In [1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings("ignore")
```

In [2]:

```
df=pd.read_csv("https://raw.githubusercontent.com/dsrscientist/DSData/maste
r/happiness_score_dataset.csv")
df
```

Out[2]:

	Country	Region	Happiness Rank	Happiness Score	Standard Error	Economy (GDP per Capita)	Family	Health (Life Expectancy)	Freedom	(Gover Corru
0	Switzerland	Western Europe	1	7.587	0.03411	1.39651	1.34951	0.94143	0.66557	0.4197
1	Iceland	Western Europe	2	7.561	0.04884	1.30232	1.40223	0.94784	0.62877	0.1414
2	Denmark	Western Europe	3	7.527	0.03328	1.32548	1.36058	0.87464	0.64938	0.4835
3	Norway	Western Europe	4	7.522	0.03880	1.45900	1.33095	0.88521	0.66973	0.3650
4	Canada	North America	5	7.427	0.03553	1.32629	1.32261	0.90563	0.63297	0.3295
...	...	...	...	...	...	...	...	...	...	...
153	Rwanda	Sub-Saharan Africa	154	3.465	0.03464	0.22208	0.77370	0.42864	0.59201	0.5519
154	Benin	Sub-Saharan Africa	155	3.340	0.03656	0.28665	0.35386	0.31910	0.48450	0.0801
155	Syria	Middle East and Northern Africa	156	3.006	0.05015	0.66320	0.47489	0.72193	0.15684	0.1890
156	Burundi	Sub-Saharan Africa	157	2.905	0.08658	0.01530	0.41587	0.22396	0.11850	0.1006
157	Togo	Sub-Saharan Africa	158	2.839	0.06727	0.20868	0.13995	0.28443	0.36453	0.1073

158 rows × 12 columns

In [3]:

```
df.head()
```

Out[3]:

	Country	Region	Happiness Rank	Happiness Score	Standard Error	Economy (GDP per Capita)	Family	Health (Life Expectancy)	Freedom	Tr (Governm Corrupti
0	Switzerland	Western Europe	1	7.587	0.03411	1.39651	1.34951	0.94143	0.66557	0.41978
1	Iceland	Western Europe	2	7.561	0.04884	1.30232	1.40223	0.94784	0.62877	0.14145
2	Denmark	Western Europe	3	7.527	0.03328	1.32548	1.36058	0.87464	0.64938	0.48357
3	Norway	Western Europe	4	7.522	0.03880	1.45900	1.33095	0.88521	0.66973	0.36503
4	Canada	North America	5	7.427	0.03553	1.32629	1.32261	0.90563	0.63297	0.32957

In [ ]:

```
#This is Regression problem as continuous data is available
```

In [5]:

```
df.shape
```

Out[5]:

```
(158, 12)
```

In [6]:

```
df.columns
```

Out[6]:

```
Index(['Country', 'Region', 'Happiness Rank', 'Happiness Score',
       'Standard Error', 'Economy (GDP per Capita)', 'Family',
       'Health (Life Expectancy)', 'Freedom', 'Trust (Government
Corruption)',
       'Generosity', 'Dystopia Residual'],
      dtype='object')
```

In [7]:

```
df.dtypes
```

Out[7]:

```
Country                           object
Region                            object
Happiness Rank                     int64
Happiness Score                  float64
Standard Error                   float64
Economy (GDP per Capita)         float64
Family                           float64
Health (Life Expectancy)         float64
Freedom                          float64
Trust (Government Corruption)    float64
Generosity                       float64
Dystopia Residual                float64
dtype: object
```

In [8]:

```
df.isnull().sum()
```

Out[8]:

```
Country                          0
Region                           0
Happiness Rank                   0
Happiness Score                  0
Standard Error                   0
Economy (GDP per Capita)         0
Family                           0
Health (Life Expectancy)         0
Freedom                          0
Trust (Government Corruption)    0
Generosity                       0
Dystopia Residual                0
dtype: int64
```

In [9]:

```
df.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 158 entries, 0 to 157
Data columns (total 12 columns):
 #   Column                         Non-Null Count  Dtype  
---  ------                         --------------  -----  
 0   Country                        158 non-null    object 
 1   Region                         158 non-null    object 
 2   Happiness Rank                 158 non-null    int64  
 3   Happiness Score                158 non-null    float64
 4   Standard Error                 158 non-null    float64
 5   Economy (GDP per Capita)       158 non-null    float64
 6   Family                         158 non-null    float64
 7   Health (Life Expectancy)       158 non-null    float64
 8   Freedom                        158 non-null    float64
 9   Trust (Government Corruption)  158 non-null    float64
 10  Generosity                     158 non-null    float64
 11  Dystopia Residual              158 non-null    float64
dtypes: float64(9), int64(1), object(2)
memory usage: 14.9+ KB
```

In [10]:

```
df.describe
```

Out[10]:

```
<bound method NDFrame.describe of          Country
Region  Happiness Rank  \
0    Switzerland                   Western Europe               1
1        Iceland                   Western Europe               2
2        Denmark                   Western Europe               3
3         Norway                   Western Europe               4
4         Canada                    North America               5
..           ...                              ...             ...
153       Rwanda               Sub-Saharan Africa             154
154        Benin               Sub-Saharan Africa             155
155        Syria  Middle East and Northern Africa             156
156      Burundi               Sub-Saharan Africa             157
157         Togo               Sub-Saharan Africa             158

     Happiness Score  Standard Error  Economy (GDP per Capita)   Family   \
0              7.587         0.03411                    1.39651  1.34951
1              7.561         0.04884                    1.30232  1.40223
2              7.527         0.03328                    1.32548  1.36058
3              7.522         0.03880                    1.45900  1.33095
4              7.427         0.03553                    1.32629  1.32261
..               ...             ...                        ...      ...
153            3.465         0.03464                    0.22208  0.77370
154            3.340         0.03656                    0.28665  0.35386
155            3.006         0.05015                    0.66320  0.47489
156            2.905         0.08658                    0.01530  0.41587
157            2.839         0.06727                    0.20868  0.13995

     Health (Life Expectancy)  Freedom  Trust (Government Corruption)  \
0                     0.94143  0.66557                        0.41978
1                     0.94784  0.62877                        0.14145
2                     0.87464  0.64938                        0.48357
3                     0.88521  0.66973                        0.36503
4                     0.90563  0.63297                        0.32957
..                        ...      ...                            ...
153                   0.42864  0.59201                        0.55191
154                   0.31910  0.48450                        0.08010
155                   0.72193  0.15684                        0.18906
156                   0.22396  0.11850                        0.10062
157                   0.28443  0.36453                        0.10731

     Generosity  Dystopia Residual
0       0.29678            2.51738
1       0.43630            2.70201
2       0.34139            2.49204
3       0.34699            2.46531
4       0.45811            2.45176
..          ...                ...
153     0.22628            0.67042
154     0.18260            1.63328
155     0.47179            0.32858
156     0.19727            1.83302
157     0.16681            1.56726

[158 rows x 12 columns]>
```

In [11]:

```
df.describe()
```

Out[11]:

	Happiness Rank	Happiness Score	Standard Error	Economy (GDP per Capita)	Family	Health (Life Expectancy)	Freedom	Trust (Government Corruption)
count	158.000000	158.000000	158.000000	158.000000	158.000000	158.000000	158.000000	158.000000
mean	79.493671	5.375734	0.047885	0.846137	0.991046	0.630259	0.428615	0.143422
std	45.754363	1.145010	0.017146	0.403121	0.272369	0.247078	0.150693	0.120034

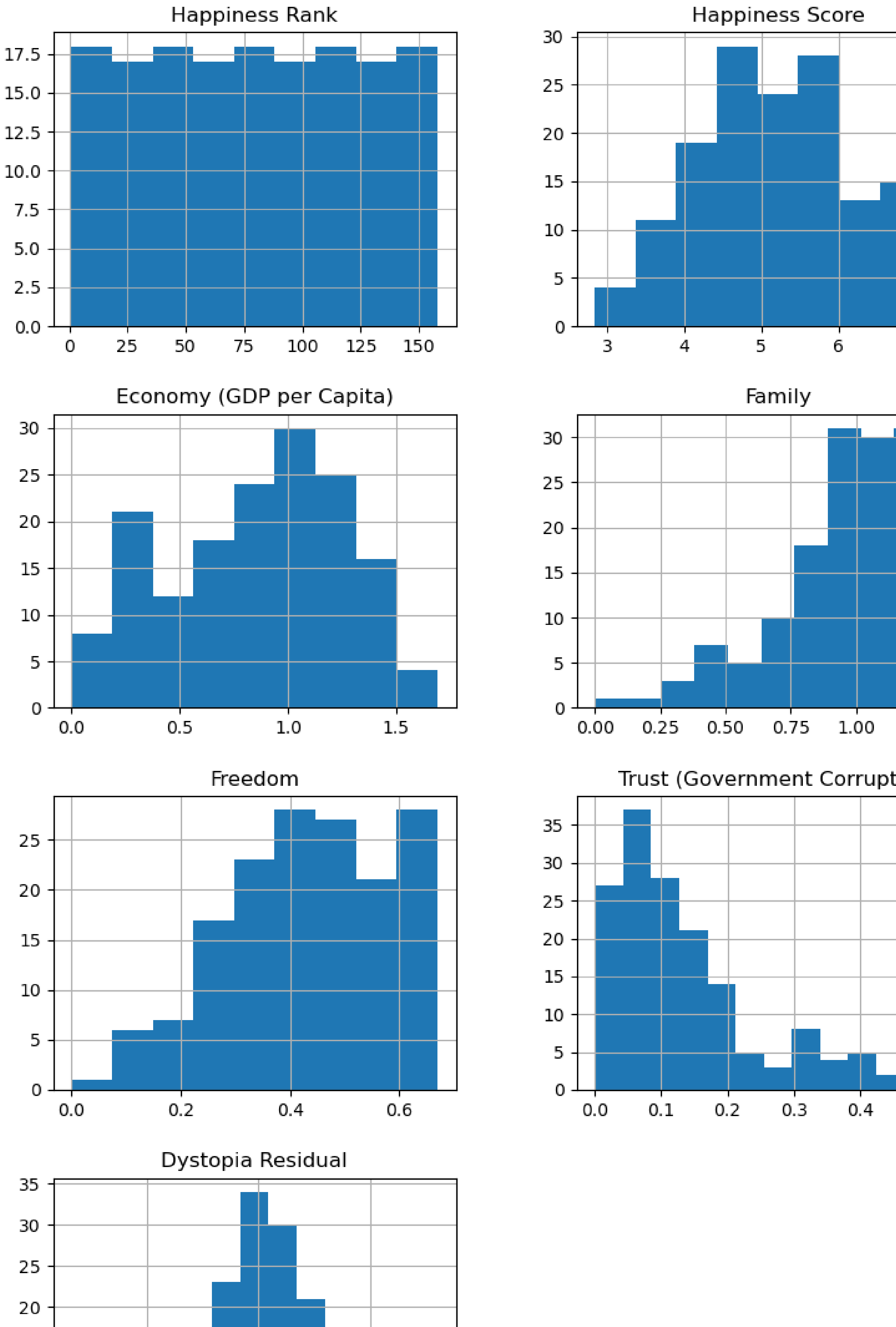
	Happiness Rank	Happiness Score	Standard Error	Economy (GDP per Capita)	Family	Health (Life Expectancy)	Freedom	Trust (Government Corruption)
min	1.000000	2.839000	0.018480	0.000000	0.000000	0.000000	0.000000	0.000000
25%	40.250000	4.526000	0.037268	0.545808	0.856823	0.439185	0.328330	0.061675
50%	79.500000	5.232500	0.043940	0.910245	1.029510	0.696705	0.435515	0.107220
75%	118.750000	6.243750	0.052300	1.158448	1.214405	0.811013	0.549092	0.180255
max	158.000000	7.587000	0.136930	1.690420	1.402230	1.025250	0.669730	0.551910

In [12]:

```
#Data Visulization
df.hist(bins="auto",figsize=(15,15))
```

Out[12]:

```
array([[<AxesSubplot:title={'center':'Happiness Rank'}>,
        <AxesSubplot:title={'center':'Happiness Score'}>,
        <AxesSubplot:title={'center':'Standard Error'}>],
       [<AxesSubplot:title={'center':'Economy (GDP per Capita)'}>,
        <AxesSubplot:title={'center':'Family'}>,
        <AxesSubplot:title={'center':'Health (Life Expectancy)'}>],
       [<AxesSubplot:title={'center':'Freedom'}>,
        <AxesSubplot:title={'center':'Trust (Government Corruption)'}>,
        <AxesSubplot:title={'center':'Generosity'}>],
       [<AxesSubplot:title={'center':'Dystopia Residual'}>,
        <AxesSubplot:>, <AxesSubplot:>]], dtype=object)
```


Happiness Rank
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0
25
50
75
100
125
150
Happiness Score
30
25
20
15
10
5
0
3
4
5
6
Economy (GDP per Capita)
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
Family
30
25
20
15
10
5
0
0.00
0.25
0.50
0.75
1.00
Freedom
25
20
15
10
5
0
0.0
0.2
0.4
0.6
Trust (Government Corrupt
35
30
25
20
15
10
5
0
0.0
0.1
0.2
0.3
0.4
Dystopia Residual
35
30
25
20

In [14]:

```
df.columns
```

Out[14]:

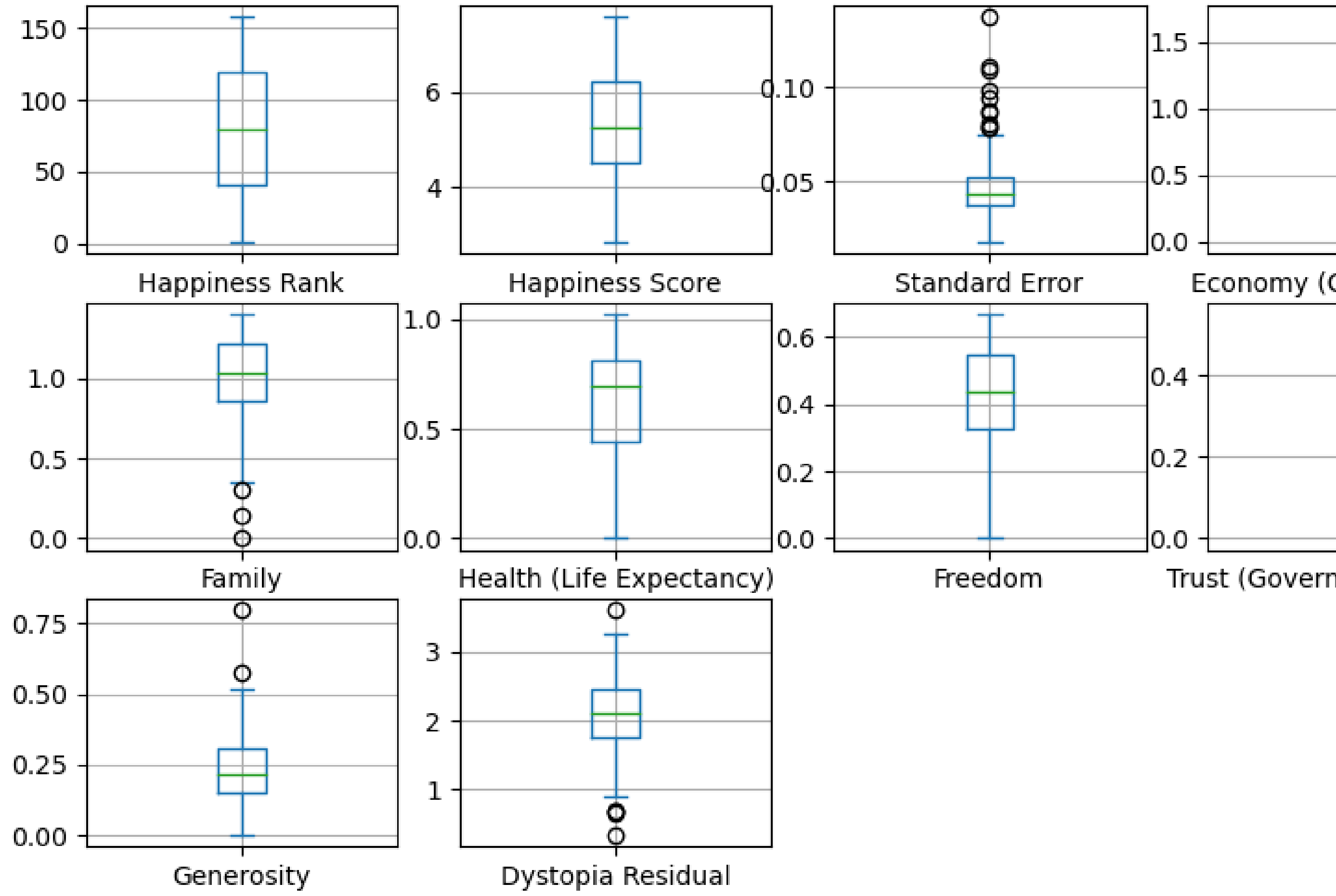
```
Index(['Country', 'Region', 'Happiness Rank', 'Happiness Score',
       'Standard Error', 'Economy (GDP per Capita)', 'Family',
       'Health (Life Expectancy)', 'Freedom', 'Trust (Government
Corruption)',
       'Generosity', 'Dystopia Residual'],
      dtype='object')
```

In [16]:

```
#Checking outliers
df[['Country','Region','Happiness Rank','Happiness Score','Standard
Error','Economy (GDP per Capita)','Family','Health (Life
Expectancy)','Freedom','Trust (Government
Corruption)','Generosity','Dystopia Residual']].plot(kind='box',
subplots=True, layout=(4,4), figsize=(10,8), grid=True)
```

Out[16]:

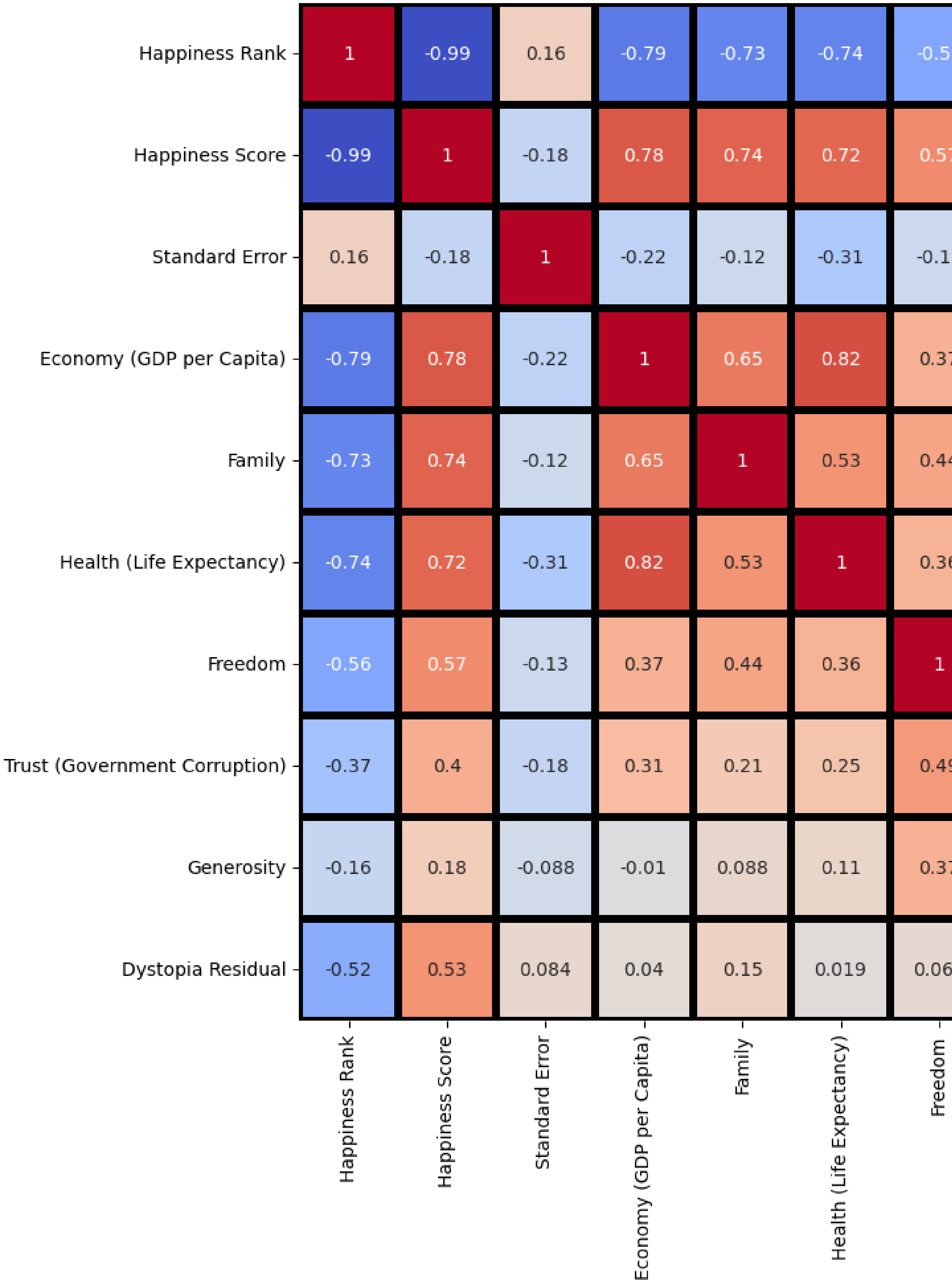
```
Happiness Rank
AxesSubplot(0.125,0.712609;0.168478x0.167391)
Happiness Score
AxesSubplot(0.327174,0.712609;0.168478x0.167391)
Standard Error
AxesSubplot(0.529348,0.712609;0.168478x0.167391)
Economy (GDP per Capita)
AxesSubplot(0.731522,0.712609;0.168478x0.167391)
Family
AxesSubplot(0.125,0.511739;0.168478x0.167391)
Health (Life Expectancy)
AxesSubplot(0.327174,0.511739;0.168478x0.167391)
Freedom
AxesSubplot(0.529348,0.511739;0.168478x0.167391)
Trust (Government Corruption)
AxesSubplot(0.731522,0.511739;0.168478x0.167391)
Generosity
AxesSubplot(0.125,0.31087;0.168478x0.167391)
Dystopia Residual
AxesSubplot(0.327174,0.31087;0.168478x0.167391)
dtype: object
```



In [17]:

```
plt.figure(figsize=(15,10))
sns.heatmap(df.corr())
sns.heatmap(df.corr(), annot = True, vmin=-1, vmax=1, center= 0, cmap=
'coolwarm', linewidths=3, linecolor='black')

plt.show()
```



Happiness Rank 1 -0.99 0.16 -0.79 -0.73 -0.74 -0.5
Happiness Score -0.99 1 -0.18 0.78 0.74 0.72 0.57
Standard Error 0.16 -0.18 1 -0.22 -0.12 -0.31 -0.1
Economy (GDP per Capita) -0.79 0.78 -0.22 1 0.65 0.82 0.37
Family -0.73 0.74 -0.12 0.65 1 0.53 0.44
Health (Life Expectancy) -0.74 0.72 -0.31 0.82 0.53 1 0.36
Freedom -0.56 0.57 -0.13 0.37 0.44 0.36 1
Trust (Government Corruption) -0.37 0.4 -0.18 0.31 0.21 0.25 0.49
Generosity -0.16 0.18 -0.088 -0.01 0.088 0.11 0.37
Dystopia Residual -0.52 0.53 0.084 0.04 0.15 0.019 0.06
Happiness Rank
Happiness Score
Standard Error
Economy (GDP per Capita)
Family
Health (Life Expectancy)
Freedom

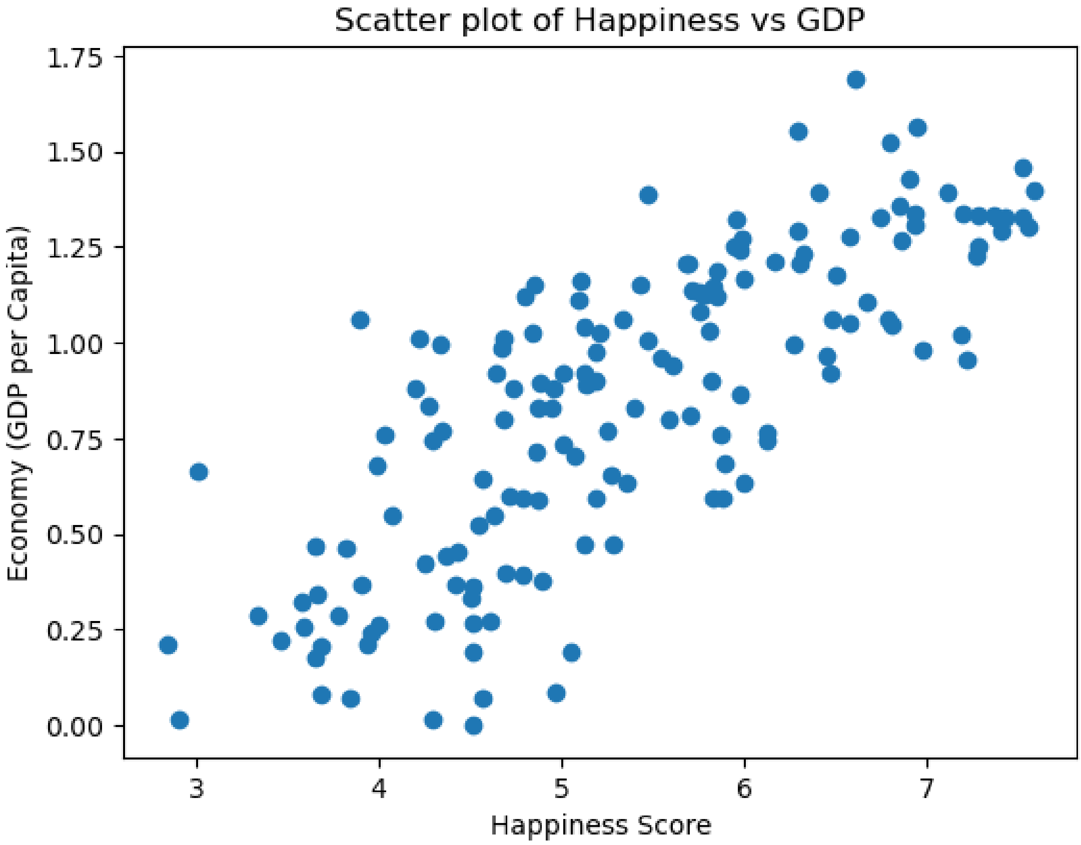
In [ ]:

```
#Happiness score is
#high relation with GDP per Capital, Family and health(Life Expectancy),
#low relation with Generosity and Government Corruption
#Negative relation with Happiness rank and standard error
```

In [19]:

```
happiness_score=df['Happiness Score']
gdp=df['Economy (GDP per Capita)']

plt.scatter(happiness_score,gdp)
plt.title('Scatter plot of Happiness vs GDP')
plt.xlabel('Happiness Score')
plt.ylabel('Economy (GDP per Capita)')
plt.show()
```



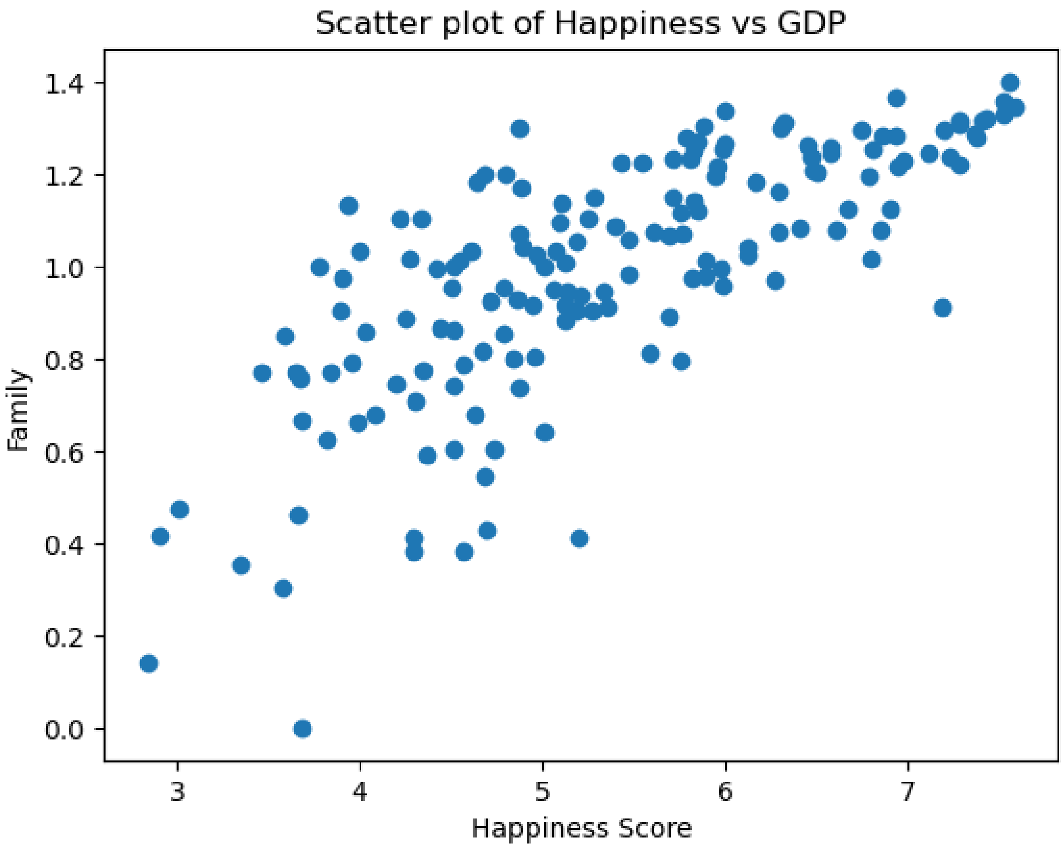
In [ ]:

```
#Higher GDP Higher happiness score
```

In [20]:

```
family=df['Family']

plt.scatter(happiness_score,family)
plt.title('Scatter plot of Happiness vs GDP')
plt.xlabel('Happiness Score')
plt.ylabel('Family')
plt.show()
```



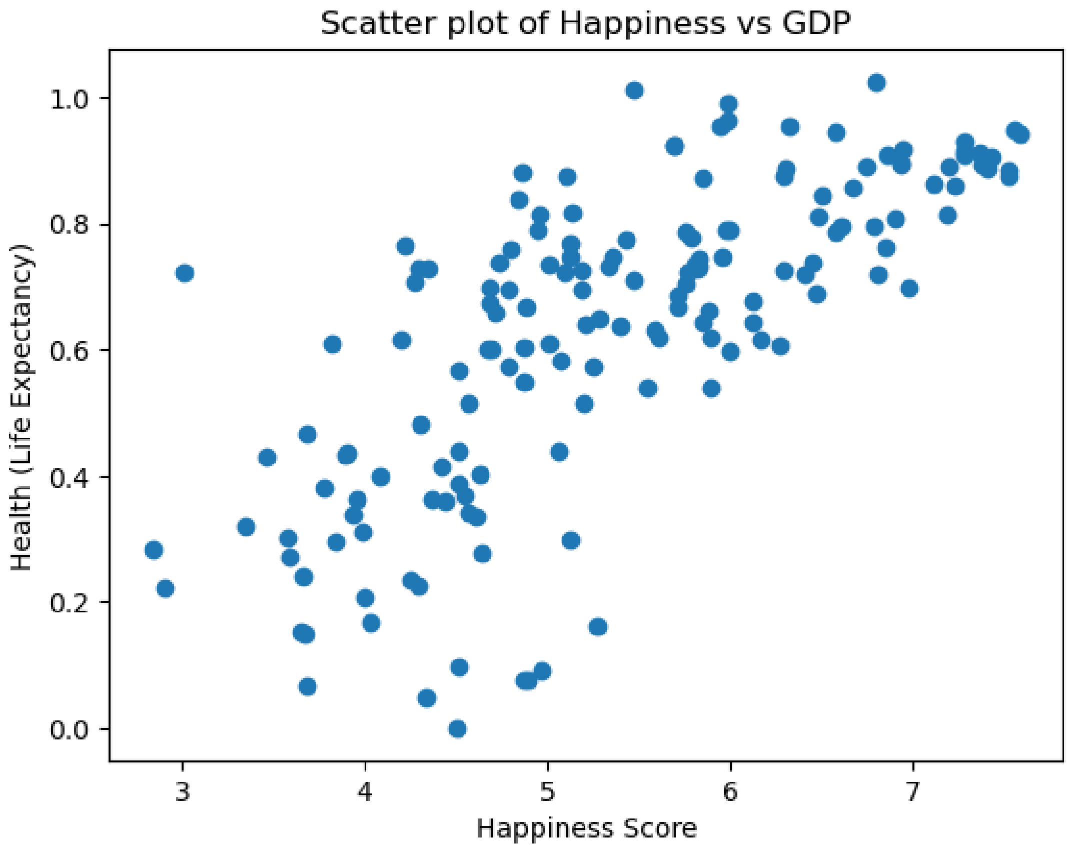
In [ ]:

```
#Higher with Family higher happiness score
```

In [21]:

```
le=df['Health (Life Expectancy)']

plt.scatter(happiness_score,le)
plt.title('Scatter plot of Happiness vs GDP')
plt.xlabel('Happiness Score')
plt.ylabel('Health (Life Expectancy)')
plt.show()
```



In [ ]:

```
#Model
```

In [22]:

```
#dropping of categorial data(Country', 'Region') and Happiness Rank as it
is irrelevant
dfnew=df.drop(['Country','Region','Happiness Rank'], axis=1)
dfnew.head()
```

Out[22]:

	Happiness Score	Standard Error	Economy (GDP per Capita)	Family	Health (Life Expectancy)	Freedom	Trust (Government Corruption)	Generosity	Dystopia Residual
0	7.587	0.03411	1.39651	1.34951	0.94143	0.66557	0.41978	0.29678	2.51738
1	7.561	0.04884	1.30232	1.40223	0.94784	0.62877	0.14145	0.43630	2.70201
2	7.527	0.03328	1.32548	1.36058	0.87464	0.64938	0.48357	0.34139	2.49204
3	7.522	0.03880	1.45900	1.33095	0.88521	0.66973	0.36503	0.34699	2.46531
4	7.427	0.03553	1.32629	1.32261	0.90563	0.63297	0.32957	0.45811	2.45176

In [23]:

```
# Spliting of data into training(80%) and testing(20%) sets

from sklearn.model_selection import train_test_split
```

In [25]:

```
#taking high correlation value
# X = features, y = target variable
```

```
X = dfnew[['Economy (GDP per Capita)','Standard Error','Family','Health
(Life Expectancy)','Freedom','Dystopia Residual']]
y = dfnew['Happiness Score']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2,
random_state = 0)
```

In [26]:

```
from sklearn.preprocessing import StandardScaler
scale=StandardScaler()
dfnew=scale.fit_transform(dfnew)
```

In [27]:

```
from sklearn.linear_model import LinearRegression
lm = LinearRegression()
lm.fit(X_train, y_train)
```

Out[27]:

```
LinearRegression()
```

In [28]:

```
y_pred=lm.predict(X_test)
actual_vs_pred=pd.DataFrame({'Actual': y_test, 'Predicted': y_pred})
actual_vs_pred
```

Out[28]:

	Actual	Predicted
7	7.364	7.102382
44	5.995	6.089890
113	4.633	4.721436
120	4.514	4.514163
63	5.716	6.015593
122	4.507	4.516562
121	4.512	4.500815
139	3.956	3.840147
109	4.686	4.561262
92	5.007	5.070774
24	6.786	6.867245
141	3.904	3.985475
26	6.670	6.561287
60	5.770	5.802416
80	5.194	4.857588
97	4.885	5.057485
129	4.297	4.266266
98	4.876	4.728840
142	3.896	4.075956
56	5.828	5.829734
45	5.987	6.172161
33	6.455	6.318034
59	5.791	6.056022

	Actual	Predicted
8	7.286	6.916054
40	6.168	6.253210
37	6.298	6.313745
101	4.857	4.998654
19	6.901	6.771712
144	3.819	3.973862
108	4.694	4.719401
51	5.889	5.925945
54	5.848	6.105799

In [30]:

```
coefficient = lm.coef_
coefficient_df = pd.DataFrame(list(zip(X.columns, lm.coef_)),
columns=['features', 'coefficients'])
coefficient_df
```

Out[30]:

	features	coefficients
0	Economy (GDP per Capita)	0.961499
1	Standard Error	-0.594621
2	Family	1.008561
3	Health (Life Expectancy)	1.058444
4	Freedom	1.707399
5	Dystopia Residual	0.935251

In [ ]:

```
#Most important factor is freedom as compared to all other factors
```

In [ ]:

```
#using Root Mean squared error for model evaluation
```

In [31]:

```
from sklearn import metrics
from sklearn.metrics import mean_squared_error as MSE
print('Root Mean Squared Error:', np.sqrt(MSE(y_test, y_pred)))
```

```
Root Mean Squared Error: 0.1609729663946279
```

In [ ]:

```
# model fits the data well as lower RMSE
```

In [ ]:

In [ ]: