In [1]:

```
# Update sklearn to prevent version mismatches
# !conda install scikit-learn
# !conda update scikit-learn
# !conda install joblib
# !conda update joblib
```

In [2]:

```
%matplotlib inline
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

Read the CSV and Perform Basic Data Cleaning

In [3]:

```
# Drop the null columns where all values are null
df = pd.read_csv("clean_2019.csv")
df = df.dropna(axis='columns', how='all')
```

In [4]:

```
new_df=df.drop(['country','happiness_rank'],axis=1)
new_df = new_df.apply(lambda x: x.fillna(0),axis=0)
new_df.head()
```

Out[4]:

	happiness_score	gdp_per_capita	social_support	life_expectancy	freedom	generosity	government_corr
0	2.853	0.306	0.575	0.295	0.010	0.202	0.091
1	3.083	0.026	0.000	0.105	0.225	0.235	0.035
2	3.203	0.350	0.517	0.361	0.000	0.158	0.025
3	3.231	0.476	0.885	0.499	0.417	0.276	0.147
4	3.334	0.359	0.711	0.614	0.555	0.217	0.411

In [5]:

```
new_df.describe()
```

Out[5]:

	happiness_score	gdp_per_capita	social_support	life_expectancy	freedom	generosity	government_corr
count	156.000000	156.000000	156.000000	156.000000	156.000000	156.000000	156.000000
mean	5.407096	0.905147	1.208814	0.725244	0.392571	0.184846	0.110603
std	1.113120	0.398389	0.299191	0.242124	0.143289	0.095254	0.094538
min	2.853000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	4.544500	0.602750	1.055750	0.547750	0.308000	0.108750	0.047000
50%	5.379500	0.960000	1.271500	0.789000	0.417000	0.177500	0.085500
75%	6.184500	1.232500	1.452500	0.881750	0.507250	0.248250	0.141250
max	7.769000	1.684000	1.624000	1.141000	0.631000	0.566000	0.453000

Create a Train Test Split

In [6]:

```
X = new_df.drop("happiness_score", axis=1)
y = new_df.happiness_score
print(X.shape, y.shape)
X
```

```
(156, 6) (156,)
```

Out[6]:

	gdp_per_capita	social_support	life_expectancy	freedom	generosity	government_corr
0	0.306	0.575	0.295	0.010	0.202	0.091
1	0.026	0.000	0.105	0.225	0.235	0.035
2	0.350	0.517	0.361	0.000	0.158	0.025
3	0.476	0.885	0.499	0.417	0.276	0.147
4	0.359	0.711	0.614	0.555	0.217	0.411
...	...	...	...	...	...	...
151	1.396	1.522	0.999	0.557	0.322	0.298
152	1.380	1.624	1.026	0.591	0.354	0.118
153	1.488	1.582	1.028	0.603	0.271	0.341
154	1.383	1.573	0.996	0.592	0.252	0.410
155	1.340	1.587	0.986	0.596	0.153	0.393

156 rows × 6 columns

In [7]:

```
y
```

Out[7]:

```
0      2.853
1      3.083
2      3.203
3      3.231
4      3.334
       ...  
151    7.488
152    7.494
153    7.554
154    7.600
155    7.769
Name: happiness_score, Length: 156, dtype: float64
```

Train test_split to create training and testing data

In [8]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42)
```

In [9]:

```
#creating the model using LinearRegression
from sklearn.linear_model import LinearRegression
model_n = LinearRegression()
```

In [10]:

```
# Fit the model to the training data and calculate the scores for the training and testing data
model_n.fit(X_train, y_train)
training_score = model_n.score(X_train, y_train)
testing_score = model_n.score(X_test, y_test)
print(f"Training Score: {training_score}")
print(f"Testing Score: {testing_score}")
```

```
Training Score: 0.7685438552559285
Testing Score: 0.8089648421597913
```

In [11]:

```
print("Intercept", model_n.intercept_)
```

```
Intercept 1.8539910898466916
```

In [12]:

```
print("Coefficients", model_n.coef_)
```

```
Coefficients [0.94570964 1.00689959 0.92466226 1.78787977 0.24101878 0.6975058 ]
```

In [13]:
```
coef = zip(X.columns, model_n.coef_)
coef_df = pd.DataFrame(list(zip(X.columns, model_n.coef_)), columns=["Features","Coefficients"])
coef_df
```

Out[13]:

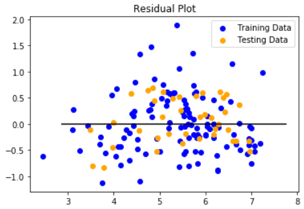
	Features	Coefficients
0	gdp_per_capita	0.945710
1	social_support	1.006900
2	life_expectancy	0.924662
3	freedom	1.787880
4	generosity	0.241019
5	government_corr	0.697506

Regression Equation

Happiness Score= 1.8539910898466916 + 0.945710*gdp_per_capita +1.006900*social_support +1.006900*life_expectancy + 1.787880*freedom +0.241019*generosity + 0.697506*government_corr

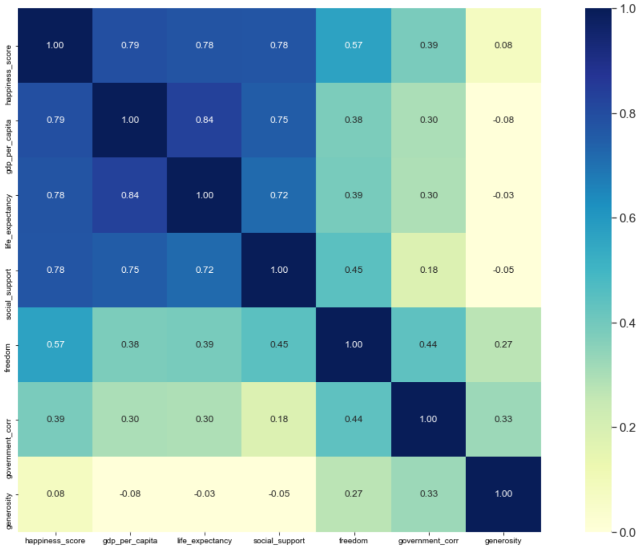
In [14]:
```
# Plot the Residuals for the Training and Testing data
plt.scatter(model_n.predict(X_train), model_n.predict(X_train) - y_train, c="blue", label="Training Data")
plt.scatter(model_n.predict(X_test), model_n.predict(X_test) - y_test, c="orange", label="Testing Data")
plt.legend()
plt.hlines(y=0, xmin=y.min(), xmax=y.max())
plt.title("Residual Plot")
```

Out[14]:
```
Text(0.5, 1.0, 'Residual Plot')
```



In [15]:
```
from __future__ import division
import seaborn as sns
```

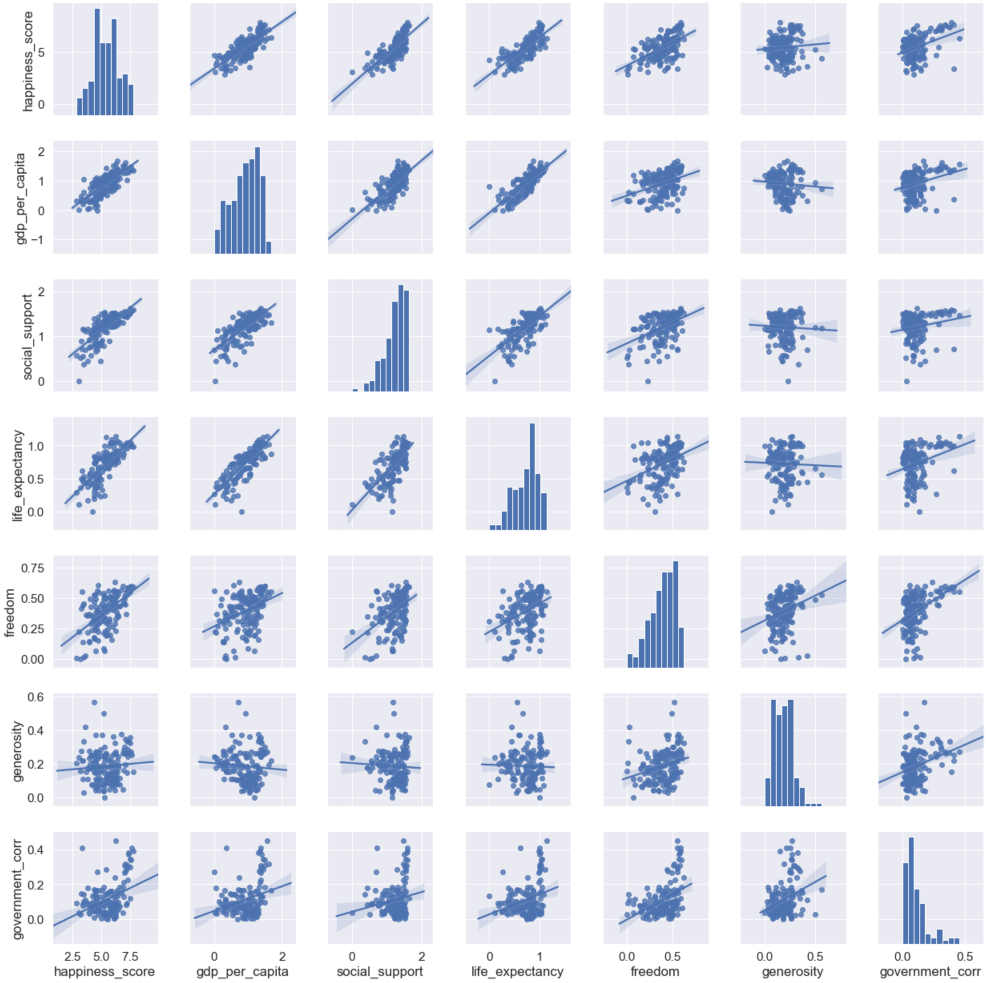
In [16]:
```
#number of variables for heatmap
k = 7
corrmat = new_df.corr()
cols = corrmat.nlargest(k, "happiness_score")["happiness_score"].index
cm = np.corrcoef(new_df[cols].values.T)
f, ax = plt.subplots(figsize=(20, 12))
sns.set(font_scale=1.4)
hm = sns.heatmap(cm, cbar=True, annot=True, square=True, fmt='.2f', annot_kws={'size': 12},
                 yticklabels=cols.values, xticklabels=cols.values,vmax=1, vmin=0, cmap='YlGnBu')
hm.set_ylim([7,0])
g0 = plt.show()
```



In [17]:
```
f.savefig('sns_heatmap.jpg')
```

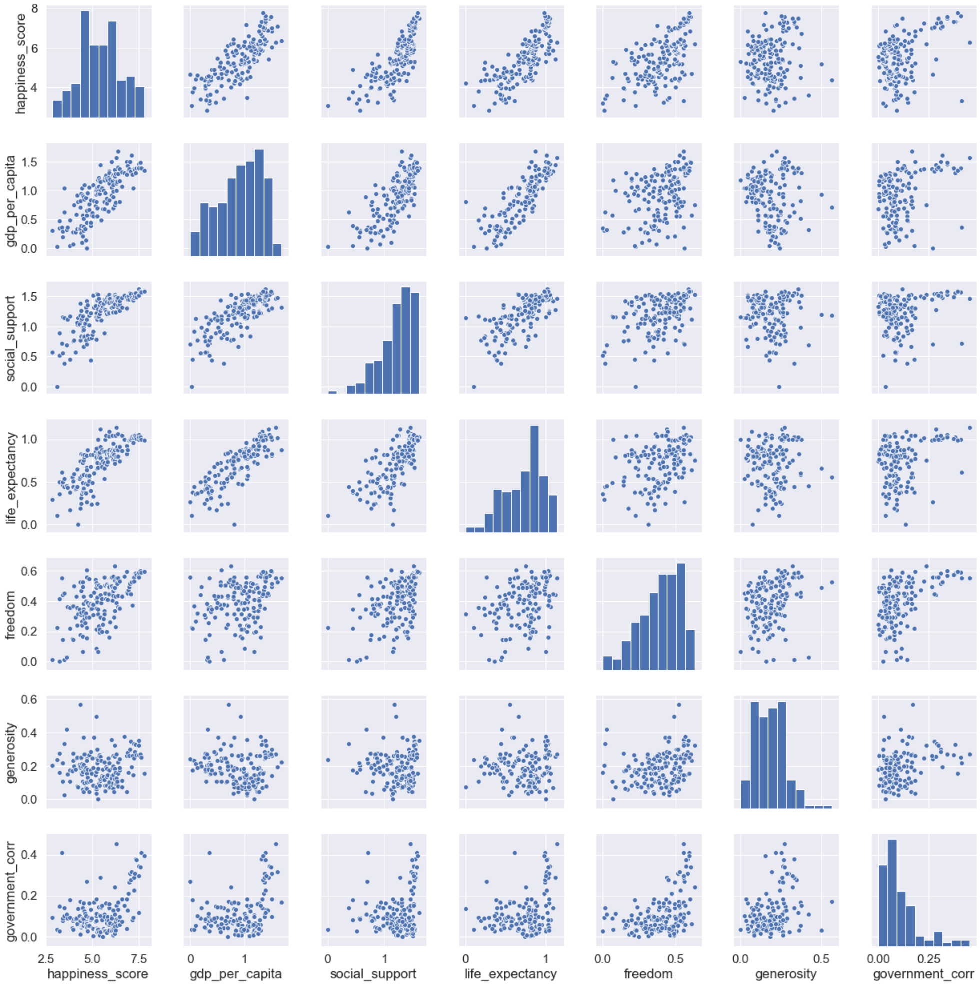
In [18]:

```
# with regression
g1 = sns.pairplot(new_df, kind="reg")
# plt.show()
```

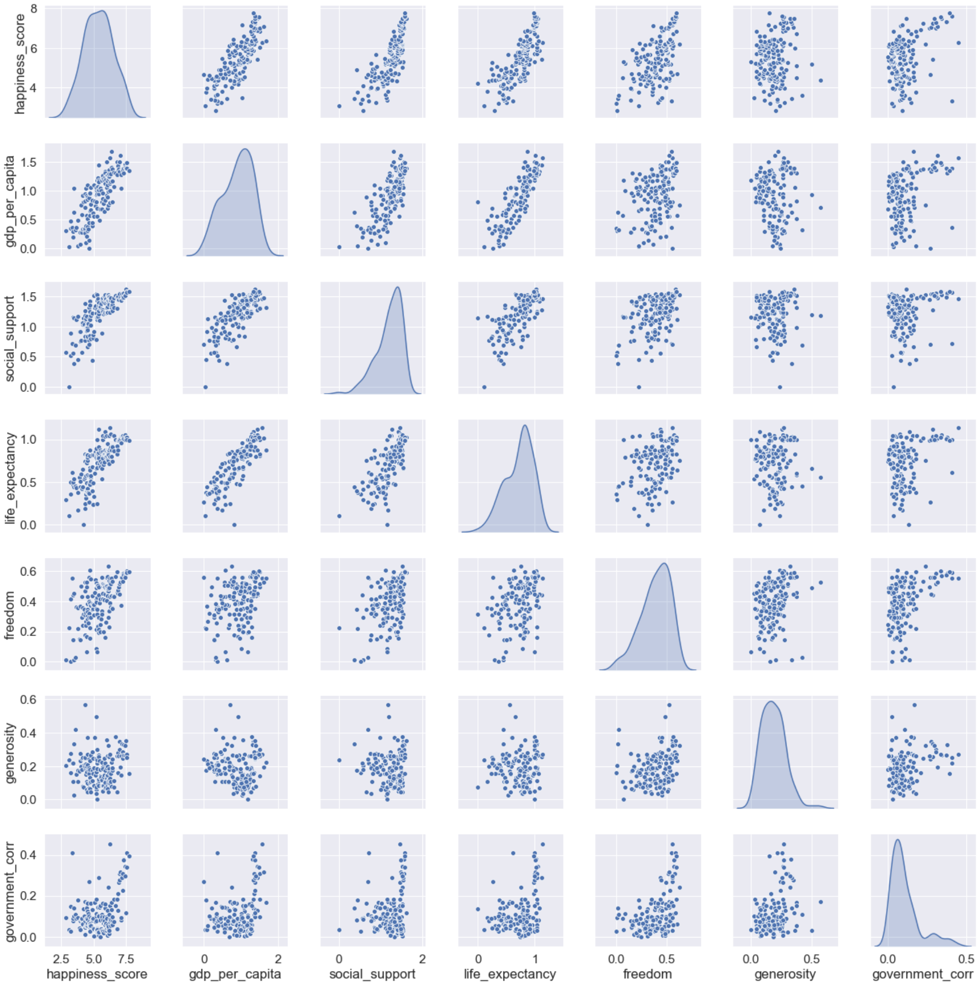


In [19]:

```
 # without regression
g2 = sns.pairplot(new_df, kind="scatter")
# plt.show()
```

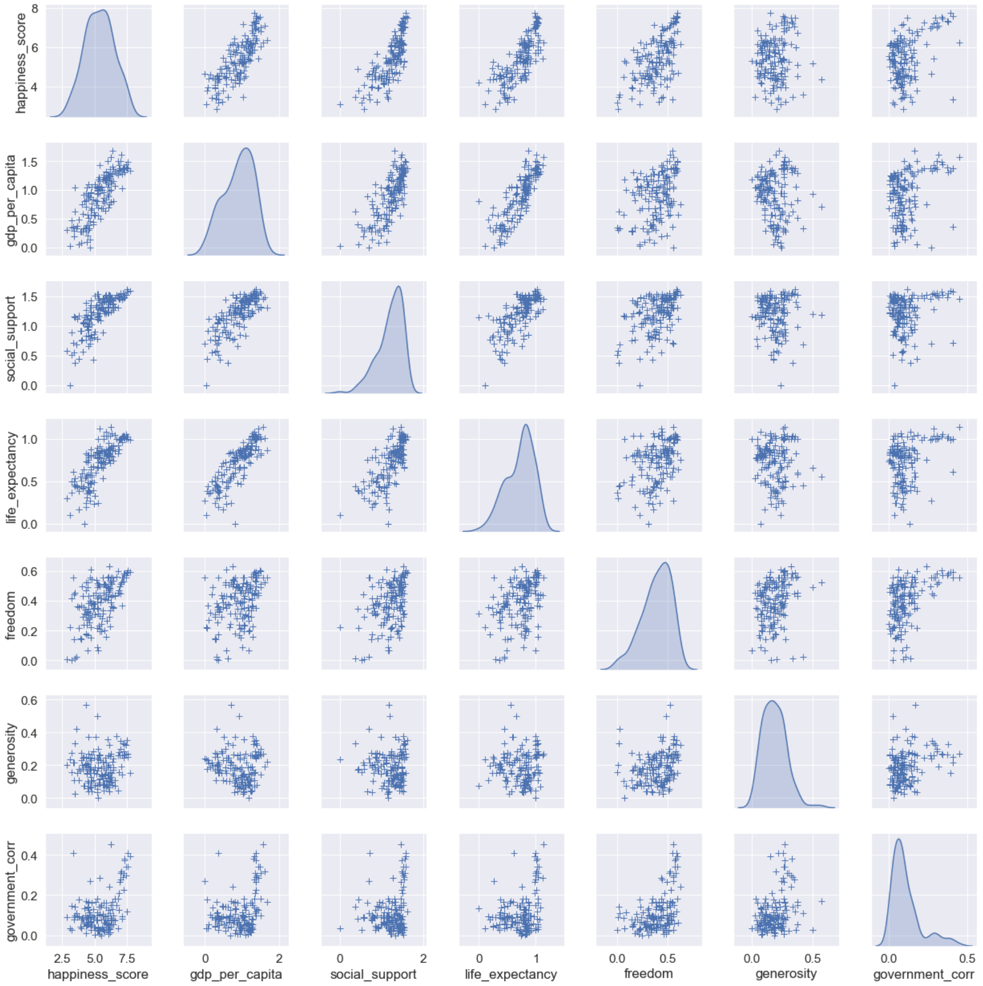


```
In [20]: g3 = sns.pairplot(new_df, diag_kind="kde")
```



In [21]:

```
g4 = sns.pairplot(new_df, diag_kind="kde", markers="+",
                 plot_kws=dict(s=50, edgecolor="b", linewidth=1),
                 diag_kws=dict(shade=True))
```


happiness_score
gdp_per_capita
social_support
life_expectancy
freedom
generosity
government_corr
happiness_score
gdp_per_capita
social_support
life_expectancy
freedom
generosity
government_corr