectancy "]
#X = pd.get_dummies(X, dummy_na=True)

from sklearn.preprocessing import OneHotEncoder
from sklearn.pipeline import Pipeline
from sklearn.compose import ColumnTransformer

#using the oneHotEncoder to transform the categorical columns
categorical_features = ['Country', 'Status','Continent','Diphtheria ','Population'

preprocessor = ColumnTransformer(
    transformers=[
        ('cat', OneHotEncoder(handle_unknown='ignore'), categorical_features)
    ],
    remainder='passthrough'
)
X_encoded = preprocessor.fit_transform(X)
X_train, X_test, y_train, y_test = train_test_split(predictVar, target, test_size=0

#establishes linear regression
lr=LinearRegression()
#fits the model onto training set
lr.fit(X_train,y_train)
prediction=lr.predict(X_test)
#checks to see models efficenecy
RMSE=(str(mean_squared_error( prediction , y_test, squared=False )))
R2_score=(str(r2_score( y_test , prediction ) * 100 ) + " %")
```

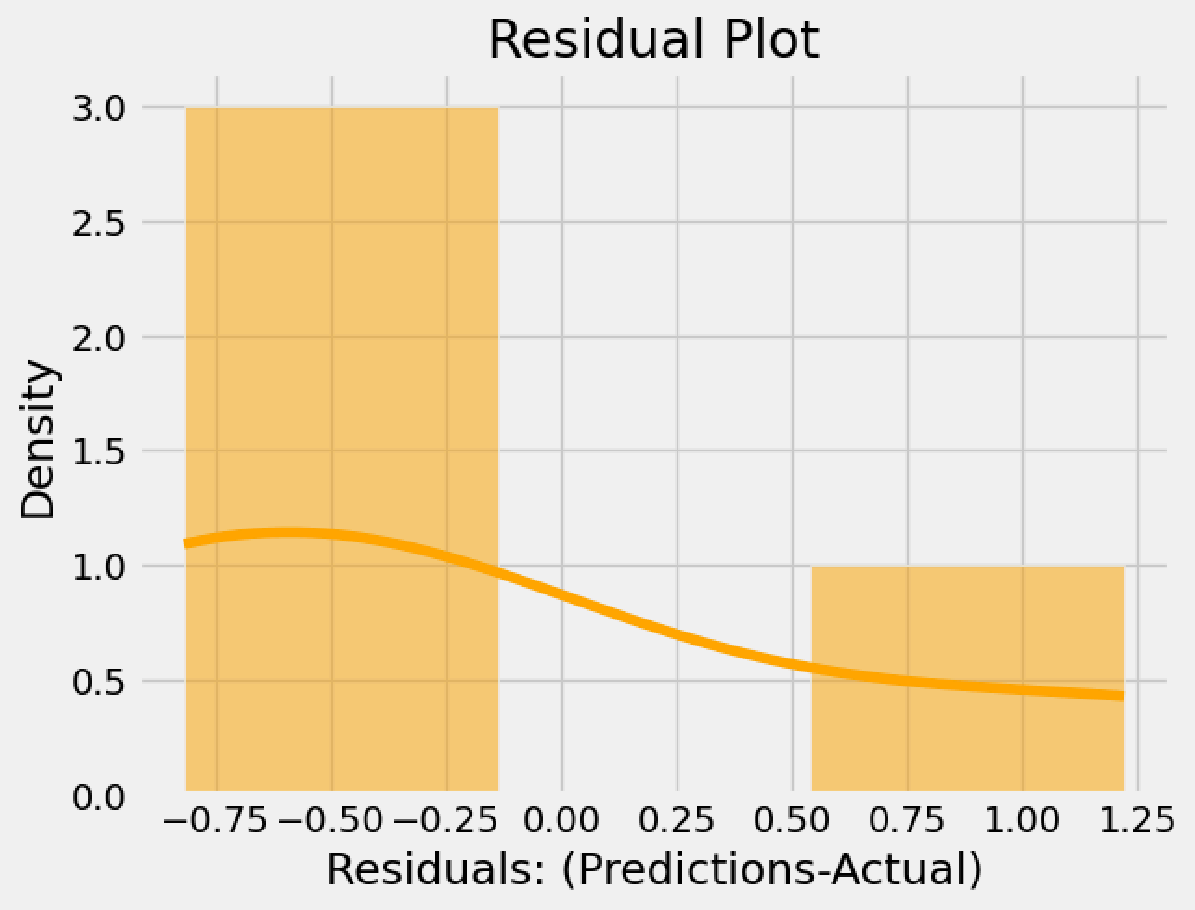
In [ ]:

```
print("Model Efficenecy")
print("RMSE:",RMSE)
print("r2:",R2_score)
print("Intercept: ",lr.intercept_)
print("Coefficent: ",lr.coef_)
print(list(zip(predictVar, lr.coef_)))
```

```
Model Efficenecy
RMSE: 0.82194832623
r2: 85.0943397465 %
Intercept:  58.6434263205
Coefficent:  [ -7.87883564e-04   1.16447122e+00   5.15689058e+00]
[('GDP', -0.00078788356391796069), ('Schooling', 1.1644712166367723), ('Income_com
position_of_resources', 5.1568905812040358)]
```

In [ ]:

```
predictions=lr.predict(X_test)
residuals=(predictions-y_test)
s.histplot(residuals, kde=True,color="orange")
plt.title('Residual Plot')
plt.xlabel('Residuals: (Predictions-Actual)')
plt.ylabel('Density')
plt.show()
residuals.head(20)
```



Out[ ]:

```
1524   -0.483607
1525   -0.551451
1529   -0.820183
1538    1.221360
Name: Life_expectancy , dtype: float64
```

In [ ]:

```
#Y=58.64-.00078(GDP)+1.16(Schooling)+5.16(ICOR)
```