⬇⬇

ML PROJECT (Mini)

Applying Regression ....

In [1]:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

In [2]:

```
data=pd.read_excel("HEALTHEXP.xlsx")
```

In [3]:

```
data.shape
```

Out[3]:

```
(274, 5)
```

In [4]:

```
data.columns
```

Out[4]:

```
Index(['Unnamed: 0', 'Year', 'Country', 'Spending_USD', 'Life_Expectancy'], dtype='object')
```

In [5]:

```
data.head(4)
```

Out[5]:

	Unnamed: 0	Year	Country	Spending_USD	Life_Expectancy
0	0	1970	Germany	252.311	70.6
1	1	1970	France	192.143	72.2
2	2	1970	Great Britain	123.993	71.9
3	3	1970	Japan	150.437	72.0

In [6]:

```
data.dtypes
```

Out[6]:

```
Unnamed: 0           int64
Year                 int64
Country             object
Spending_USD       float64
Life_Expectancy    float64
dtype: object
```

In [7]:

```
data.tail(4)
```

Out[7]:

	Unnamed: 0	Year	Country	Spending_USD	Life_Expectancy
270	270	2020	France	5468.418	82.3
271	271	2020	Great Britain	5018.700	80.4
272	272	2020	Japan	4665.641	84.7
273	273	2020	USA	11859.179	77.0

In [8]:

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

Out[8]:

```
Unnamed: 0         0
Year               0
Country            0
Spending_USD       0
Life_Expectancy    0
dtype: int64
```

In [9]:

```
data.drop(['Unnamed: 0'],axis=1,inplace=True)
```

In [10]:

```
data.head(2)
```

Out[10]:

	Year	Country	Spending_USD	Life_Expectancy
0	1970	Germany	252.311	70.6
1	1970	France	192.143	72.2

In [11]:

```
data.nunique()
```

Out[11]:

```
Year                 51
Country               6
Spending_USD        274
Life_Expectancy     118
dtype: int64
```

In [12]:

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

Out[12]:

```
array(['Germany', 'France', 'Great Britain', 'Japan', 'USA', 'Canada'],
      dtype=object)
```

In [13]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 274 entries, 0 to 273
Data columns (total 4 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   Year             274 non-null    int64  
 1   Country          274 non-null    object 
 2   Spending_USD     274 non-null    float64
 3   Life_Expectancy  274 non-null    float64
dtypes: float64(2), int64(1), object(1)
memory usage: 8.7+ KB
```

In [14]:

```
data.describe()
```

Out[14]:

	Year	Spending_USD	Life_Expectancy
count	274.000000	274.000000	274.000000
mean	1996.992701	2789.338905	77.909489
std	14.180933	2194.939785	3.276263
min	1970.000000	123.993000	70.600000
25%	1985.250000	1038.357000	75.525000
50%	1998.000000	2295.578000	78.100000
75%	2009.000000	4055.610000	80.575000
max	2020.000000	11859.179000	84.700000

EDA__

In [15]:

```
sns.set(style="whitegrid")
```

In [16]:

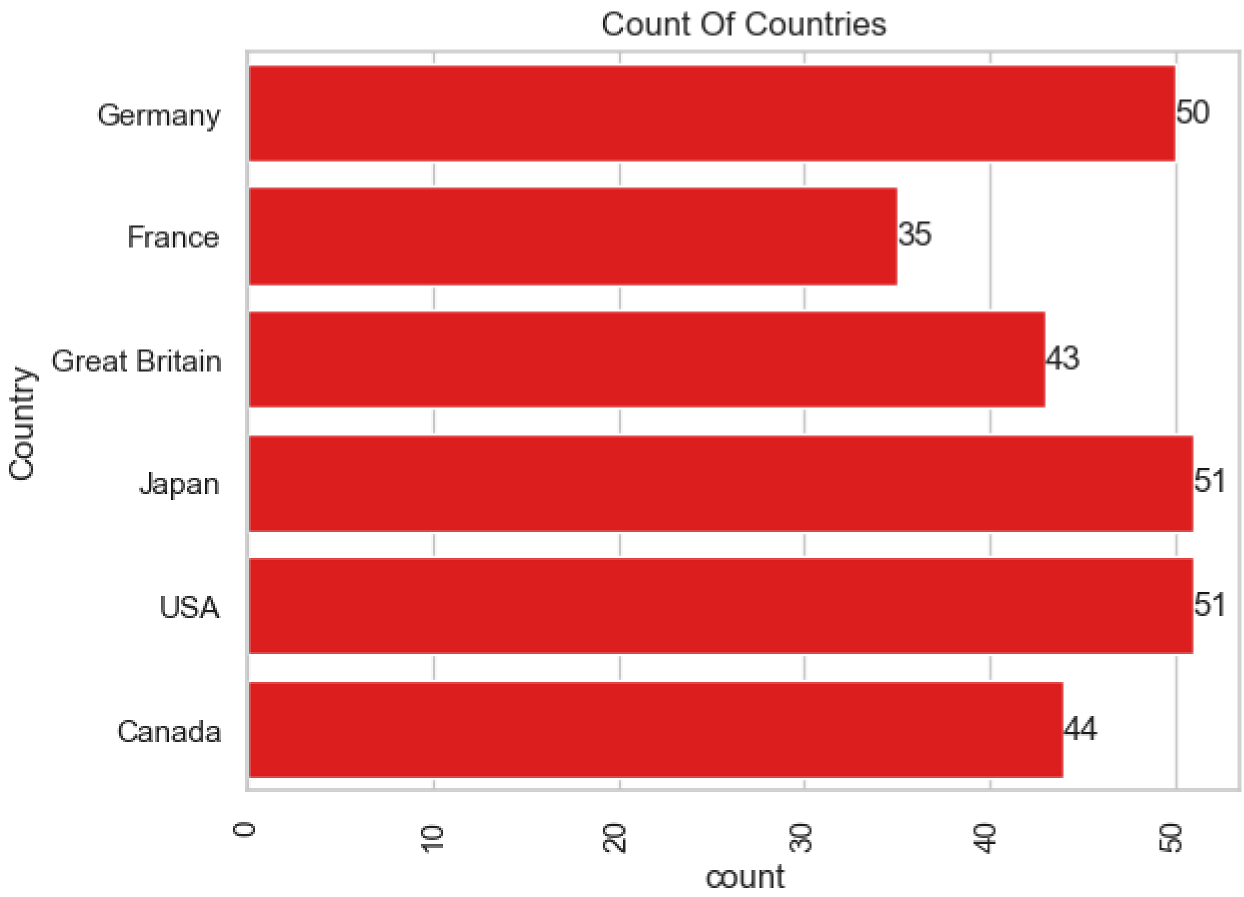
```
data.head(3)
```

Out[16]:

	Year	Country	Spending_USD	Life_Expectancy
0	1970	Germany	252.311	70.6
1	1970	France	192.143	72.2
2	1970	Great Britain	123.993	71.9

In [17]:

```
ax=sns.countplot(y='Country',data=data,color='red')
for bars in ax.containers:
    ax.bar_label(bars)
plt.title('Count Of Countries')
plt.xticks(rotation=90)
plt.show()
```

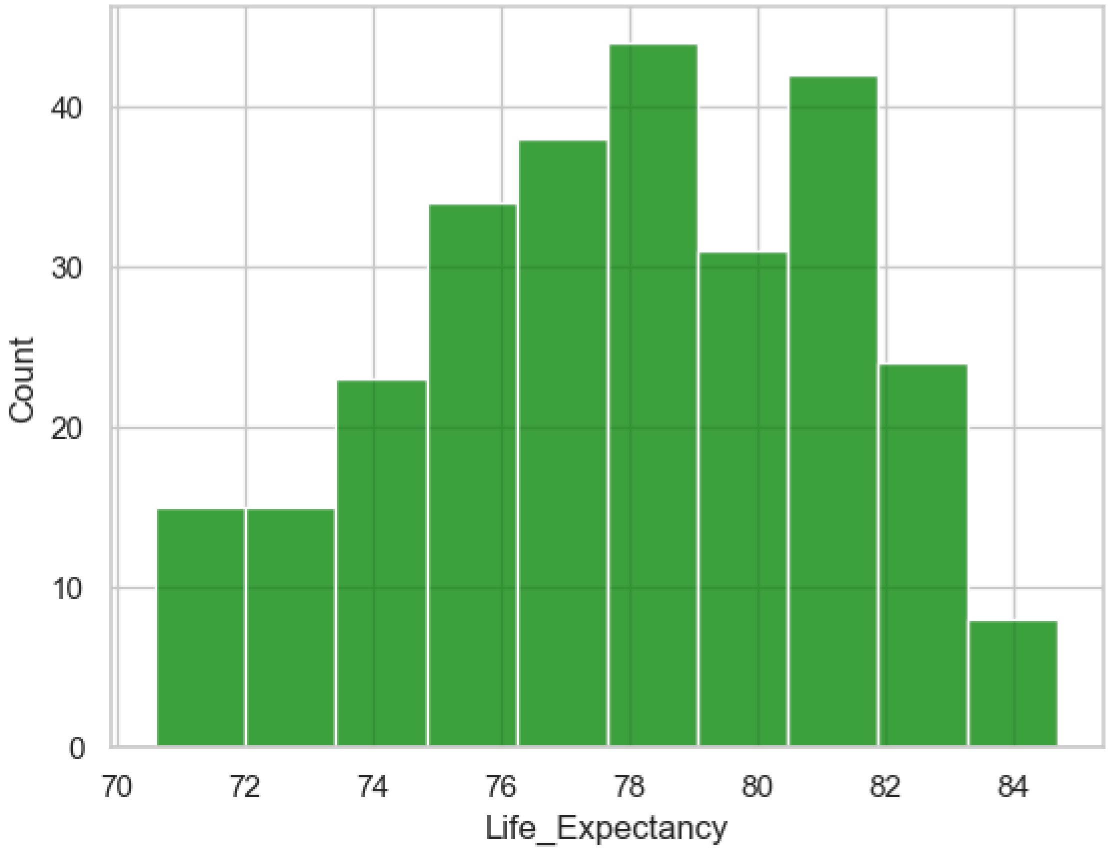


In [18]:

```
sns.histplot(data['Life_Expectancy'],color='green')
```

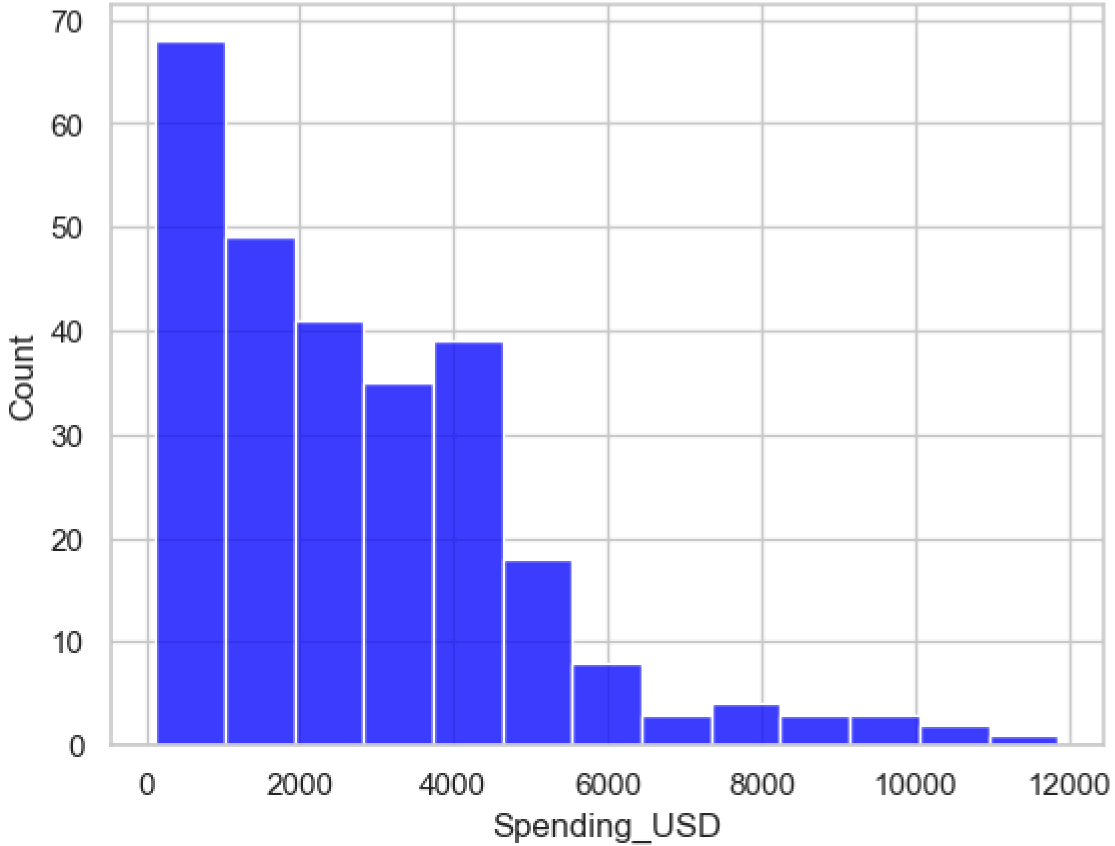
Out[18]:

```
<Axes: xlabel='Life_Expectancy', ylabel='Count'>
```



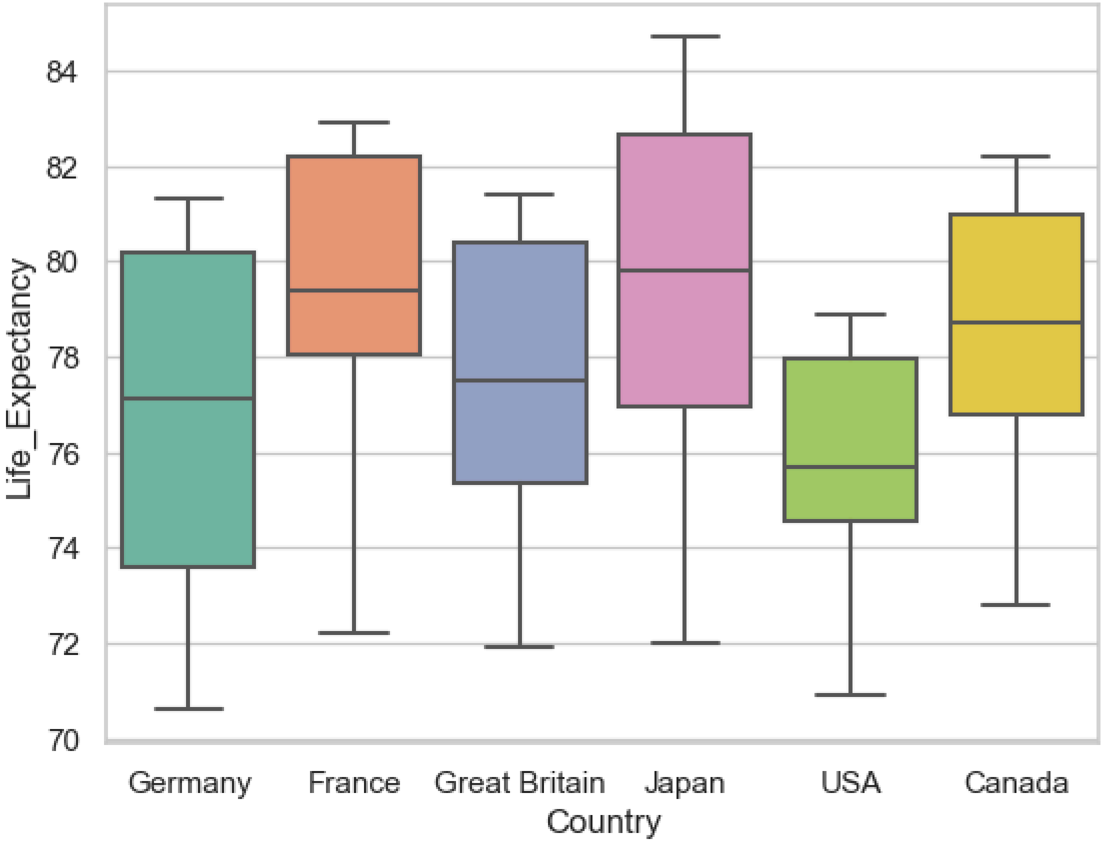
```
In [19]: sns.histplot(data['Spending_USD'],color='blue')
```

```
Out[19]: <Axes: xlabel='Spending_USD', ylabel='Count'>
```



In [20]:
```
sns.boxplot(x=data['Country'],y=data['Life_Expectancy'],palette='Set2')
```

Out[20]:
```
<Axes: xlabel='Country', ylabel='Life_Expectancy'>
```



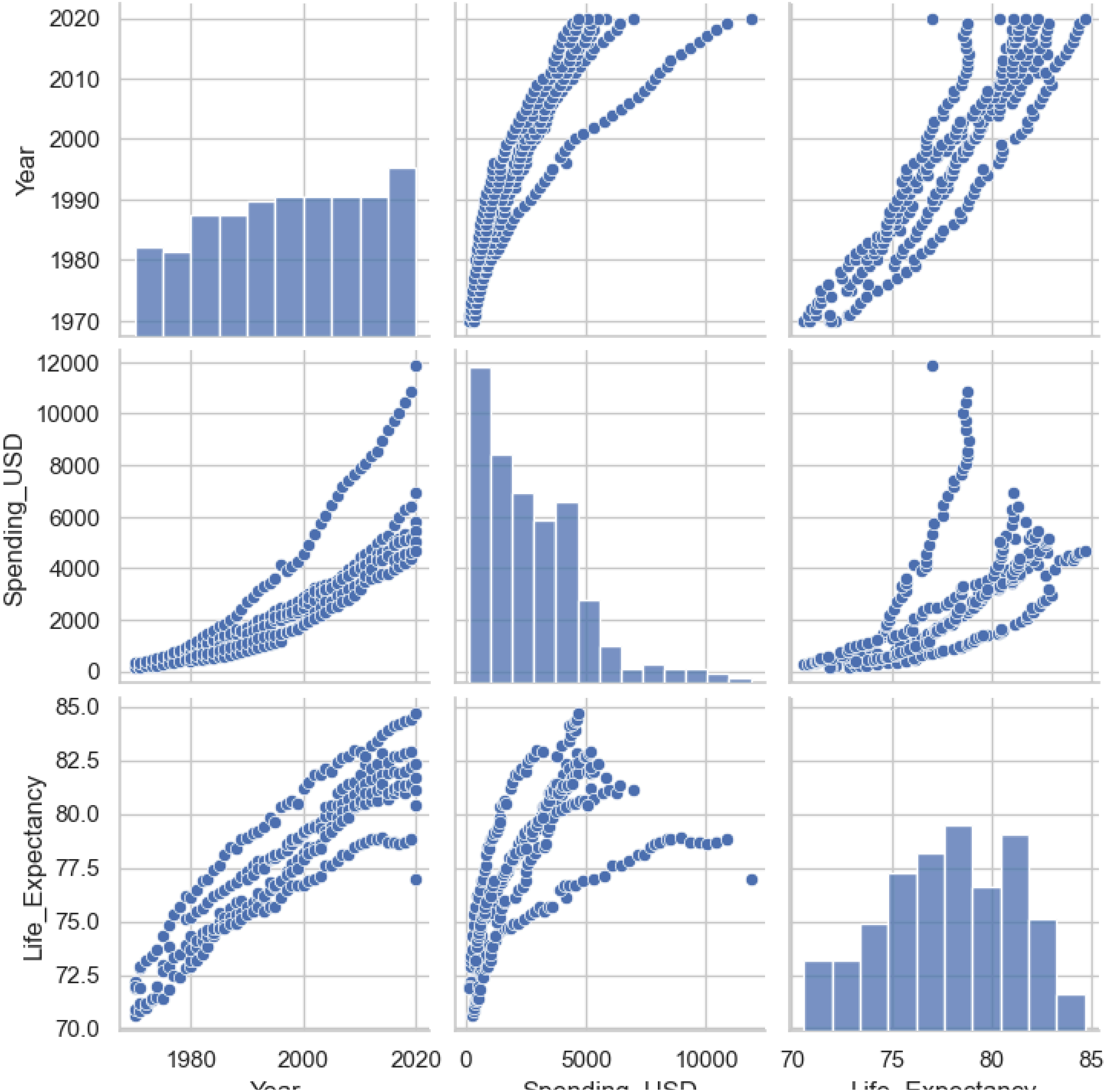
In [21]:

```
sns.pairplot(data=data)
```

```
C:\Users\19mri\anaconda4\Lib\site-packages\seaborn\axisgrid.py:118: UserWarning: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```

Out[21]:

```
<seaborn.axisgrid.PairGrid at 0x1e3f9d8a390>
```


Year
Spending_USD
Life_Expectancy
2020
2010
2000
1990
1980
1970
12000
10000
8000
6000
4000
2000
0
85.0
82.5
80.0
77.5
75.0
72.5
70.0
1980
2000
2020
0
5000
10000
70
75
80
85
Year
Spending_USD
Life_Expectancy

Multiple Linear Regression (Country= Japan):

```
In [22]: data.head(4)
```

Out[22]:

	Year	Country	Spending_USD	Life_Expectancy
0	1970	Germany	252.311	70.6
1	1970	France	192.143	72.2
2	1970	Great Britain	123.993	71.9
3	1970	Japan	150.437	72.0

```
In [23]: country_J=data.groupby(['Country']).get_group('Japan')
```

```
In [24]: country_J.head(6)
```

Out[24]:

	Year	Country	Spending_USD	Life_Expectancy
3	1970	Japan	150.437	72.0
8	1971	Japan	163.854	72.9
11	1972	Japan	185.390	73.2
14	1973	Japan	205.778	73.4
17	1974	Japan	242.018	73.7
21	1975	Japan	284.269	74.3

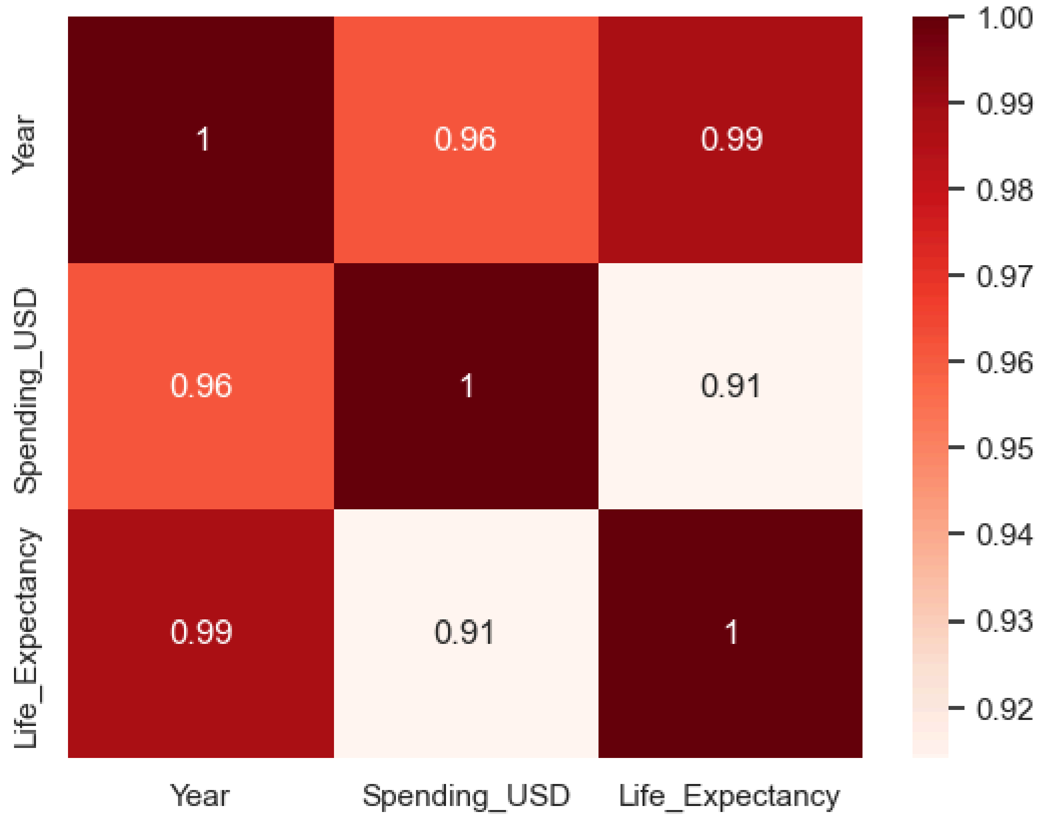
```
In [25]: country_J.corr(numeric_only=True)
```

Out[25]:

	Year	Spending_USD	Life_Expectancy
Year	1.000000	0.960871	0.987683
Spending_USD	0.960871	1.000000	0.914187
Life_Expectancy	0.987683	0.914187	1.000000

In [26]:
```
sns.heatmap(country_J.corr(numeric_only=True),annot=True,cmap='Reds')
```

Out[26]:
```
<Axes: >
```



In [27]:
```
from sklearn import linear_model
```

In [28]:
```
model=linear_model.LinearRegression()
```

In [29]:
```
x=country_J.iloc[:,[0,3]]
```

In [30]:
```
y=country_J.Spending_USD
```

In [31]:
```
model.fit(x,y)
```

Out[31]:
```
▾ LinearRegression
LinearRegression()
```

In [32]:
```
country_J['Prediction in USD']=model.predict(x)
```

```
C:\Users\19mri\AppData\Local\Temp\ipykernel_20308\3600233059.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  country_J['Prediction in USD']=model.predict(x)
```

In [33]:
```
country_J['error found']=country_J['Spending_USD']-country_J['Prediction in USD']
```

```
C:\Users\19mri\AppData\Local\Temp\ipykernel_20308\2124572304.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  country_J['error found']=country_J['Spending_USD']-country_J['Prediction in USD']
```

In [34]:
```
country_J=country_J.iloc[:,[0,1,3,2,4,5]]   # Overwrite
```

In [35]:
```
country_J.head(10)
```

Out[35]:

	Year	Country	Life_Expectancy	Spending_USD	Prediction in USD	error found
3	1970	Japan	72.0	150.437	468.501454	-318.064454
8	1971	Japan	72.9	163.854	172.219913	-8.365913
11	1972	Japan	73.2	185.390	229.183092	-43.793092
14	1973	Japan	73.4	205.778	345.020392	-139.242392
17	1974	Japan	73.7	242.018	401.983572	-159.965572
21	1975	Japan	74.3	284.269	282.324391	1.944609
25	1976	Japan	74.8	303.725	221.539331	82.185669
28	1977	Japan	75.3	340.628	160.754270	179.873730
31	1978	Japan	75.7	392.577	158.843329	233.733671
35	1979	Japan	76.2	452.931	98.058269	354.872731

In [36]:

```
model.coef_
```

Out[36]:

```
array([ 233.58554048, -588.74120239])
```

In [37]:

```
model.intercept_
```

Out[37]:

```
-417305.64671194326
```

In [38]:

```
model.predict([[2023,70]])
```

```
C:\Users\19mri\anaconda4\Lib\site-packages\sklearn\base.py:464: UserWarning: X does not have valid feature names, but LinearRegr
ession was fitted with feature names
  warnings.warn(
```

Out[38]:

```
array([14026.01750441])
```

In [39]:

```
from sklearn.metrics import r2_score
r2_score(country_J['Spending_USD'],country_J['Prediction in USD'])
```

Out[39]:

```
0.9728761149928565
```

FINAL SCORE OF THIS MOBEL (JAPAN) :

97. % (Super-Model) ...

Multiple Linear Regression (Country= France):

In [40]:

```
data.head(5)
```

Out[40]:

	Year	Country	Spending_USD	Life_Expectancy
0	1970	Germany	252.311	70.6
1	1970	France	192.143	72.2
2	1970	Great Britain	123.993	71.9
3	1970	Japan	150.437	72.0
4	1970	USA	326.961	70.9

In [41]:

```
F=data.groupby(['Country']).get_group('France')
```

In [42]:

```
F.head(10)
```

Out[42]:

	Year	Country	Spending_USD	Life_Expectancy
1	1970	France	192.143	72.2
20	1975	France	363.610	73.0
39	1980	France	659.826	74.3
65	1985	France	1001.145	75.4
91	1990	France	1459.110	77.0
96	1991	France	1558.033	77.2
102	1992	France	1651.139	77.5
108	1993	France	1753.485	77.5
114	1994	France	1817.042	78.0
120	1995	France	2100.918	78.1

In [43]:

```
F.corr(numeric_only=True)
```

Out[43]:

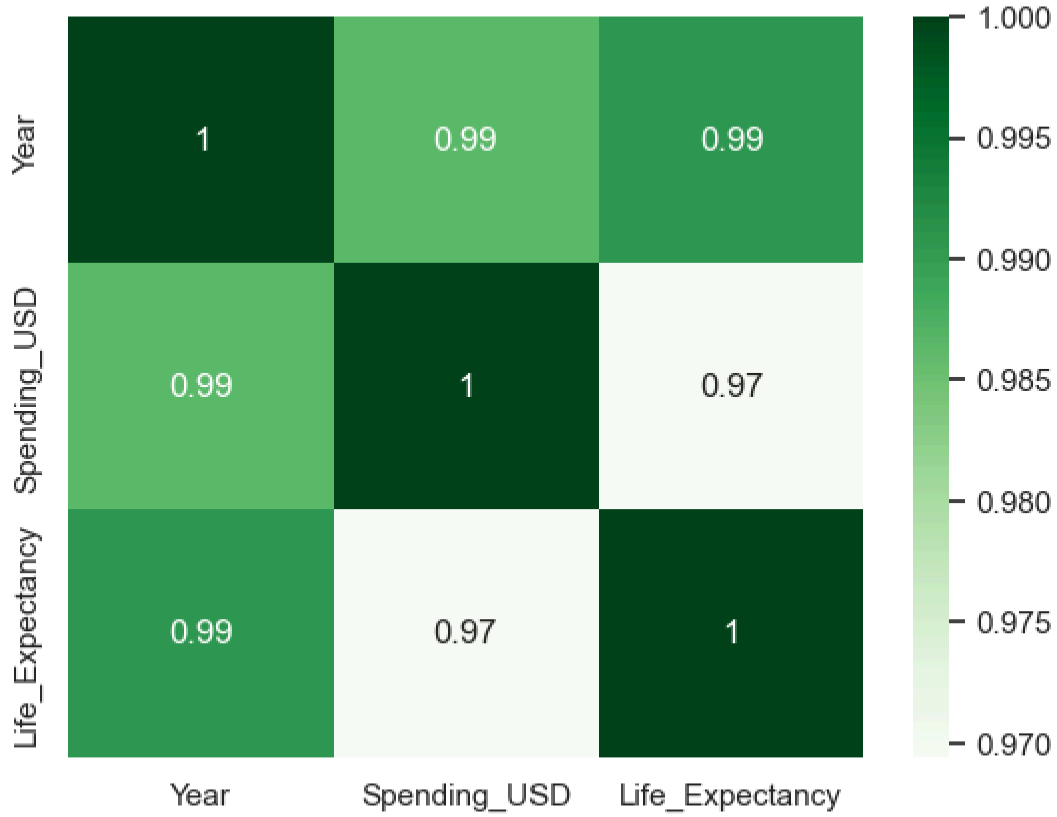
	Year	Spending_USD	Life_Expectancy
Year	1.000000	0.986430	0.990654
Spending_USD	0.986430	1.000000	0.969428
Life_Expectancy	0.990654	0.969428	1.000000

In [44]:

```
sns.heatmap(F.corr(numeric_only=True),annot=True,cmap='Greens')
```

Out[44]:

```
<Axes: >
```



```
In [45]: x=F.iloc[:,[0,3]]
```

```
In [46]: y=F.Spending_USD
```

```
In [47]: model2=linear_model.LinearRegression()
```

```
In [48]: model2.fit(x,y)
```

```
Out[48]: ▾ LinearRegression
         LinearRegression()
```

```
In [49]: F['USD Predict']=model2.predict(x)
```

```
C:\Users\19mri\AppData\Local\Temp\ipykernel_20308\3198144415.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  F['USD Predict']=model2.predict(x)
```

In [50]:

```
F['Error Found']=F['Spending_USD']-F['USD Predict']
```

```
C:\Users\19mri\AppData\Local\Temp\ipykernel_20308\130598603.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  F['Error Found']=F['Spending_USD']-F['USD Predict']
```

In [51]:

```
F.head(10)
```

Out[51]:

	Year	Country	Spending_USD	Life_Expectancy	USD Predict	Error Found
1	1970	France	192.143	72.2	-630.119491	822.262491
20	1975	France	363.610	73.0	23.134459	340.475541
39	1980	France	659.826	74.3	569.074985	90.751015
65	1985	France	1001.145	75.4	1157.940881	-156.795881
91	1990	France	1459.110	77.0	1639.493353	-180.383353
96	1991	France	1558.033	77.2	1761.559069	-203.526069
102	1992	France	1651.139	77.5	1862.162101	-211.023101
108	1993	France	1753.485	77.5	2027.153187	-273.668187
114	1994	France	1817.042	78.0	2084.830848	-267.788848
120	1995	France	2100.918	78.1	2228.359249	-127.441249

In [52]:

```
model2.coef_
```

Out[52]:

```
array([ 164.99108568, -214.6268477 ])
```

In [53]:

```
model2.intercept_
```

Out[53]:

```
-310166.49987721804
```

In [54]:

```
r2=r2_score(F['Spending_USD'],F['USD Predict'])
```

In [55]:

```
print(r2)
```

```
0.9763009619905436
```

FINAL SCORE OF THIS MOBEL (FRANCE) :

98 % (Very Super-Model) ...

⬆⬆