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Trusted | Python 3 (ipykernel)

Run Code

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
pd.options.display.float_format = '{:.2f}'.format
import warnings
warnings.filterwarnings('ignore')

from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
from mpl_toolkits.mplot3d import Axes3D

import plotly.express as px
!pip install -U kaleido
import kaleido
```

```
Defaulting to user installation because normal site-packages is not writeable
Collecting kaleido
  Downloading kaleido-0.2.1-py2.py3-none-win_amd64.whl (65.9 MB)
Installing collected packages: kaleido
Successfully installed kaleido-0.2.1
```

In [2]:
```
data = pd.read_csv('Country-data.csv')
data.head()
```

Out[2]:

| | country | child_mort | exports | health | imports | income | inflation | life_expec | total_fer | gdpp |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Afghanistan | 90.20 | 10.00 | 7.58 | 44.90 | 1610 | 9.44 | 56.20 | 5.82 | 553 |
| 1 | Albania | 16.60 | 28.00 | 6.55 | 48.60 | 9930 | 4.49 | 76.30 | 1.65 | 4090 |
| 2 | Algeria | 27.30 | 38.40 | 4.17 | 31.40 | 12900 | 16.10 | 76.50 | 2.89 | 4460 |
| 3 | Angola | 119.00 | 62.30 | 2.85 | 42.90 | 5900 | 22.40 | 60.10 | 6.16 | 3530 |
| 4 | Antigua and Barbuda | 10.30 | 45.50 | 6.03 | 58.90 | 19100 | 1.44 | 76.80 | 2.13 | 12200 |

In [3]:
```
data.shape
```

Out[3]: (167, 10)

In [4]:
```
data.columns
```

Out[4]:
```
Index(['country', 'child_mort', 'exports', 'health', 'imports', 'income',
       'inflation', 'life_expec', 'total_fer', 'gdpp'],
      dtype='object')
```

In [5]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 167 entries, 0 to 166
Data columns (total 10 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
```

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Trusted | Python 3 (ipykernel)

Run Code

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
pd.options.display.float_format = '{:.2f}'.format
import warnings
warnings.filterwarnings('ignore')

from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
from mpl_toolkits.mplot3d import Axes3D

import plotly.express as px
!pip install -U kaleido
import kaleido
```

```
Defaulting to user installation because normal site-packages is not writeable
Collecting kaleido
  Downloading kaleido-0.2.1-py2.py3-none-win_amd64.whl (65.9 MB)
Installing collected packages: kaleido
Successfully installed kaleido-0.2.1
```

In [2]:
```
data = pd.read_csv('Country-data.csv')
data.head()
```

Out[2]:

| | country | child_mort | exports | health | imports | income | inflation | life_expec | total_fer | gdpp |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Afghanistan | 90.20 | 10.00 | 7.58 | 44.90 | 1610 | 9.44 | 56.20 | 5.82 | 553 |
| 1 | Albania | 16.60 | 28.00 | 6.55 | 48.60 | 9930 | 4.49 | 76.30 | 1.65 | 4090 |
| 2 | Algeria | 27.30 | 38.40 | 4.17 | 31.40 | 12900 | 16.10 | 76.50 | 2.89 | 4460 |
| 3 | Angola | 119.00 | 62.30 | 2.85 | 42.90 | 5900 | 22.40 | 60.10 | 6.16 | 3530 |
| 4 | Antigua and Barbuda | 10.30 | 45.50 | 6.03 | 58.90 | 19100 | 1.44 | 76.80 | 2.13 | 12200 |

In [3]:
```
data.shape
```

Out[3]: (167, 10)

In [4]:
```
data.columns
```

Out[4]:
```
Index(['country', 'child_mort', 'exports', 'health', 'imports', 'income',
       'inflation', 'life_expec', 'total_fer', 'gdpp'],
      dtype='object')
```

In [5]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 167 entries, 0 to 166
Data columns (total 10 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
```

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Run Code

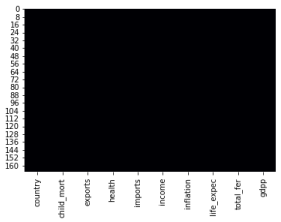
In [4]:
```
data.columns
```

Out[4]:
```
Index(['country', 'child_mort', 'exports', 'health', 'imports', 'income',
       'inflation', 'life_expec', 'total_fer', 'gdpp'],
      dtype='object')
```

In [5]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 167 entries, 0 to 166
Data columns (total 10 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   country     167 non-null    object 
 1   child_mort  167 non-null    float64
 2   exports     167 non-null    float64
 3   health      167 non-null    float64
 4   imports     167 non-null    float64
 5   income      167 non-null    int64  
 6   inflation   167 non-null    float64
 7   life_expec  167 non-null    float64
 8   total_fer   167 non-null    float64
 9   gdpp        167 non-null    int64  
dtypes: float64(7), int64(2), object(1)
memory usage: 13.2+ KB
```

In [6]:
```
sns.heatmap(data.isnull(),cmap = 'magma',cbar = False);
```




In [7]:
```
data.describe()
```

Out[7]:

| | child_mort | exports | health | imports | income | inflation | life_expec | total_fer | gdpp |
|---|---|---|---|---|---|---|---|---|---|
| count | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 |
| mean | 38.27 | 41.11 | 6.82 | 46.89 | 17144.69 | 7.78 | 70.56 | 2.95 | 12964.16 |
| std | 40.33 | 27.41 | 2.75 | 24.21 | 19278.07 | 10.57 | 8.89 | 1.51 | 18328.70 |

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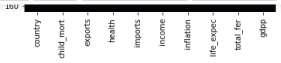
Run Code




In [7]:
```
data.describe()
```

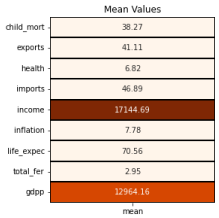
Out[7]:

| | child_mort | exports | health | imports | income | inflation | life_expec | total_fer | gdpp |
|---|---|---|---|---|---|---|---|---|---|
| count | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 | 167.00 |
| mean | 38.27 | 41.11 | 6.82 | 46.89 | 17144.69 | 7.78 | 70.56 | 2.95 | 12964.16 |
| std | 40.33 | 27.41 | 2.75 | 24.21 | 19278.07 | 10.57 | 8.89 | 1.51 | 18328.70 |
| min | 2.60 | 0.11 | 1.81 | 0.07 | 609.00 | -4.21 | 32.10 | 1.15 | 231.00 |
| 25% | 8.25 | 23.80 | 4.92 | 30.20 | 3355.00 | 1.81 | 65.30 | 1.79 | 1330.00 |
| 50% | 19.30 | 35.00 | 6.32 | 43.30 | 9960.00 | 5.39 | 73.10 | 2.41 | 4660.00 |
| 75% | 62.10 | 51.35 | 8.60 | 58.75 | 22800.00 | 10.75 | 76.80 | 3.88 | 14050.00 |
| max | 208.00 | 200.00 | 17.90 | 174.00 | 125000.00 | 104.00 | 82.80 | 7.49 | 105000.00 |

In [8]:
```
fig,ax = plt.subplots(nrows = 1,ncols = 1,figsize = (5,5))

colors = ['#FF781F','#2D2926']
plt.subplot(1,1,1)
sns.heatmap(data.describe().T[['mean']],cmap = 'Oranges',annot = True,fmt = '.2f',linecolor = 'black',linewidths = 0.4,cbar = Fal
plt.title('Mean Values');

fig.tight_layout(pad = 4)
```




In [9]:
```
col = list(data.columns)
col.remove('country')
categorical_features = ['country']
numerical_features = [*col]
print('Categorical Features :',*categorical_features)
```

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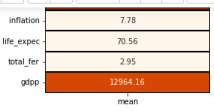
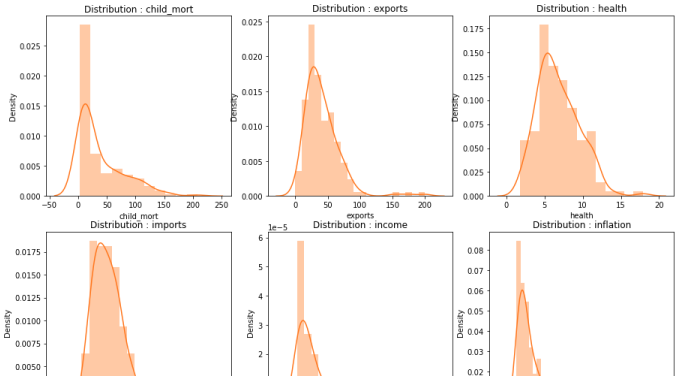
Run Code




In [9]:
```
col = list(data.columns)
col.remove('country')
categorical_features = ['country']
numerical_features = [*col]
print('Categorical Features :',*categorical_features)
print('Numerical Features :',*numerical_features)
```

```
Categorical Features : country
Numerical Features : child_mort exports health imports income inflation life_expec total_fer gdpp
```

In [10]:
```
fig, ax = plt.subplots(nrows = 3,ncols = 3,figsize = (15,15))
for i in range(len(numerical_features)):
    plt.subplot(3,3,i+1)
    sns.distplot(data[numerical_features[i]],color = colors[0])
    title = 'Distribution : ' + numerical_features[i]
    plt.title(title)
plt.show()
```

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Run Code

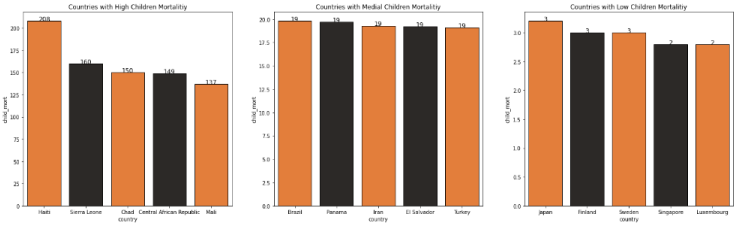

In [11]:
```
len(data['country'].unique()) == len(data)
```

Out[11]: True

In [12]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'child_mort', data = data.sort_values(ascending = False,by = 'child_mort').iloc[:5],palette =
plt.title('Countries with High Children Mortality')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,2)
ax = sns.barplot(x = 'country',y = 'child_mort', data = data.sort_values(ascending = False,by = 'child_mort').iloc[81:86],palette
plt.title('Countries with Medial Children Mortality')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,3)
ax = sns.barplot(x = 'country',y = 'child_mort', data = data.sort_values(ascending = False,by = 'child_mort').iloc[161:166],palet
plt.title('Countries with Low Children Mortality')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)
plt.show()
```




In [13]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'exports', data = data.sort_values(ascending = False,by = 'exports').iloc[:5],palette = colors
plt.title('Countries with High Exports (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
```

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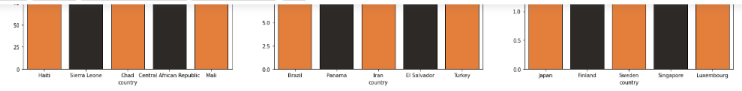
Trusted Python 3 (ipykernel)

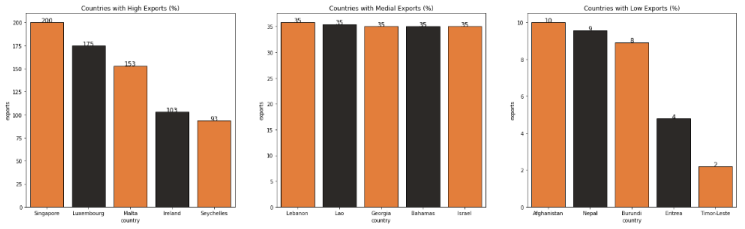
Run Code



In [13]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'exports', data = data.sort_values(ascending = False,by = 'exports').iloc[:5],palette = colors
plt.title('Countries with High Exports (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,2)
ax = sns.barplot(x = 'country',y = 'exports', data = data.sort_values(ascending = False,by = 'exports').iloc[81:86],palette = col
plt.title('Countries with Medial Exports (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,3)
ax = sns.barplot(x = 'country',y = 'exports', data = data.sort_values(ascending = False,by = 'exports').iloc[161:166],palette = c
plt.title('Countries with Low Exports (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)
plt.show()
```




In [14]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'health', data = data.sort_values(ascending = False,by = 'health').iloc[:5],palette = colors,e
plt.title('Countries with High Health Spending (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
```

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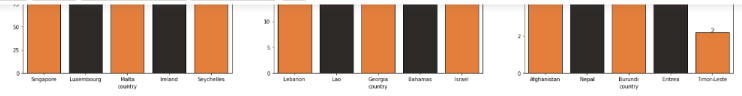
Trusted Python 3 (ipykernel)

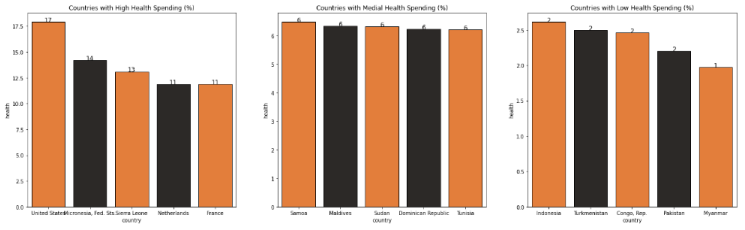
Run Code



In [14]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'health', data = data.sort_values(ascending = False,by = 'health').iloc[:5],palette = colors,e
plt.title('Countries with High Health Spending (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,2)
ax = sns.barplot(x = 'country',y = 'health', data = data.sort_values(ascending = False,by = 'health').iloc[81:86],palette = color
plt.title('Countries with Medial Health Spending (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,3)
ax = sns.barplot(x = 'country',y = 'health', data = data.sort_values(ascending = False,by = 'health').iloc[161:166],palette = col
plt.title('Countries with Low Health Spending (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)
plt.show()
```




In [15]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'imports', data = data.sort_values(ascending = False,by = 'imports').iloc[:5],palette = colors
plt.title('Countries with High Imports (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
```

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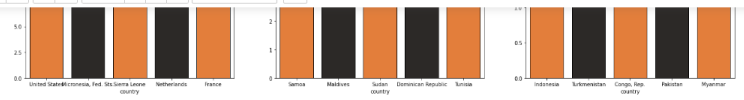
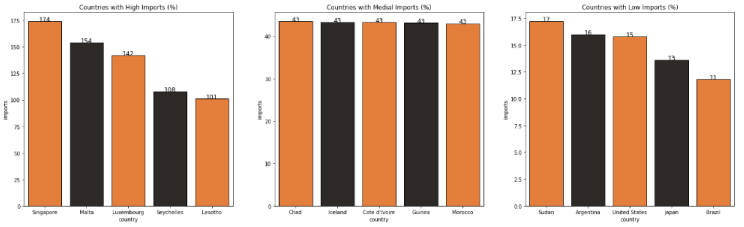
Run Code



In [15]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'imports', data = data.sort_values(ascending = False,by = 'imports').iloc[:5],palette = colors
plt.title('Countries with High Imports (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,2)
ax = sns.barplot(x = 'country',y = 'imports', data = data.sort_values(ascending = False,by = 'imports').iloc[81:86],palette = col
plt.title('Countries with Medial Imports (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,3)
ax = sns.barplot(x = 'country',y = 'imports', data = data.sort_values(ascending = False,by = 'imports').iloc[161:166],palette = c
plt.title('Countries with Low Imports (%)')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)
plt.show()
```




In [16]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'income', data = data.sort_values(ascending = False,by = 'income').iloc[:5],palette = colors,e
plt.title('Countries with High Income/Person')
for rect in ax.patches:
```

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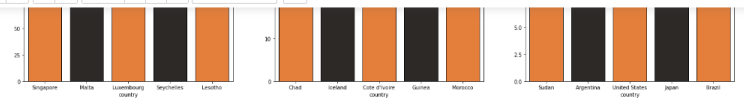
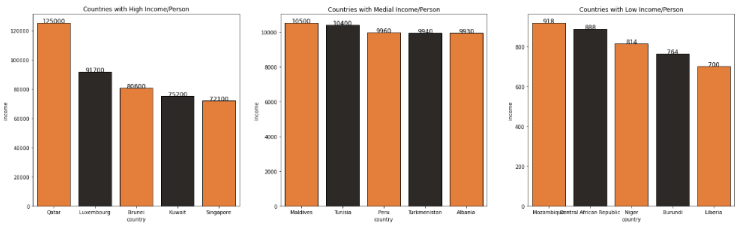
Run Code



In [16]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'income', data = data.sort_values(ascending = False,by = 'income').iloc[:5],palette = colors,e
plt.title('Countries with High Income/Person')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,2)
ax = sns.barplot(x = 'country',y = 'income', data = data.sort_values(ascending = False,by = 'income').iloc[81:86],palette = color
plt.title('Countries with Medial Income/Person')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,3)
ax = sns.barplot(x = 'country',y = 'income', data = data.sort_values(ascending = False,by = 'income').iloc[161:166],palette = col
plt.title('Countries with Low Income/Person')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)
plt.show()
```




In [17]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'inflation', data = data.sort_values(ascending = False,by = 'inflation').iloc[:5],palette = cc
plt.title('Countries with High Inflation')
for rect in ax.patches:
```

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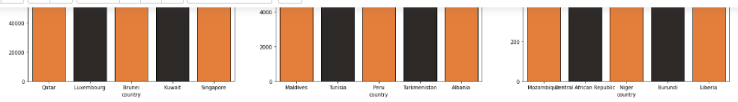
Trusted Python 3 (ipykernel)

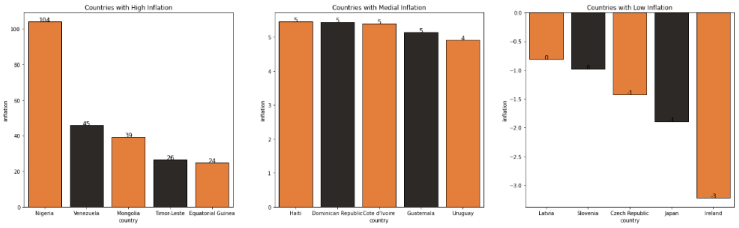
Run Code



In [17]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'inflation', data = data.sort_values(ascending = False,by = 'inflation').iloc[:5],palette = cc
plt.title('Countries with High Inflation')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,2)
ax = sns.barplot(x = 'country',y = 'inflation', data = data.sort_values(ascending = False,by = 'inflation').iloc[81:86],palette =
plt.title('Countries with Medial Inflation')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,3)
ax = sns.barplot(x = 'country',y = 'inflation', data = data.sort_values(ascending = False,by = 'inflation').iloc[161:166],palette
plt.title('Countries with Low Inflation')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)
plt.show()
```




In [18]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'life_expec', data = data.sort_values(ascending = False,by = 'life_expec').iloc[:5],palette =
plt.title('Countries with High Life Expectancy')
for rect in ax.patches:
```

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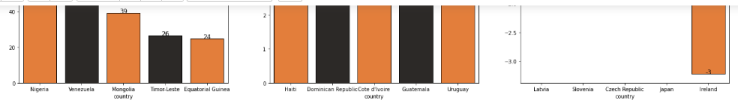
Trusted Python 3 (ipykernel)

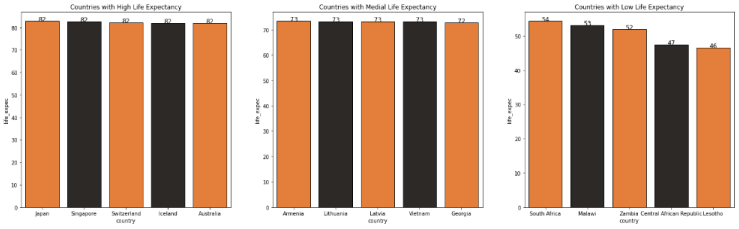
Run Code



In [18]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'life_expec', data = data.sort_values(ascending = False,by = 'life_expec').iloc[:5],palette =
plt.title('Countries with High Life Expectancy')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,2)
ax = sns.barplot(x = 'country',y = 'life_expec', data = data.sort_values(ascending = False,by = 'life_expec').iloc[81:86],palette
plt.title('Countries with Medial Life Expectancy')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,3)
ax = sns.barplot(x = 'country',y = 'life_expec', data = data.sort_values(ascending = False,by = 'life_expec').iloc[161:166],palet
plt.title('Countries with Low Life Expectancy')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)
plt.show()
```




In [19]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'total_fer', data = data.sort_values(ascending = False,by = 'total_fer').iloc[:5],palette = cc
plt.title('Countries with High Female Fertility Rate')
for rect in ax.patches:
```

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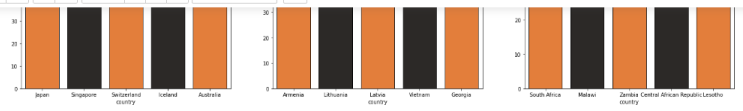
Trusted Python 3 (ipykernel)

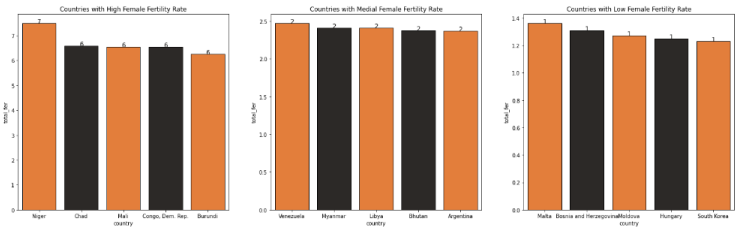
Run Code



In [19]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'total_fer', data = data.sort_values(ascending = False,by = 'total_fer').iloc[:5],palette = cc
plt.title('Countries with High Female Fertility Rate')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,2)
ax = sns.barplot(x = 'country',y = 'total_fer', data = data.sort_values(ascending = False,by = 'total_fer').iloc[81:86],palette =
plt.title('Countries with Medial Female Fertility Rate')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,3)
ax = sns.barplot(x = 'country',y = 'total_fer', data = data.sort_values(ascending = False,by = 'total_fer').iloc[161:166],palette
plt.title('Countries with Low Female Fertility Rate')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)
plt.show()
```




In [20]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'gdpp', data = data.sort_values(ascending = False,by = 'gdpp').iloc[:5],palette = colors,edgec
plt.title('Countries with High GDP Contribution /Person')
for rect in ax.patches:
```

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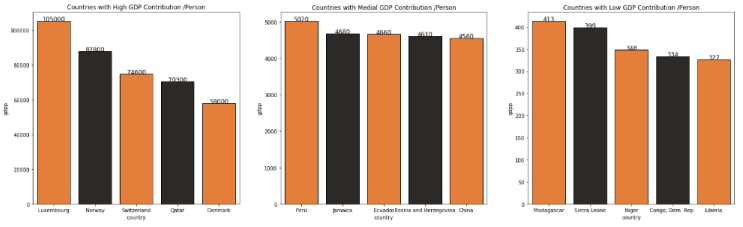
Trusted Python 3 (ipykernel)

Run Code

In [20]:
```
fig = plt.subplots(nrows = 1,ncols = 3,figsize = (25,7))
plt.subplot(1,3,1)
ax = sns.barplot(x = 'country',y = 'gdpp', data = data.sort_values(ascending = False,by = 'gdpp').iloc[:5],palette = colors,edgec
plt.title('Countries with High GDP Contribution /Person')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,2)
ax = sns.barplot(x = 'country',y = 'gdpp', data = data.sort_values(ascending = False,by = 'gdpp').iloc[81:86],palette = colors,ec
plt.title('Countries with Medial GDP Contribution /Person')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)

plt.subplot(1,3,3)
ax = sns.barplot(x = 'country',y = 'gdpp', data = data.sort_values(ascending = False,by = 'gdpp').iloc[161:166],palette = colors,
plt.title('Countries with Low GDP Contribution /Person')
for rect in ax.patches:
    ax.text(rect.get_x() + rect.get_width()/2, rect.get_height(), int(rect.get_height()),
            horizontalalignment='center', fontsize = 12)
plt.show()
```




In [21]:
```
fig  = plt.subplots(nrows = 3,ncols = 3,figsize = (15,15))
for i in range(len(numerical_features)):
    plt.subplot(3,3,i+1)
    ax = sns.boxplot(data[numerical_features[i]],color = colors[0])
```

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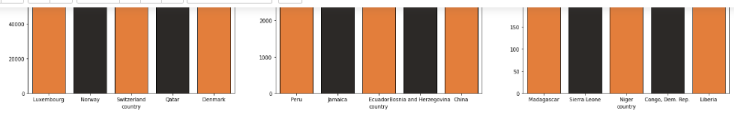
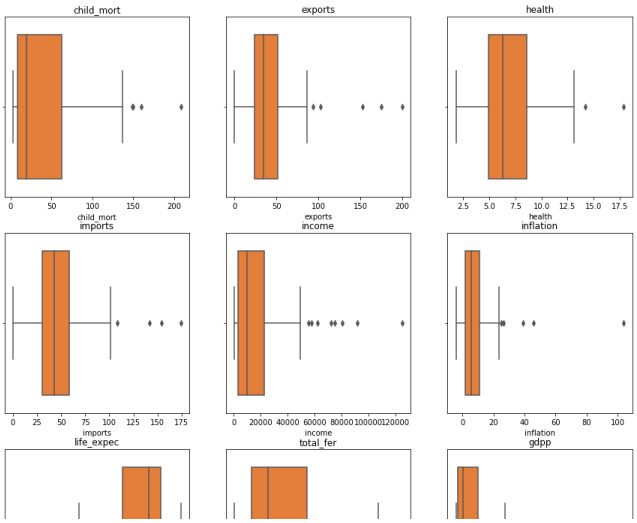
Trusted Python 3 (ipykernel)

Run Code



In [21]:
```
fig  = plt.subplots(nrows = 3,ncols = 3,figsize = (15,15))
for i in range(len(numerical_features)):
    plt.subplot(3,3,i+1)
    ax = sns.boxplot(data[numerical_features[i]],color = colors[0])
    plt.title(numerical_features[i])
plt.show()
```

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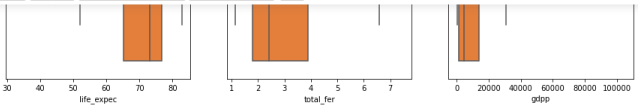
Trusted Python 3 (ipykernel)

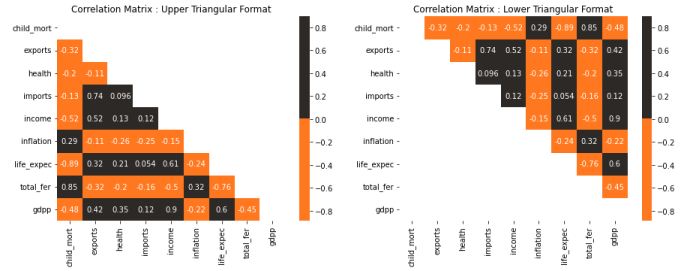
Run Code



In [22]:
```
ut = np.triu(data.corr())
lt = np.tril(data.corr())

fig,ax = plt.subplots(nrows = 1, ncols = 2,figsize = (15,5))
plt.subplot(1,2,1)
sns.heatmap(data.corr(),cmap = colors,annot = True,cbar = 'True',mask = ut);
plt.title('Correlation Matrix : Upper Triangular Format');

plt.subplot(1,2,2)
sns.heatmap(data.corr(),cmap = colors,annot = True,cbar = 'True',mask = lt);
plt.title('Correlation Matrix : Lower Triangular Format');
```




In [23]:
```
df1 = pd.DataFrame()
df1['Health'] = (data['child_mort'] / data['child_mort'].mean()) + (data['health'] / data['health'].mean()) + (data['life_expec']
df1['Trade'] = (data['imports'] / data['imports'].mean()) + (data['exports'] / data['exports'].mean())
df1['Finance'] = (data['income'] / data['income'].mean()) + (data['inflation'] / data['inflation'].mean()) + (data['gdpp'] / data
df1.head()
```

Out[23]:

| | Health | Trade | Finance |
|---|---|---|---|
| 0 | 6.24 | 1.20 | 1.35 |
| 1 | 3.04 | 1.72 | 1.47 |
| 2 | 3.99 | 1.60 | 2.17 |

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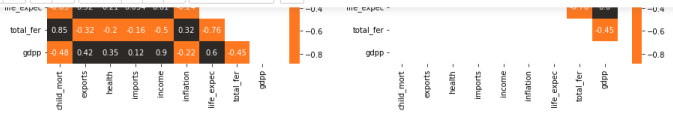


In [23]:
```
df1 = pd.DataFrame()
df1['Health'] = (data['child_mort'] / data['child_mort'].mean()) + (data['health'] / data['health'].mean()) + (data['life_expec'
df1['Trade'] = (data['imports'] / data['imports'].mean()) + (data['exports'] / data['exports'].mean())
df1['Finance'] = (data['income'] / data['income'].mean()) + (data['inflation'] / data['inflation'].mean()) + (data['gdpp'] / data
df1.head()
```

Out[23]:

| | Health | Trade | Finance |
|---|---|---|---|
| 0 | 6.24 | 1.20 | 1.35 |
| 1 | 3.04 | 1.72 | 1.47 |
| 2 | 3.39 | 1.60 | 3.17 |
| 3 | 6.47 | 2.43 | 3.49 |
| 4 | 2.96 | 2.36 | 2.24 |

In [24]:
```
from sklearn.preprocessing import MinMaxScaler,StandardScaler
mms = MinMaxScaler() # Normalization
ss = StandardScaler() # Standardization

df1['Health'] = mms.fit_transform(df1[['Health']])
df1['Trade'] = mms.fit_transform(df1[['Trade']])
df1['Finance'] = mms.fit_transform(df1[['Finance']])
df1.insert(loc = 0, value = list(data['country']), column = 'Country')
df1.head()
```

Out[24]:

| | Country | Health | Trade | Finance |
|---|---|---|---|---|
| 0 | Afghanistan | 0.63 | 0.14 | 0.08 |
| 1 | Albania | 0.13 | 0.20 | 0.09 |
| 2 | Algeria | 0.18 | 0.19 | 0.21 |
| 3 | Angola | 0.66 | 0.28 | 0.24 |
| 4 | Antigua and Barbuda | 0.12 | 0.28 | 0.15 |

In [25]:
```
df2 = data.copy(deep = True)

col = list(data.columns)
col.remove('health'); col.remove('country')

df2['health'] = ss.fit_transform(df2[['health']]) # Standardization

for i in col:
    df2[i] = mms.fit_transform(df2[[i]]) # Normalization
df2.drop(columns = 'country',inplace = True)
df2.head()
```

Out[25]:

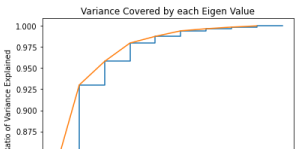
| | child_mort | exports | health | imports | income | inflation | life_expec | total_fer | gdpp |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.43 | 0.05 | 0.28 | 0.26 | 0.01 | 0.13 | 0.48 | 0.74 | 0.00 |
| 1 | 0.07 | 0.14 | -0.10 | 0.28 | 0.07 | 0.08 | 0.87 | 0.08 | 0.04 |
| 2 | 0.12 | 0.19 | -0.97 | 0.18 | 0.10 | 0.19 | 0.88 | 0.27 | 0.04 |
| 3 | 0.57 | 0.31 | -1.45 | 0.25 | 0.04 | 0.25 | 0.55 | 0.79 | 0.03 |
| 4 | 0.04 | 0.23 | -0.29 | 0.34 | 0.15 | 0.05 | 0.88 | 0.15 | 0.11 |

In [26]:
```
from sklearn.decomposition import PCA

pca = PCA()
pca_df2 = pd.DataFrame(pca.fit_transform(df2))
pca.explained_variance_
```

Out[26]:
```
array([1.01740511, 0.13090418, 0.03450018, 0.02679822, 0.00979752,
       0.00803398, 0.00307055, 0.00239976, 0.00179388])
```

In [27]:
```
plt.step(list(range(1,10)), np.cumsum(pca.explained_variance_ratio_))
plt.plot(np.cumsum(pca.explained_variance_ratio_))
plt.xlabel('Eigen Values')
plt.ylabel('Ratio of Variance Explained')
plt.title('Variance Covered by each Eigen Value')
plt.show()
```



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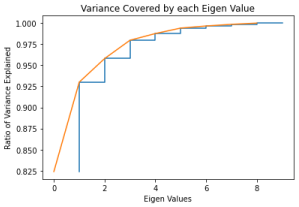
```
plt.title('Variance Covered by each Eigen Value')
plt.show()
```




In [28]:
```
pca_df2 = pca_df2.drop(columns = [3,4,5,6,7,8])
pca_df2.head()
```

Out[28]:

| | 0 | 1 | 2 |
|---|---|---|---|
| 0 | 0.22 | 0.64 | 0.09 |
| 1 | -0.08 | -0.17 | -0.21 |
| 2 | -0.96 | -0.13 | -0.13 |
| 3 | -1.51 | 0.47 | 0.28 |
| 4 | -0.26 | -0.24 | -0.06 |

In [29]:
```
m1 = df1.drop(columns = ['Country']).values # Feature Combination : Health - Trade - Finance
m2 = pca_df2.values # PCA Data
```

In [30]:
```
sse = {};sil = [];kmax = 10
fig = plt.subplots(nrows = 1, ncols = 2, figsize = (20,5))

# Elbow Method :
plt.subplot(1,2,1)
for k in range(1, 10):
    kmeans = KMeans(n_clusters=k, max_iter=1000).fit(m1)
    sse[k] = kmeans.inertia_ # Inertia: Sum of distances of samples to their closest cluster center
sns.lineplot(x = list(sse.keys()), y = list(sse.values()));
plt.title('Elbow Method')
plt.xlabel("k : Number of cluster")
plt.ylabel("Sum of Squared Error")
plt.grid()

# Silhouette Score Method
plt.subplot(1,2,2)
for k in range(2, kmax + 1):
    kmeans = KMeans(n_clusters = k).fit(m1)
    labels = kmeans.labels_
```

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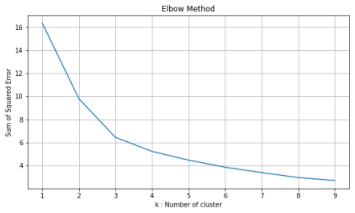
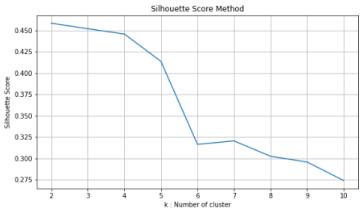
```
for k in range(1, 10):
    kmeans = KMeans(n_clusters=k, max_iter=1000).fit(m1)
    sse[k] = kmeans.inertia_ # Inertia: Sum of distances of samples to their closest cluster center
sns.lineplot(x = list(sse.keys()), y = list(sse.values()));
plt.title('Elbow Method')
plt.xlabel("k : Number of cluster")
plt.ylabel("Sum of Squared Error")
plt.grid()

# Silhouette Score Method
plt.subplot(1,2,2)
for k in range(2, kmax + 1):
    kmeans = KMeans(n_clusters = k).fit(m1)
    labels = kmeans.labels_
    sil.append(silhouette_score(m1, labels, metric = 'euclidean'))
sns.lineplot(x = range(2,kmax + 1), y = sil);
plt.title('Silhouette Score Method')
plt.xlabel("k : Number of cluster")
plt.ylabel("Silhouette Score")
plt.grid()

plt.show()
```




In [31]:
```
model = KMeans(n_clusters = 3,max_iter = 1000)
model.fit(m1)
cluster = model.cluster_centers_
centroids = np.array(cluster)
labels = model.labels_
data['Class'] = labels; df1['Class'] = labels

fig = plt.figure()
ax = Axes3D(fig)
x = np.array(df1['Health'])
y = np.array(df1['Trade'])
z = np.array(df1['Finance'])
ax.scatter(centroids[:,0],centroids[:,1],centroids[:,2],marker="X", color = 'b')
ax.scatter(x,y,z,c = y)
plt.title('Health vs Trade vs Finance')
ax.set_xlabel('Health')
```

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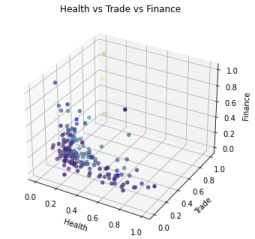
```
cluster = model.cluster_centers_
centroids = np.array(cluster)
labels = model.labels_
data['Class'] = labels; df1['Class'] = labels

fig = plt.figure()
ax = Axes3D(fig)
x = np.array(df1['Health'])
y = np.array(df1['Trade'])
z = np.array(df1['Finance'])
ax.scatter(centroids[:,0],centroids[:,1],centroids[:,2],marker="X", color = 'b')
ax.scatter(x,y,z,c = y)
plt.title('Health vs Trade vs Finance')
ax.set_xlabel('Health')
ax.set_ylabel('Trade')
ax.set_zlabel('Finance')
plt.show();
```

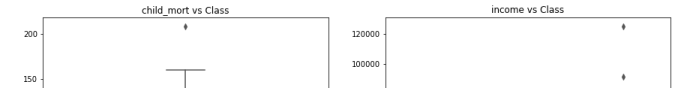



In [32]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')

plt.subplot(1,2,2)
sns.boxplot(x = 'Class', y = 'income', data  = data, color = '#FF781F');
plt.title('income vs Class')

plt.show()
```

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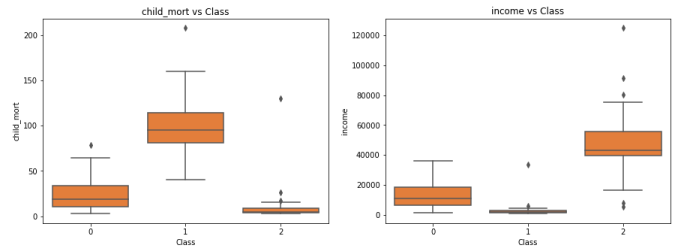


In [33]:
```
df1['Class'].loc[df1['Class'] == 0] = 'No Help Needed'
df1['Class'].loc[df1['Class'] == 1] = 'Help Needed'
df1['Class'].loc[df1['Class'] == 2] = 'Might Need Help'

fig = px.choropleth(df1[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = df1['Class'],
                    color_discrete_map = {'Help Needed':'Red',
                                          'No Help Needed':'Green',
                                          'Might Need Help':'Yellow'}
                   )
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```

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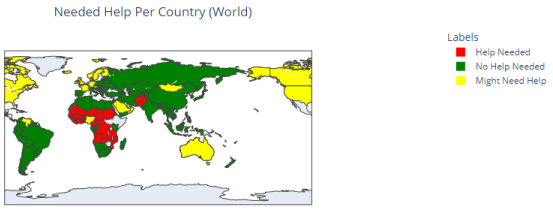
Run Code

Class Class

In [33]:
```
df1['Class'].loc[df1['Class'] == 0] = 'No Help Needed'
df1['Class'].loc[df1['Class'] == 1] = 'Help Needed'
df1['Class'].loc[df1['Class'] == 2] = 'Might Need Help'

fig = px.choropleth(df1[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = df1['Class'],
                    color_discrete_map = {'Help Needed':'Red',
                                          'No Help Needed':'Green',
                                          'Might Need Help':'Yellow'}
                   )
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```




In [34]:
```
sse = {};sil = [];kmax = 10
fig = plt.subplots(nrows = 1, ncols = 2, figsize = (20,5))

# Elbow Method :
plt.subplot(1,2,1)
```

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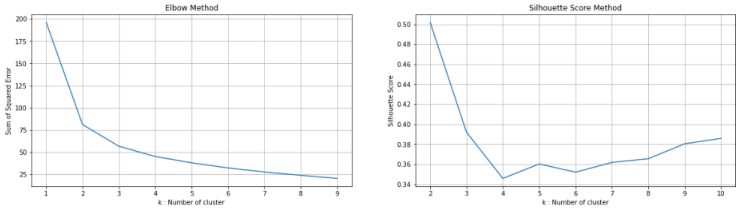
Run Code

In [34]:
```
sse = {};sil = [];kmax = 10
fig = plt.subplots(nrows = 1, ncols = 2, figsize = (20,5))

# Elbow Method :
plt.subplot(1,2,1)
for k in range(1, 10):
    kmeans = KMeans(n_clusters=k, max_iter=1000).fit(m2)
    sse[k] = kmeans.inertia_ # Inertia: Sum of distances of samples to their closest cluster center
sns.lineplot(x = list(sse.keys()), y = list(sse.values()));
plt.title('Elbow Method')
plt.xlabel("k : Number of cluster")
plt.ylabel("Sum of Squared Error")
plt.grid()

# Silhouette Score Method
plt.subplot(1,2,2)
for k in range(2, kmax + 1):
    kmeans = KMeans(n_clusters = k).fit(m2)
    labels = kmeans.labels_
    sil.append(silhouette_score(m2, labels, metric = 'euclidean'))
sns.lineplot(x = range(2,kmax + 1), y = sil);
plt.title('Silhouette Score Method')
plt.xlabel("k : Number of cluster")
plt.ylabel("Silhouette Score")
plt.grid()

plt.show()
```




In [35]:
```
model = KMeans(n_clusters = 3,max_iter = 1000)
model.fit(m2)
cluster = model.cluster_centers_
centroids = np.array(cluster)
labels = model.labels_
data['Class'] = labels; pca_df2['Class'] = labels

fig = plt.figure()
ax = Axes3D(fig)
ax.scatter(centroids[:,0],centroids[:,1],centroids[:,2],marker="X", color = 'b')
```

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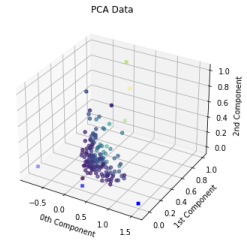
Run Code


In [35]:
```
model = KMeans(n_clusters = 3,max_iter = 1000)
model.fit(m2)
cluster = model.cluster_centers_
centroids = np.array(cluster)
labels = model.labels_
data['Class'] = labels; pca_df2['Class'] = labels

fig = plt.figure()
ax = Axes3D(fig)
ax.scatter(centroids[:,0],centroids[:,1],centroids[:,2],marker="X", color = 'b')
plt.title('PCA Data')
ax.set_xlabel('0th Component')
ax.set_ylabel('1st Component')
ax.set_zlabel('2nd Component')
ax.scatter(x,y,z,c = y)
plt.show();
```




In [36]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')

plt.subplot(1,2,2)
sns.boxplot(x = 'Class', y = 'income', data  = data, color = '#FF781F');
plt.title('income vs Class')

plt.show()
```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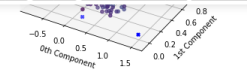
Run Code

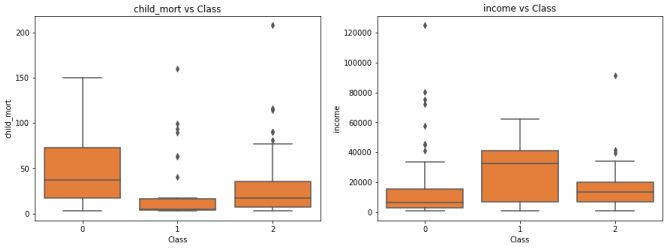



In [36]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')

plt.subplot(1,2,2)
sns.boxplot(x = 'Class', y = 'income', data  = data, color = '#FF781F');
plt.title('income vs Class')

plt.show()
```




In [37]:
```
pca_df2.insert(0,column = 'Country', value = data['country'])

pca_df2['Class'].loc[pca_df2['Class'] == 0] = 'Might Need Help'
pca_df2['Class'].loc[pca_df2['Class'] == 1] = 'Help Needed'
pca_df2['Class'].loc[pca_df2['Class'] == 2] = 'No Help Needed'

fig = px.choropleth(pca_df2[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = pca_df2['Class'],
                    color_discrete_map = {'Help Needed':'Red',
                                          'Might Need Help':'Yellow',
                                          'No Help Needed': 'Green'})
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```

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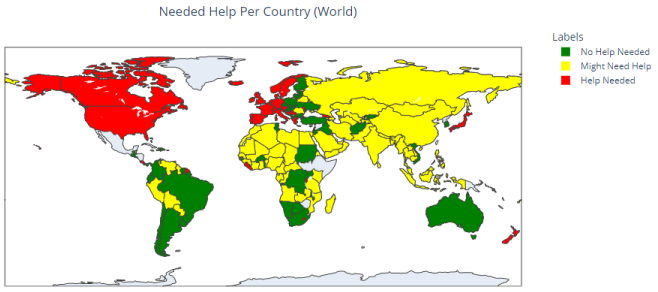
Run Code

```
pca_df2['Class'].loc[pca_df2['Class'] == 1] = 'Help Needed'
pca_df2['Class'].loc[pca_df2['Class'] == 2] = 'No Help Needed'

fig = px.choropleth(pca_df2[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = pca_df2['Class'],
                    color_discrete_map = {'Help Needed':'Red',
                                          'Might Need Help':'Yellow',
                                          'No Help Needed': 'Green'})
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```




In [38]:
```
from sklearn.cluster import DBSCAN
from sklearn.neighbors import NearestNeighbors
```

In [39]:
```
knn = NearestNeighbors(n_neighbors = 7)
model = knn.fit(m1)
distances, indices = knn.kneighbors(m1)
distances = np.sort(distances, axis=0)
distances = distances[:,1]
plt.grid()
```

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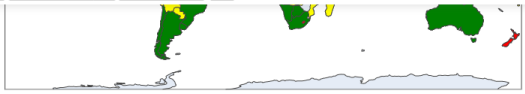
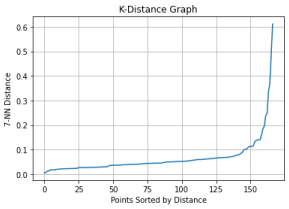
Run Code



In [38]:
```
from sklearn.cluster import DBSCAN
from sklearn.neighbors import NearestNeighbors
```

In [39]:
```
knn = NearestNeighbors(n_neighbors = 7)
model = knn.fit(m1)
distances, indices = knn.kneighbors(m1)
distances = np.sort(distances, axis=0)
distances = distances[:,1]
plt.grid()
plt.plot(distances);
plt.xlabel('Points Sorted by Distance')
plt.ylabel('7-NN Distance')
plt.title('K-Distance Graph');
```




In [40]:
```
db = DBSCAN(eps = 0.080, min_samples = 8).fit(m1)
core_samples_mask = np.zeros_like(db.labels_, dtype=bool)
core_samples_mask[db.core_sample_indices_] = True
labels = db.labels_

# Number of clusters in labels, ignoring noise if present

n_clusters_ = len(set(labels)) - (1 if -1 in labels else 0)
n_noise_ = list(labels).count(-1)
print('Number of Clusters : ', n_clusters_)
print('Number of Outliers : ', n_noise_)
```

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In [40]:
```
db = DBSCAN(eps = 0.080, min_samples = 8).fit(m1)
core_samples_mask = np.zeros_like(db.labels_, dtype=bool)
core_samples_mask[db.core_sample_indices_] = True
labels = db.labels_

# Number of clusters in labels, ignoring noise if present

n_clusters_ = len(set(labels)) - (1 if -1 in labels else 0)
n_noise_ = list(labels).count(-1)
print('Number of Clusters : ', n_clusters_)
print('Number of Outliers : ', n_noise_)

data['Class'] = labels; df1['Class'] = labels
```

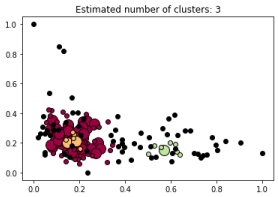
```
Number of Clusters :  3
Number of Outliers :  67
```

In [41]:
```
unique_labels = set(labels)
colors = [plt.cm.Spectral(each) for each in np.linspace(0, 1, len(unique_labels))]
for k, col in zip(unique_labels, colors):
    if k == -1:
        # Black used for noise.
        col = [0, 0, 0, 1]
    class_member_mask = labels == k

    xy = m1[class_member_mask & core_samples_mask]
    plt.plot(xy[:, 0], xy[:, 1], "o", markerfacecolor = tuple(col), markeredgecolor = "k", markersize = 14)

    xy = m1[class_member_mask & ~core_samples_mask]
    plt.plot(xy[:, 0], xy[:, 1], "o", markerfacecolor = tuple(col), markeredgecolor = "k", markersize = 6)

plt.title("Estimated number of clusters: %d" % n_clusters_)
plt.show()
```




In [42]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
```

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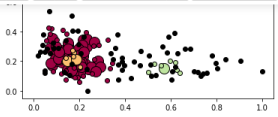
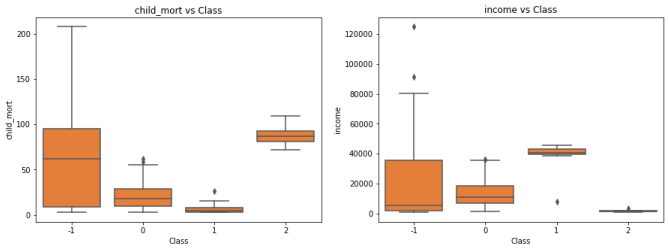



In [42]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')

plt.subplot(1,2,2)
sns.boxplot(x = 'Class', y = 'income', data  = data, color = '#FF781F');
plt.title('income vs Class')

plt.show()
```




In [43]:
```
df1['Class'].loc[df1['Class'] == -1] = 'Noise / Outliers'
df1['Class'].loc[df1['Class'] == 0] = 'Might Need Help'
df1['Class'].loc[df1['Class'] == 1] = 'No Help Needed'
df1['Class'].loc[df1['Class'] == 2] ='Help Needed'

fig = px.choropleth(df1[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = df1['Class'],
                    color_discrete_map={'Noise / Outliers' : 'Black',
                                        'Help Needed':'Red',
                                        'Might Need Help':'Yellow',
                                        'No Help Needed':'Green'})
```

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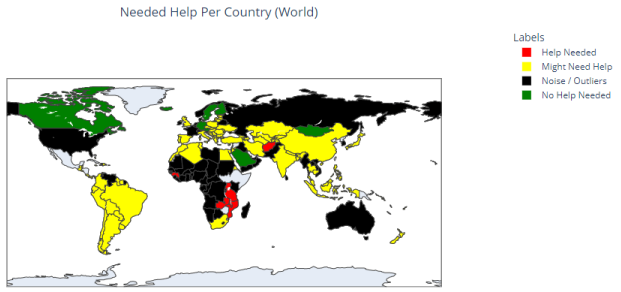
Trusted | Python 3 (ipykernel)

Run Code

In [43]:
```
df1['Class'].loc[df1['Class'] == -1] = 'Noise / Outliers'
df1['Class'].loc[df1['Class'] == 0] = 'Might Need Help'
df1['Class'].loc[df1['Class'] == 1] = 'No Help Needed'
df1['Class'].loc[df1['Class'] == 2] ='Help Needed'

fig = px.choropleth(df1[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = df1['Class'],
                    color_discrete_map={'Noise / Outliers' : 'Black',
                                        'Help Needed':'Red',
                                        'Might Need Help':'Yellow',
                                        'No Help Needed':'Green'})
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```




In [44]:
```
knn = NearestNeighbors(n_neighbors = 7)
model = knn.fit(m2)
distances, indices = knn.kneighbors(m2)
distances = np.sort(distances, axis=0)
distances = distances[:,1]
plt.xlabel('Points Sorted by Distance')
plt.ylabel('7-NN Distance')
```

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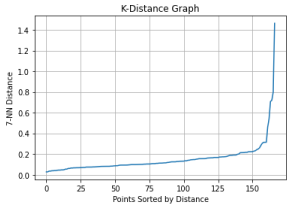
Run Code

In [44]:
```
knn = NearestNeighbors(n_neighbors = 7)
model = knn.fit(m2)
distances, indices = knn.kneighbors(m2)
distances = np.sort(distances, axis=0)
distances = distances[:,1]
plt.xlabel('Points Sorted by Distance')
plt.ylabel('7-NN Distance')
plt.title('K-Distance Graph');
plt.grid()
plt.plot(distances);
```




In [45]:
```
db = DBSCAN(eps = 0.2, min_samples = 8).fit(m2)
core_samples_mask = np.zeros_like(db.labels_, dtype=bool)
core_samples_mask[db.core_sample_indices_] = True
labels = db.labels_

# Number of clusters in labels, ignoring noise if present
n_clusters_ = len(set(labels)) - (1 if -1 in labels else 0)
n_noise_ = list(labels).count(-1)
print('Number of Clusters : ', n_clusters_)
print('Number of Outliers : ', n_noise_)

data['Class'] = labels; pca_df2['Class'] = labels
```

```
Number of Clusters :  3
Number of Outliers :  94
```

In [46]:
```
unique_labels = set(labels)
colors = [plt.cm.Spectral(each) for each in np.linspace(0, 1, len(unique_labels))]
for k, col in zip(unique_labels, colors):
    if k == -1:
        # Black used for noise.
```

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Run Code

In [45]:
```
db = DBSCAN(eps = 0.2, min_samples = 8).fit(m2)
core_samples_mask = np.zeros_like(db.labels_, dtype=bool)
core_samples_mask[db.core_sample_indices_] = True
labels = db.labels_

# Number of clusters in labels, ignoring noise if present
n_clusters_ = len(set(labels)) - (1 if -1 in labels else 0)
n_noise_ = list(labels).count(-1)
print('Number of Clusters : ', n_clusters_)
print('Number of Outliers : ', n_noise_)

data['Class'] = labels; pca_df2['Class'] = labels
```

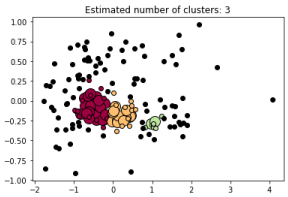
```
Number of Clusters :  3
Number of Outliers :  94
```

In [46]:
```
unique_labels = set(labels)
colors = [plt.cm.Spectral(each) for each in np.linspace(0, 1, len(unique_labels))]
for k, col in zip(unique_labels, colors):
    if k == -1:
        # Black used for noise.
        col = [0, 0, 0, 1]
    class_member_mask = labels == k

    xy = m2[class_member_mask & core_samples_mask]
    plt.plot(xy[:, 0], xy[:, 1], "o", markerfacecolor = tuple(col), markeredgecolor = "k", markersize = 14)

    xy = m2[class_member_mask & ~core_samples_mask]
    plt.plot(xy[:, 0], xy[:, 1], "o", markerfacecolor = tuple(col), markeredgecolor = "k", markersize = 6)

plt.title("Estimated number of clusters: %d" % n_clusters_)
plt.show()
```




In [47]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')
```

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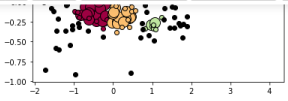
Trusted | Python 3 (ipykernel)

Run Code

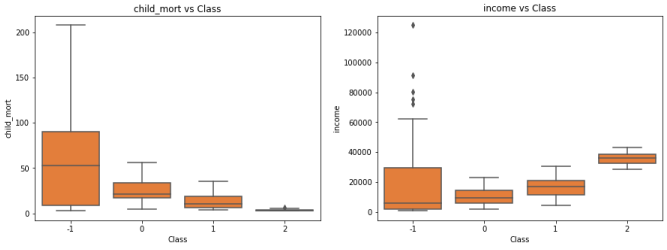


In [47]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')
```

```
plt.subplot(1,2,2)
sns.boxplot(x = 'Class', y = 'income', data  = data, color = '#FF781F');
plt.title('income vs Class')

plt.show()
```




In [48]:
```
pca_df2['Class'].loc[pca_df2['Class'] == -1] = 'Noise / Outliers'
pca_df2['Class'].loc[pca_df2['Class'] == 0] = 'Help Needed'
pca_df2['Class'].loc[pca_df2['Class'] == 1] = 'Might Need Help'
pca_df2['Class'].loc[pca_df2['Class'] == 2] ='No Help Needed'

fig = px.choropleth(pca_df2[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color_discrete_sequence=["orange", "red", "green",'black'],
                    color = pca_df2['Class'],
                    color_discrete_map={'Noise / Outliers' : 'Black',
                                        'Help Needed':'Red',
                                        'Might Need Help':'Yellow',
                                        'No Help Needed':'Green'})
```

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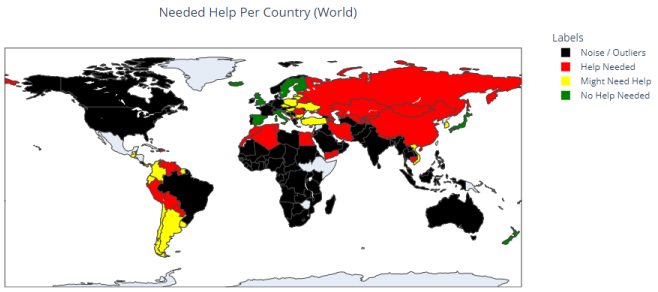
```
pca_df2['Class'].loc[pca_df2['Class'] == 0] = 'Help Needed'
pca_df2['Class'].loc[pca_df2['Class'] == 1] = 'Might Need Help'
pca_df2['Class'].loc[pca_df2['Class'] == 2] ='No Help Needed'

fig = px.choropleth(pca_df2[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color_discrete_sequence=["orange", "red", "green",'black'],
                    color = pca_df2['Class'],
                    color_discrete_map={'Noise / Outliers' : 'Black',
                                        'Help Needed':'Red',
                                        'Might Need Help':'Yellow',
                                        'No Help Needed':'Green'})
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```




In [49]:
```
from scipy.cluster.hierarchy import dendrogram, linkage
```

In [50]:
```
linkage_data = linkage(m1, method = 'ward', metric = 'euclidean')
dendrogram(linkage_data)
plt.tight_layout()
plt.show()
```

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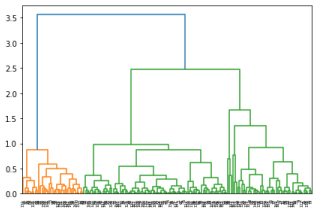
In [49]:
```
from scipy.cluster.hierarchy import dendrogram, linkage
```

In [50]:
```
linkage_data = linkage(m1, method = 'ward', metric = 'euclidean')
dendrogram(linkage_data)
plt.tight_layout()
plt.show()
```




In [51]:
```
from sklearn.cluster import AgglomerativeClustering
hierarchical_cluster = AgglomerativeClustering(n_clusters = 3, affinity = 'euclidean', linkage = 'ward')
labels = hierarchical_cluster.fit(m1)

pred_agc = pd.Series(hierarchical_cluster.labels_)
data['Class'] = pred_agc; df1['Class'] = pred_agc
```

In [52]:
```
fig = plt.figure()
ax = Axes3D(fig)
x = np.array(df1['Health'])
y = np.array(df1['Trade'])
z = np.array(df1['Finance'])
ax.scatter(x,y,z,c = df1['Class'])
plt.title('Health vs Trade vs Finance')
ax.set_xlabel('Health')
ax.set_ylabel('Trade')
ax.set_zlabel('Finance')
plt.show();
```

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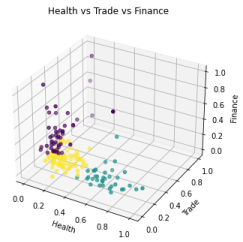
Trusted Python 3 (ipykernel)

```
labels = hierarchical_cluster.fit(m1)

pred_agc = pd.Series(hierarchical_cluster.labels_)
data['Class'] = pred_agc; df1['Class'] = pred_agc
```

In [52]:
```
fig = plt.figure()
ax = Axes3D(fig)
x = np.array(df1['Health'])
y = np.array(df1['Trade'])
z = np.array(df1['Finance'])
ax.scatter(x,y,z,c = df1['Class'])
plt.title('Health vs Trade vs Finance')
ax.set_xlabel('Health')
ax.set_ylabel('Trade')
ax.set_zlabel('Finance')
plt.show();
```

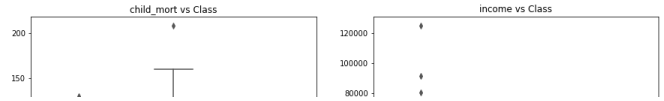



In [53]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')

plt.subplot(1,2,2)
sns.boxplot(x = 'Class', y = 'income', data  = data, color = '#FF781F');
plt.title('income vs Class')

plt.show()
```

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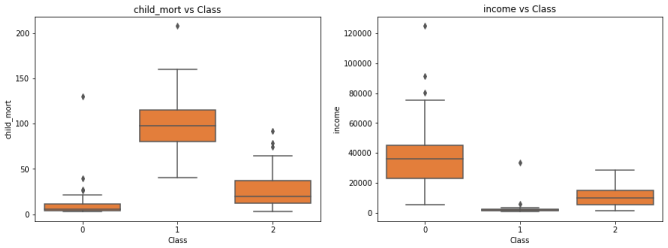
Trusted Python 3 (ipykernel)

In [53]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')

plt.subplot(1,2,2)
sns.boxplot(x = 'Class', y = 'income', data  = data, color = '#FF781F');
plt.title('income vs Class')

plt.show()
```




In [54]:
```
df1['Class'].loc[df1['Class'] == 0] = 'No Help Needed'
df1['Class'].loc[df1['Class'] == 1] = 'Help Needed'
df1['Class'].loc[df1['Class'] == 2] = 'Might Need Help'

fig = px.choropleth(df1[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = df1['Class'],
                    color_discrete_map = {'Help Needed' : 'Red',
                                          'Might Need Help' : 'Yellow',
                                          'No Help Needed' : 'Green'})
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```

Needed Help Per Country (World)

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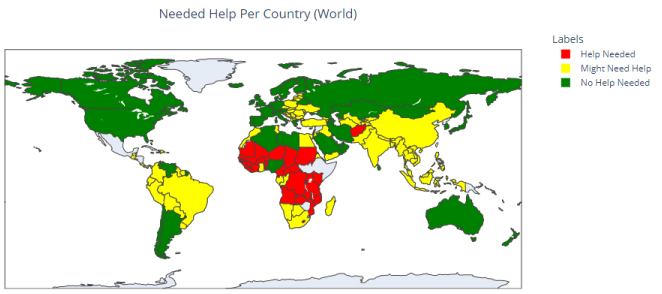
Run Code

In [54]:
```
df1['Class'].loc[df1['Class'] == 0] = 'No Help Needed'
df1['Class'].loc[df1['Class'] == 1] = 'Help Needed'
df1['Class'].loc[df1['Class'] == 2] = 'Might Need Help'

fig = px.choropleth(df1[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = df1['Class'],
                    color_discrete_map = {'Help Needed' : 'Red',
                                          'Might Need Help' : 'Yellow',
                                          'No Help Needed' : 'Green'})
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```




In [55]:
```
linkage_data = linkage(m2, method = 'ward', metric = 'euclidean')
dendrogram(linkage_data)
plt.tight_layout()
plt.show()
```

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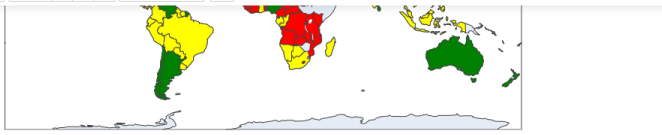
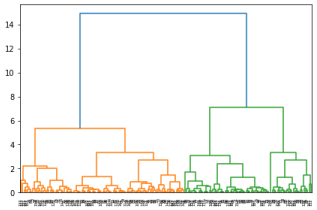
Run Code



In [55]:
```
linkage_data = linkage(m2, method = 'ward', metric = 'euclidean')
dendrogram(linkage_data)
plt.tight_layout()
plt.show()
```




In [56]:
```
from sklearn.cluster import AgglomerativeClustering
hierarchical_cluster = AgglomerativeClustering(n_clusters = 3, affinity = 'euclidean', linkage = 'ward')
labels = hierarchical_cluster.fit(m2)

pred_agc = pd.Series(hierarchical_cluster.labels_)
data['Class'] = pred_agc; pca_df2['Class'] = pred_agc
```

In [57]:
```
fig = plt.figure()
ax = Axes3D(fig)
x = np.array(pca_df2[0])
y = np.array(pca_df2[1])
z = np.array(pca_df2[2])
ax.scatter(x,y,z,c = pca_df2['Class'])
plt.title('PCA Data')
ax.set_xlabel('0th Component')
ax.set_ylabel('1st Component')
ax.set_zlabel('2nd Component')
plt.show();
```

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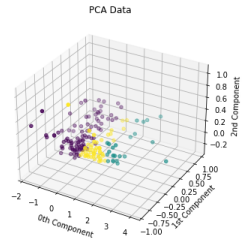
Run Code

```
pred_agc = pd.Series(hierarchical_cluster.labels_)
data['Class'] = pred_agc; pca_df2['Class'] = pred_agc
```

In [57]:
```
fig = plt.figure()
ax = Axes3D(fig)
x = np.array(pca_df2[0])
y = np.array(pca_df2[1])
z = np.array(pca_df2[2])
ax.scatter(x,y,z,c = pca_df2['Class'])
plt.title('PCA Data')
ax.set_xlabel('0th Component')
ax.set_ylabel('1st Component')
ax.set_zlabel('2nd Component')
plt.show();
```

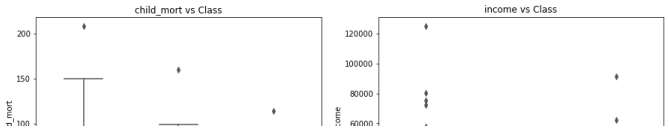



In [58]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')

plt.subplot(1,2,2)
sns.boxplot(x = 'Class', y = 'income', data  = data, color = '#FF781F');
plt.title('income vs Class')

plt.show()
```

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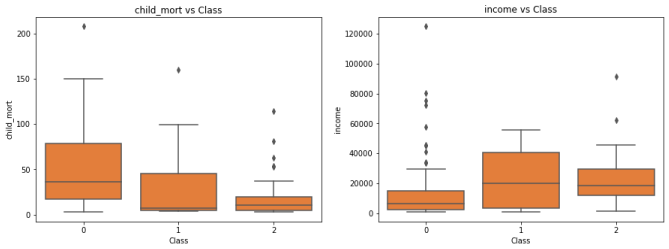
Run Code

In [58]:
```
fig, ax = plt.subplots(nrows = 1, ncols = 2, figsize = (15,5))

plt.subplot(1,2,1)
sns.boxplot(x = 'Class', y = 'child_mort', data  = data, color = '#FF781F');
plt.title('child_mort vs Class')

plt.subplot(1,2,2)
sns.boxplot(x = 'Class', y = 'income', data  = data, color = '#FF781F');
plt.title('income vs Class')

plt.show()
```




In [59]:
```
pca_df2['Class'].loc[pca_df2['Class'] == 0] = 'Help Needed'
pca_df2['Class'].loc[pca_df2['Class'] == 1] = 'Might Need Help'
pca_df2['Class'].loc[pca_df2['Class'] == 2] = 'No Help Needed'

fig = px.choropleth(pca_df2[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = pca_df2['Class'],
                    color_discrete_map={'Help Needed':'Red',
                                        'Might Need Help':'Yellow',
                                        'No Help Needed':'Green'})
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```

Needed Help Per Country (World)

Labels

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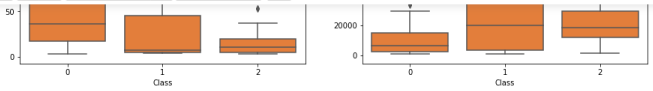
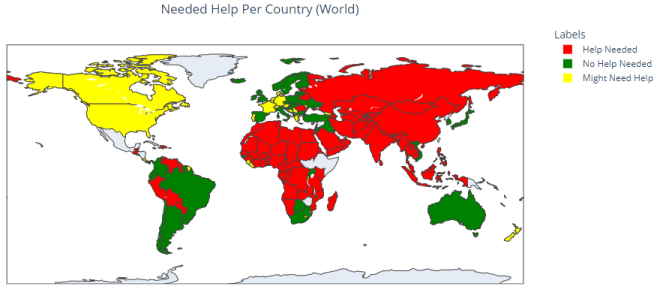
Run Code




In [59]:
```
pca_df2['Class'].loc[pca_df2['Class'] == 0] = 'Help Needed'
pca_df2['Class'].loc[pca_df2['Class'] == 1] = 'Might Need Help'
pca_df2['Class'].loc[pca_df2['Class'] == 2] = 'No Help Needed'

fig = px.choropleth(pca_df2[['Country','Class']],
                    locationmode = 'country names',
                    locations = 'Country',
                    title = 'Needed Help Per Country (World)',
                    color = pca_df2['Class'],
                    color_discrete_map={'Help Needed':'Red',
                                        'Might Need Help':'Yellow',
                                        'No Help Needed':'Green'})
fig.update_geos(fitbounds = "locations", visible = True)
fig.update_layout(legend_title_text = 'Labels',legend_title_side = 'top',title_pad_l = 260,title_y = 0.86)
fig.show(engine = 'kaleido')
```




In [ ]: