Welcome to the Covid-19 Data Analysis Notebook

Let's import the modules

In [476…
```
# Importing necessary libraries for data analysis and visualization
import pandas as pd          # For data manipulation and analysis
import numpy as np           # For numerical operations
import seaborn as sns        # For statistical data visualization
import matplotlib.pyplot as plt  # For plotting graphs and figures

print('Modules are imported.')
```

```
Modules are imported.
```

Task 2

Task 2.1: Importing the Covid-19 dataset

Importing "Covid19_Confirmed_dataset.csv" from the "./Dataset" folder.

In [477…
```
# Import dataset.
data = pd.read_csv('Datasets/covid19_Confirmed_dataset.csv')
data.head()
```

Out[477…

	Province/ State	Country/ Region	Lat	Long	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20
0	NaN	Afghanistan	33.0000	65.0000	0	0	0	0	0
1	NaN	Albania	41.1533	20.1683	0	0	0	0	0
2	NaN	Algeria	28.0339	1.6596	0	0	0	0	0
3	NaN	Andorra	42.5063	1.5218	0	0	0	0	0
4	NaN	Angola	-11.2027	17.8739	0	0	0	0	0

5 rows × 104 columns

Let's check the shape of the DataFrame

In [478…
```
data.shape
```

Out[478…
```
(266, 104)
```

Task 2.2: Delete the unnecessary columns

In [479…
```
data.drop(['Lat', 'Long'], axis=1, inplace=True)  # Dropping unnecessary columns
```

In [480…
```
data.head()
```

Out[480…

	Province/ State	Country/ Region	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20	1/27/20	1/28/20
0	NaN	Afghanistan	0	0	0	0	0	0	0
1	NaN	Albania	0	0	0	0	0	0	0
2	NaN	Algeria	0	0	0	0	0	0	0
3	NaN	Andorra	0	0	0	0	0	0	0
4	NaN	Angola	0	0	0	0	0	0	0

5 rows × 102 columns

Task 2.3: Aggregating the rows by country

In [481…
```
data_aggregated = data.groupby('Country/Region').sum()
```

In [482…
```
data_aggregated.head()
```

Out[482…

Country/ Region	Province/ State	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20	1/27/20	1/28/20
Afghanistan	0	0	0	0	0	0	0	0
Albania	0	0	0	0	0	0	0	0
Algeria	0	0	0	0	0	0	0	0
Andorra	0	0	0	0	0	0	0	0
Angola	0	0	0	0	0	0	0	0

5 rows × 101 columns

In [483…
```
data_aggregated.shape
```

Out[483…
```
(187, 101)
```

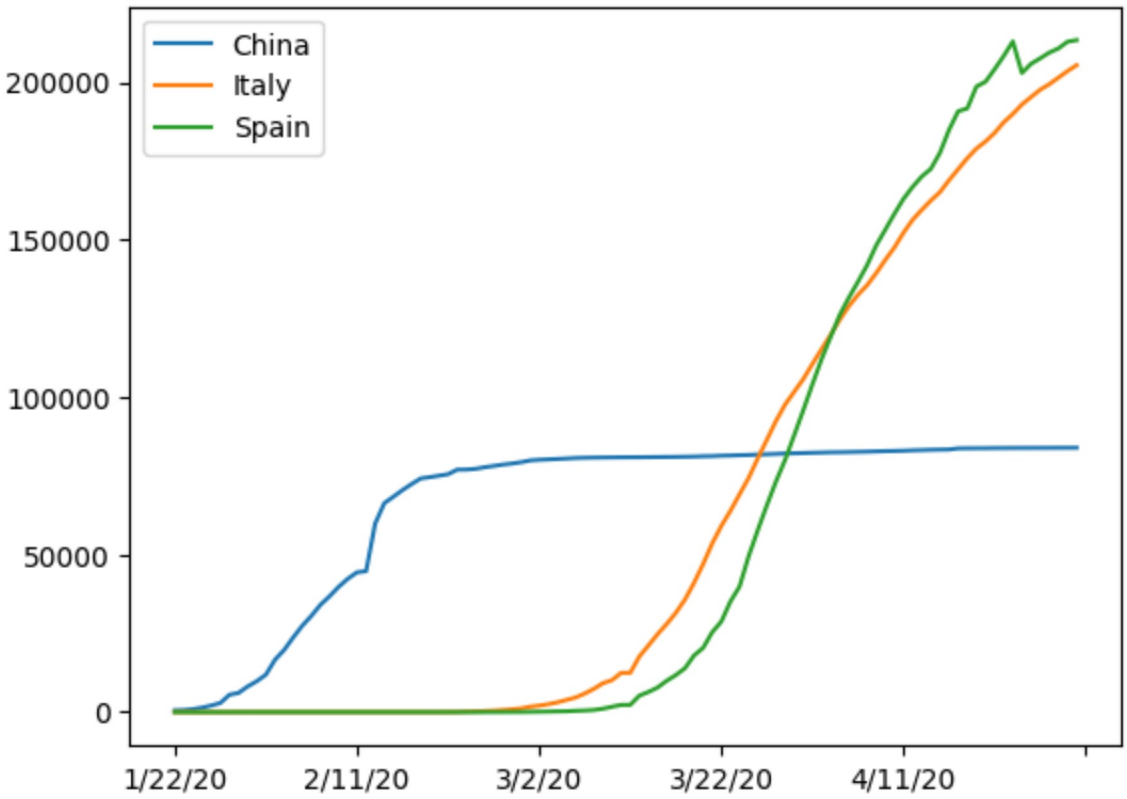
Task 2.4: Visualizing data related to a country, for example, China

Visualization always helps us better understand our data.

In [484…
```
# Select only the numeric (date) columns for China and plot
data_aggregated.loc['China'].drop('Province/State', errors='ignore').plot()
data_aggregated.loc['Italy'].drop('Province/State', errors='ignore').plot()
data_aggregated.loc['Spain'].drop('Province/State', errors='ignore').plot()

plt.legend()
```

Out[484…
```
<matplotlib.legend.Legend at 0x255a23b68d0>
```

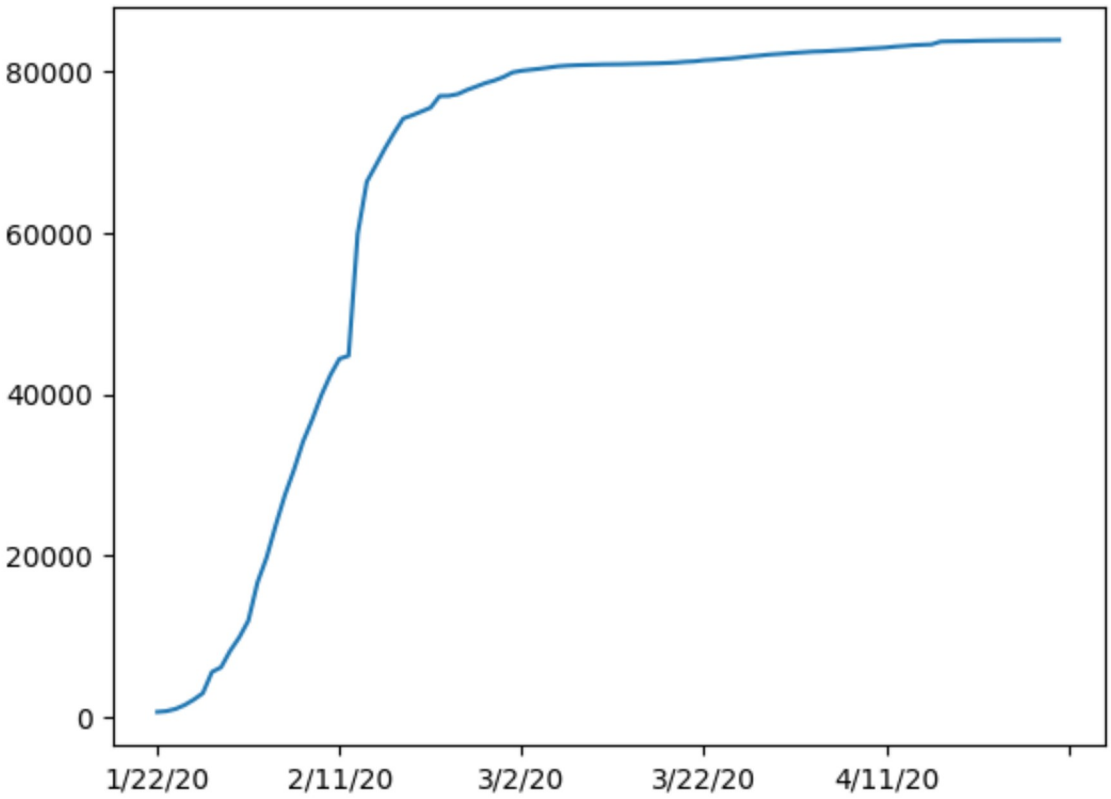


Task 3: Calculating a good measure

We need to find a good measure, represented as a number, describing the spread of the virus in a country.

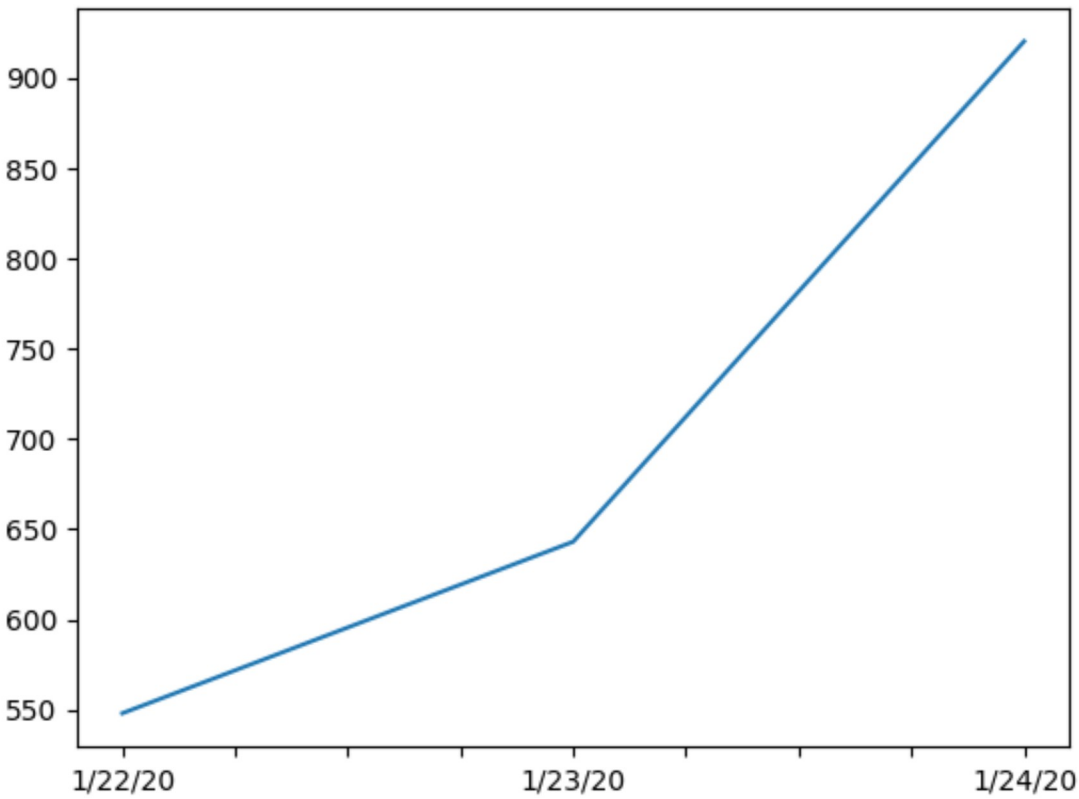
In [485…
```
data_aggregated.loc['China'].drop('Province/State', errors='ignore').plot()
```

Out[485…
```
<Axes: >
```



In [486…
```
# Plot the first 3 date columns for China (excluding 'Province/State' if present)
data_aggregated.loc['China'].drop('Province/State', errors='ignore').iloc[:3].plot(
```

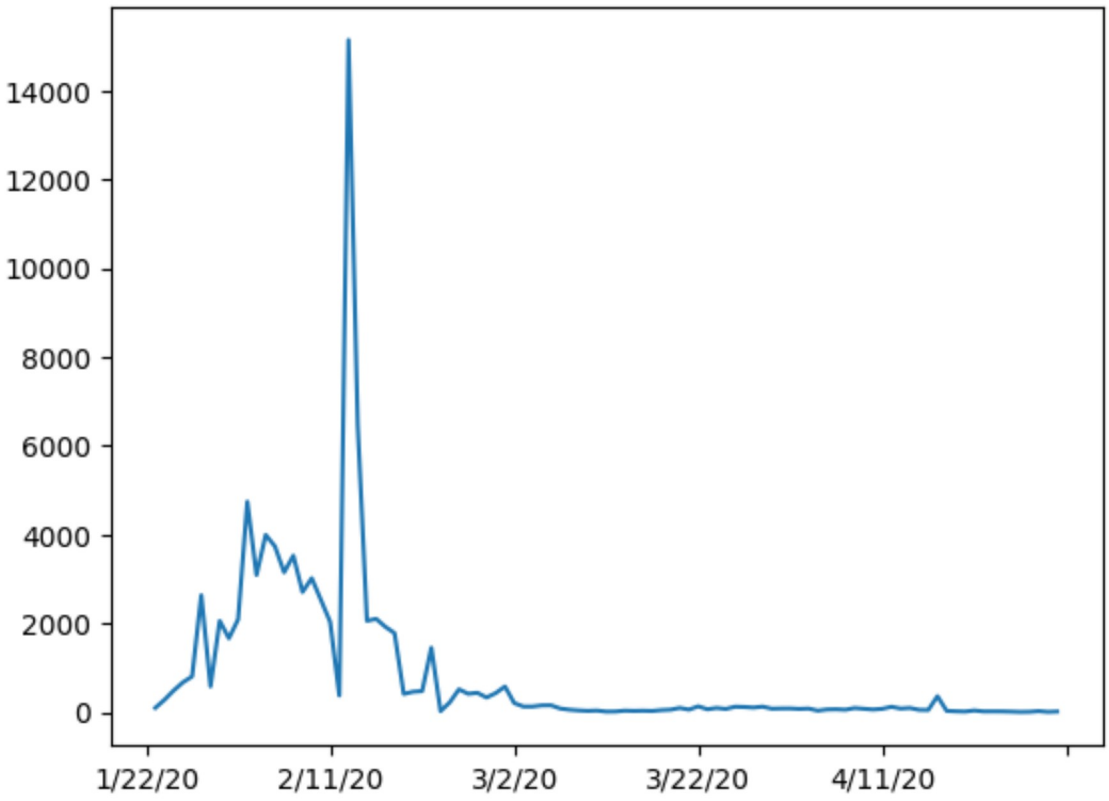
Out[486… <Axes: >



Task 3.1: Calculating the first derivative of the curve

In [487…
```
data_aggregated.loc['China'].drop('Province/State', errors='ignore').diff().plot()
```

Out[487…
```
<Axes: >
```



Task 3.2: Find the maximum infection rate for China

In [488…
```
data_aggregated.loc['China'].drop('Province/State', errors='ignore').diff().max()
```

Out[488…
```
15136
```

In [489…
```
data_aggregated.loc['Italy'].drop('Province/State', errors='ignore').diff().max()
```

Out[489…
```
6557
```

In [490…
```
data_aggregated.loc['Spain'].drop('Province/State', errors='ignore').diff().max()
```

Out[490…
```
9630
```

In [491…
```
data_aggregated.loc['US'].drop('Province/State', errors='ignore').diff().max()
```

Out[491…
```
36188
```

Task 3.3: Find the maximum infection rate for all countries

In [492…
```
max_infection_rates = []
```

```
for c in countries:
    max_infection_rates.append(
        data_aggregated.loc[c].drop('Province/State', errors='ignore').diff().max()
    )
data_aggregated['max_infection_rate'] = max_infection_rates
```

In [493...
```
data_aggregated.head()
```

Out[493...

Country/Region	Province/State	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20	1/27/20	1/28/20
Afghanistan	0	0	0	0	0	0	0	0
Albania	0	0	0	0	0	0	0	0
Algeria	0	0	0	0	0	0	0	0
Andorra	0	0	0	0	0	0	0	0
Angola	0	0	0	0	0	0	0	0

5 rows × 102 columns

Task 3.4: Create a new DataFrame with only the needed column

In [494...
```
data_dropped = pd.DataFrame(data_aggregated['max_infection_rate'])
```

In [495...
```
data_dropped.head()
```

Out[495...

Country/Region	max_infection_rate
Afghanistan	232
Albania	34
Algeria	199
Andorra	43
Angola	5

In [496...
```
corona_data = data_dropped
```

Task4:

- Importing the WorldHappinessReport.csv dataset
- selecting needed columns for our analysis
- join the datasets

- calculate the correlations as the result of our analysis

Task 4.1 : importing the dataset

In [497…
```
happiness_report = pd.read_csv('Datasets/worldwide_happiness_report.csv')
```

In [498…
```
happiness_report.head()
```

Out[498…

	Overall rank	Country or region	Score	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices	Generosity	Percepti corrup
0	1	Finland	7.769	1.340	1.587	0.986	0.596	0.153	0
1	2	Denmark	7.600	1.383	1.573	0.996	0.592	0.252	0
2	3	Norway	7.554	1.488	1.582	1.028	0.603	0.271	0
3	4	Iceland	7.494	1.380	1.624	1.026	0.591	0.354	0
4	5	Netherlands	7.488	1.396	1.522	0.999	0.557	0.322	0

Task 4.2: let's drop the useless columns

In [499…
```
columns_to_drop = ['Overall rank', 'Score', 'Generosity', 'Perceptions of corruptio
```

In [500…
```
happiness_report.drop(columns=columns_to_drop, axis=1,inplace=True)
happiness_report.head()
```

Out[500…

	Country or region	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices
0	Finland	1.340	1.587	0.986	0.596
1	Denmark	1.383	1.573	0.996	0.592
2	Norway	1.488	1.582	1.028	0.603
3	Iceland	1.380	1.624	1.026	0.591
4	Netherlands	1.396	1.522	0.999	0.557

Task 4.3: changing the indices of the dataframe

In [501…
```
happiness_report.set_index('Country or region', inplace=True)  # Set 'Country name'
happiness_report.head()
```

Out[501...

Country or region	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices
Finland	1.340	1.587	0.986	0.596
Denmark	1.383	1.573	0.996	0.592
Norway	1.488	1.582	1.028	0.603
Iceland	1.380	1.624	1.026	0.591
Netherlands	1.396	1.522	0.999	0.557

Task4.4: now let's join two dataset we have prepared

Corona Dataset:

In [502...
```
corona_data.head()
```

Out[502...

Country/Region	max_infection_rate
Afghanistan	232
Albania	34
Algeria	199
Andorra	43
Angola	5

In [503...
```
corona_data.shape
```

Out[503... (187, 1)

World Happiness Report Dataset:

In [504...
```
happiness_report.head()
```

Out[504...

Country or region	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices
Finland	1.340	1.587	0.986	0.596
Denmark	1.383	1.573	0.996	0.592
Norway	1.488	1.582	1.028	0.603
Iceland	1.380	1.624	1.026	0.591
Netherlands	1.396	1.522	0.999	0.557

In [505...
```
happiness_report.shape
```

Out[505... (156, 4)

Task 4.5: correlation matrix

In [506...
```
combined_data = corona_data.join(happiness_report, how='inner')
combined_data.head()
```

Out[506...

	max_infection_rate	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices
Afghanistan	232	0.350	0.517	0.361	0.000
Albania	34	0.947	0.848	0.874	0.383
Algeria	199	1.002	1.160	0.785	0.086
Argentina	291	1.092	1.432	0.881	0.471
Armenia	134	0.850	1.055	0.815	0.283

Task 5: Visualization of the results

our Analysis is not finished unless we visualize the results in terms figures and graphs so that everyone can understand what you get out of our analysis

In [507...
```
combined_data.corr().style.background_gradient(cmap='coolwarm')
```

Out[507...

	max_infection_rate	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices
max_infection_rate	1.000000	0.250118	0.191958	0.289263	0.078196
GDP per capita	0.250118	1.000000	0.759468	0.863062	0.394603
Social support	0.191958	0.759468	1.000000	0.765286	0.456246
Healthy life expectancy	0.289263	0.863062	0.765286	1.000000	0.427892
Freedom to make life choices	0.078196	0.394603	0.456246	0.427892	1.000000

Task 5.1: Plotting GDP per capita vs. maximum infection rate

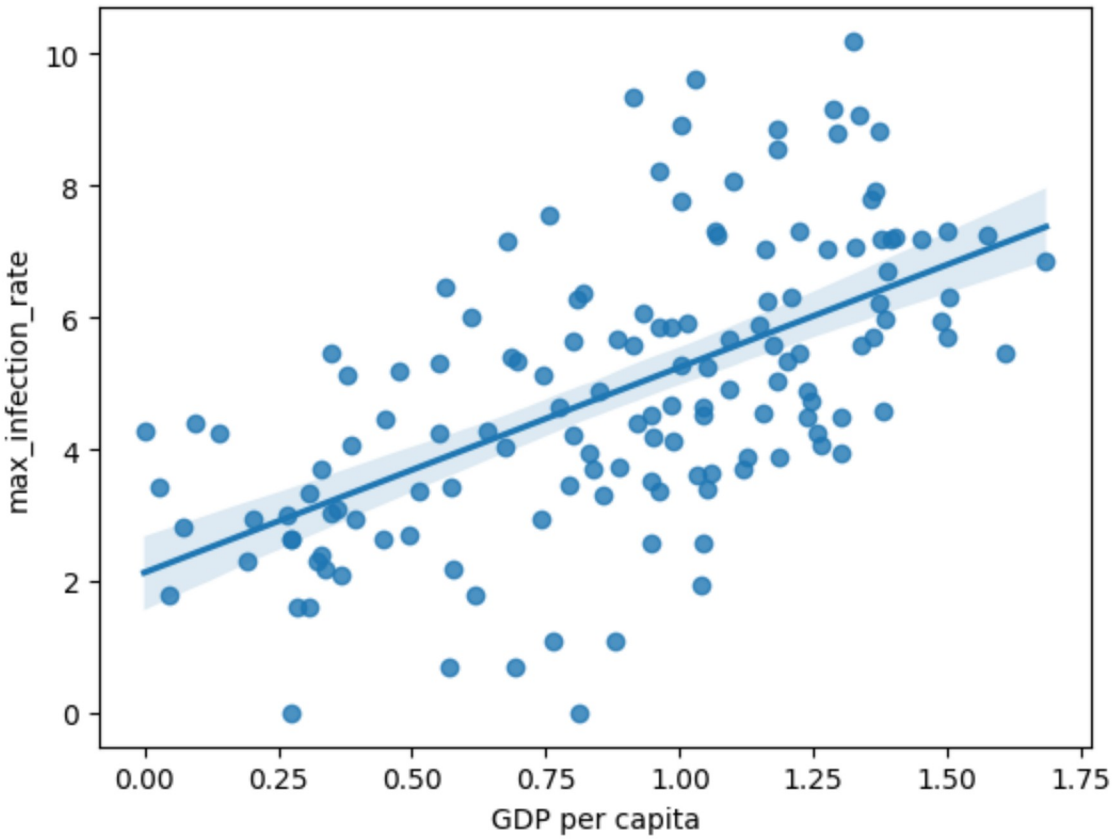
In [508...
```
combined_data.head()
```

Out[508...

	max_infection_rate	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices
Afghanistan	232	0.350	0.517	0.361	0.000
Albania	34	0.947	0.848	0.874	0.383
Algeria	199	1.002	1.160	0.785	0.086
Argentina	291	1.092	1.432	0.881	0.471
Armenia	134	0.850	1.055	0.815	0.283

In [509...
```
x = combined_data['GDP per capita']
y = combined_data['max_infection_rate']
sns.regplot(x=x, y=np.log(y))
```

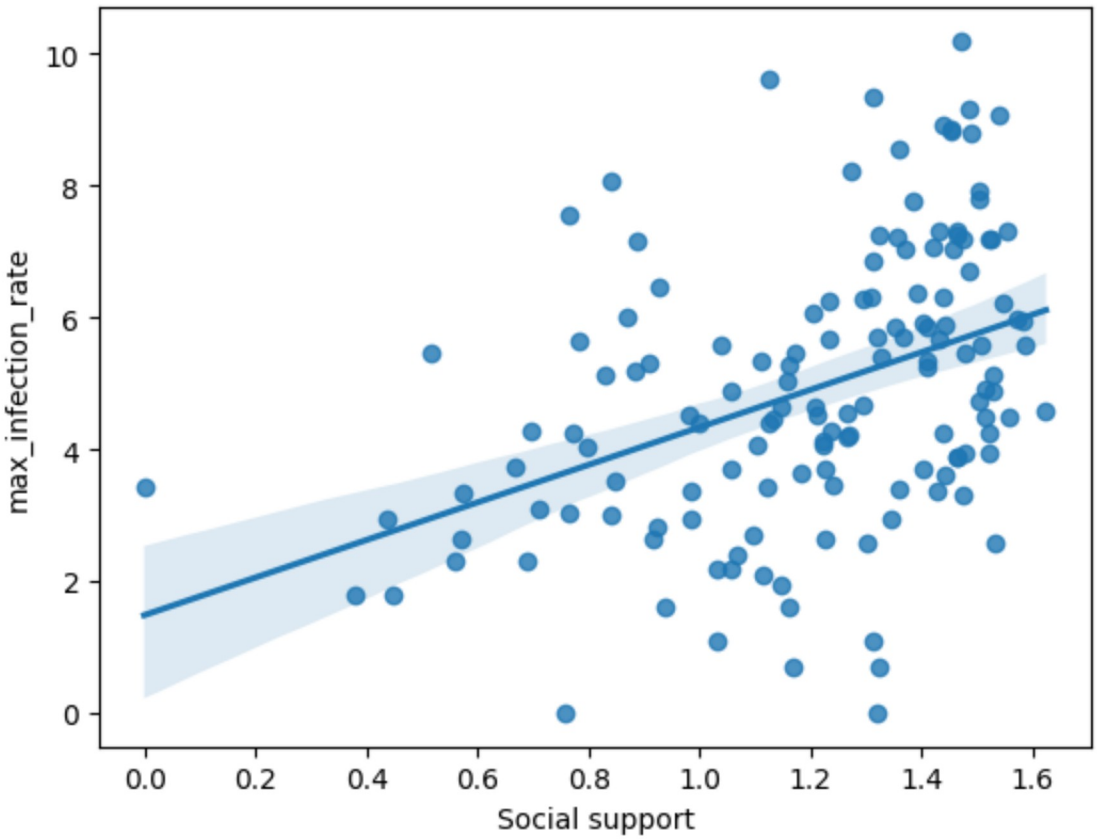
Out[509...
```
<Axes: xlabel='GDP per capita', ylabel='max_infection_rate'>
```



Task 5.2: Plotting Social Support vs. Maximum Infection Rate

In [510…
```
x = combined_data['Social support']
y = combined_data['max_infection_rate']
sns.regplot(x=x, y=np.log(y))
```

Out[510…
```
<Axes: xlabel='Social support', ylabel='max_infection_rate'>
```



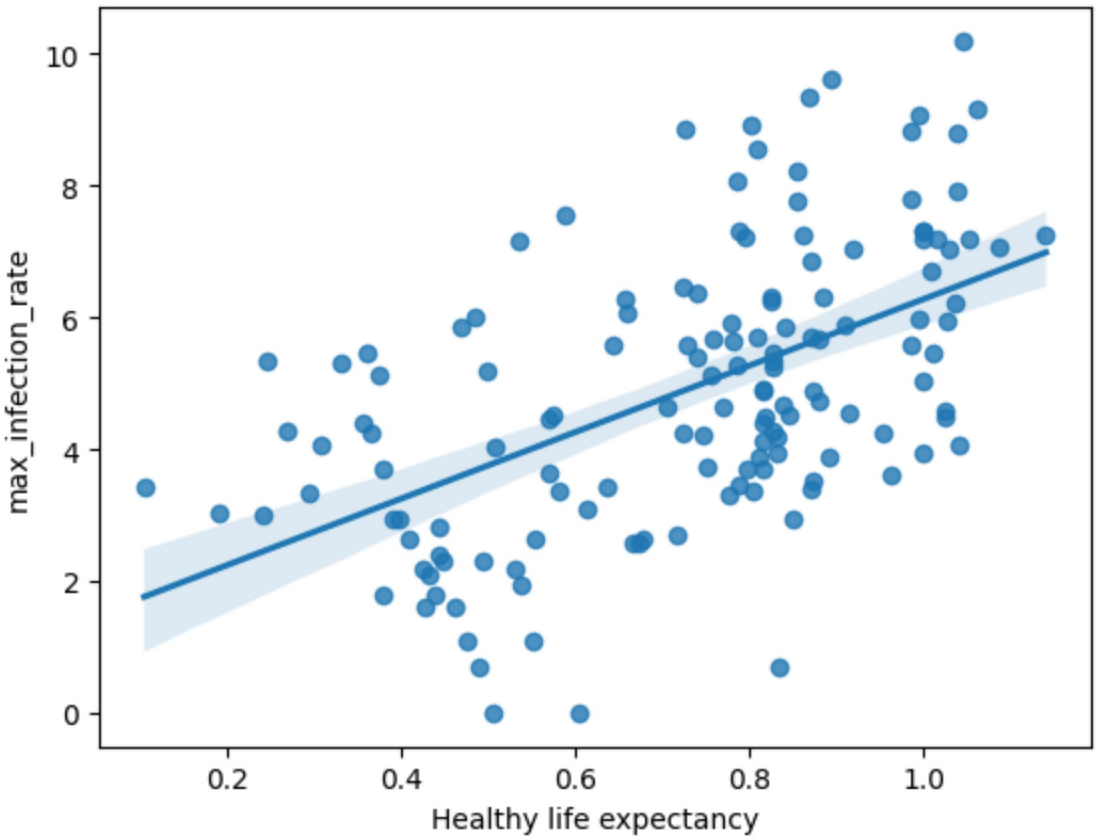
Task 5.3: Plotting Healthy Life Expectancy vs. Maximum Infection Rate

In [511…

```
x = combined_data['Healthy life expectancy']
y = combined_data['max_infection_rate']
sns.regplot(x=x, y=np.log(y))
```

Out[511…

```
<Axes: xlabel='Healthy life expectancy', ylabel='max_infection_rate'>
```



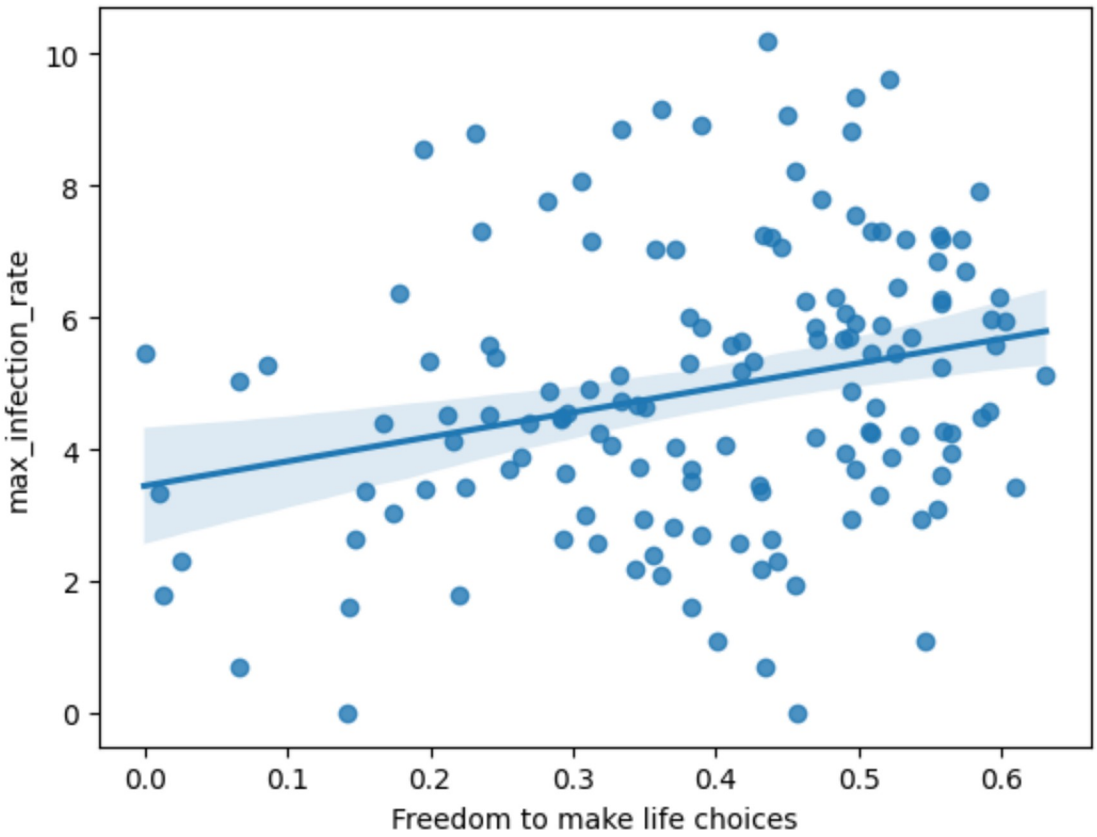
Task 5.4: Plotting Freedom to Make Life Choices vs. Maximum Infection Rate

In [512…

```
x = combined_data['Freedom to make life choices']
y = combined_data['max_infection_rate']
sns.regplot(x=x, y=np.log(y))
```

Out[512…

```
<Axes: xlabel='Freedom to make life choices', ylabel='max_infection_rate'>
```



Task 6:

- Import the covid19_deaths_dataset.csv dataset
- Select the needed columns for our analysis
- Join the datasets
- Calculate the correlations as the result of our analysis

Task 6.1: Importing the dataset - Covid-19 Deaths

In [513…
```
covid19_deaths = pd.read_csv('Dataset for practice/covid19_deaths_dataset.csv')
```

In [514…
```
covid19_deaths.head()
```

Out[514...

	Province/ State	Country/ Region	Lat	Long	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20
0	NaN	Afghanistan	33.0000	65.0000	0	0	0	0	0
1	NaN	Albania	41.1533	20.1683	0	0	0	0	0
2	NaN	Algeria	28.0339	1.6596	0	0	0	0	0
3	NaN	Andorra	42.5063	1.5218	0	0	0	0	0
4	NaN	Angola	-11.2027	17.8739	0	0	0	0	0

5 rows × 104 columns

Task 6.2: Delete the unnecessary columns

In [515...
```
covid19_deaths.drop(['Lat', 'Long'], axis=1, inplace=True)  # Dropping unnecessary
```

In [516...
```
covid19_deaths.head()
```

Out[516...

	Province/ State	Country/ Region	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20	1/27/20	1/28/20
0	NaN	Afghanistan	0	0	0	0	0	0	0
1	NaN	Albania	0	0	0	0	0	0	0
2	NaN	Algeria	0	0	0	0	0	0	0
3	NaN	Andorra	0	0	0	0	0	0	0
4	NaN	Angola	0	0	0	0	0	0	0

5 rows × 102 columns

In [517...
```
covid19_deaths_aggregated = covid19_deaths.groupby('Country/Region').sum()
```

In [518...
```
covid19_deaths_aggregated.head()
```

Out[518...

Country/ Region	Province/ State	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20	1/27/20	1/28/20
Afghanistan		0	0	0	0	0	0	0
Albania		0	0	0	0	0	0	0
Algeria		0	0	0	0	0	0	0
Andorra		0	0	0	0	0	0	0
Angola		0	0	0	0	0	0	0

5 rows × 101 columns

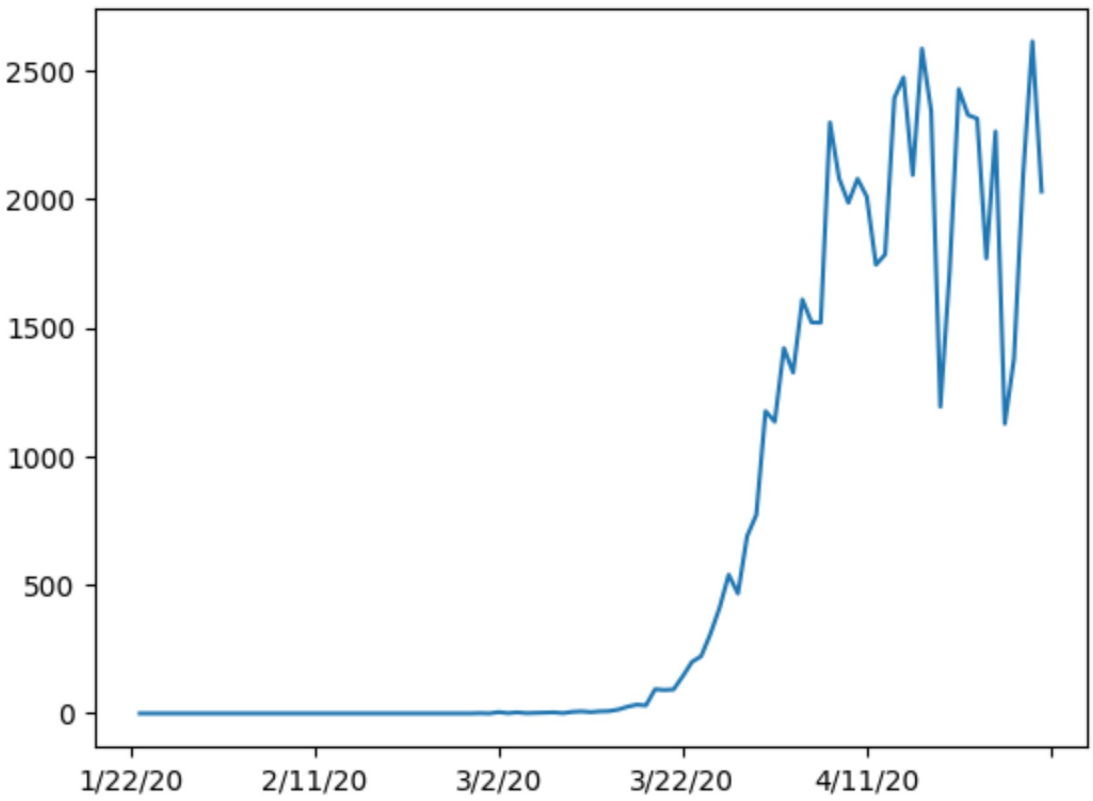
In [519...
```
covid19_deaths_aggregated.shape
```

Out[519... (187, 101)

Task 6.3: Calculating the first derivative of the curve

In [520...
```
covid19_deaths_aggregated.loc['US'].drop('Province/State', errors='ignore').diff().
```

Out[520... <Axes: >



Task 6.4: Find the maximum death rate for all countries

In [521…
```
max_death_rates = []
for c in countries:
    max_death_rates.append(
        covid19_deaths_aggregated.loc[c].drop('Province/State', errors='ignore').di
    )
covid19_deaths_aggregated['max_death_rate'] = max_death_rates
```

In [522…
```
covid19_deaths_aggregated.head()
```

Out[522…

Country/Region	Province/State	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20	1/27/20	1/28/20
Afghanistan	0	0	0	0	0	0	0	0
Albania	0	0	0	0	0	0	0	0
Algeria	0	0	0	0	0	0	0	0
Andorra	0	0	0	0	0	0	0	0
Angola	0	0	0	0	0	0	0	0

5 rows × 102 columns

Task 6.5: Create a new DataFrame with only the needed column

In [523…
```
covid19_deaths_dropped = pd.DataFrame(covid19_deaths_aggregated['max_death_rate'])
```

In [524…
```
covid19_deaths_dropped.head()
```

Out[524…

Country/Region	max_death_rate
Afghanistan	7
Albania	4
Algeria	30
Andorra	4
Angola	2

In [525…
```
covid19_death_data = covid19_deaths_dropped
```

Task 7.1: Now let's join the three datasets we have prepared

Corona Dataset:

In [526...
```
corona_data.head()
```

Out[526...

Country/Region	max_infection_rate
Afghanistan	232
Albania	34
Algeria	199
Andorra	43
Angola	5

In [527...
```
corona_data.shape
```

Out[527... (187, 1)

World Happiness Report Dataset:

In [528...
```
happiness_report.head()
```

Out[528...

Country or region	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices
Finland	1.340	1.587	0.986	0.596
Denmark	1.383	1.573	0.996	0.592
Norway	1.488	1.582	1.028	0.603
Iceland	1.380	1.624	1.026	0.591
Netherlands	1.396	1.522	0.999	0.557

In [529...
```
happiness_report.shape
```

Out[529... (156, 4)

Covid19 Deaths Dataset:

In [530...
```
covid19_death_data.head()
```

Out[530…

Country/Region	max_death_rate
Afghanistan	7
Albania	4
Algeria	30
Andorra	4
Angola	2

In [531…
```
covid19_death_data.shape
```

Out[531… (187, 1)

In [532…
```
combined_data = combined_data.join(covid19_death_data, how='inner')
combined_data.head()
```

Out[532…

	max_infection_rate	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices	max_death_rate
Afghanistan	232	0.350	0.517	0.361	0.000	7
Albania	34	0.947	0.848	0.874	0.383	4
Algeria	199	1.002	1.160	0.785	0.086	30
Argentina	291	1.092	1.432	0.881	0.471	13
Armenia	134	0.850	1.055	0.815	0.283	3

Task 8: Visualization of the results

Our analysis is not complete unless we visualize the results with figures and graphs so that everyone can understand the insights from our analysis.

In [533…
```
combined_data.corr().style.background_gradient(cmap='coolwarm')
```

Out[533...

	max_infection_rate	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices	max_deat
max_infection_rate	1.000000	0.250118	0.191958	0.289263	0.078196	0.8
GDP per capita	0.250118	1.000000	0.759468	0.863062	0.394603	0.2
Social support	0.191958	0.759468	1.000000	0.765286	0.456246	0.2
Healthy life expectancy	0.289263	0.863062	0.765286	1.000000	0.427892	0.3
Freedom to make life choices	0.078196	0.394603	0.456246	0.427892	1.000000	0.(
max_death_rate	0.880597	0.259893	0.204148	0.309666	0.080166	1.(

Task 8.1: Plotting GDP per capita vs. maximum death rate

In [534...

```
combined_data.head()
```

Out[534...

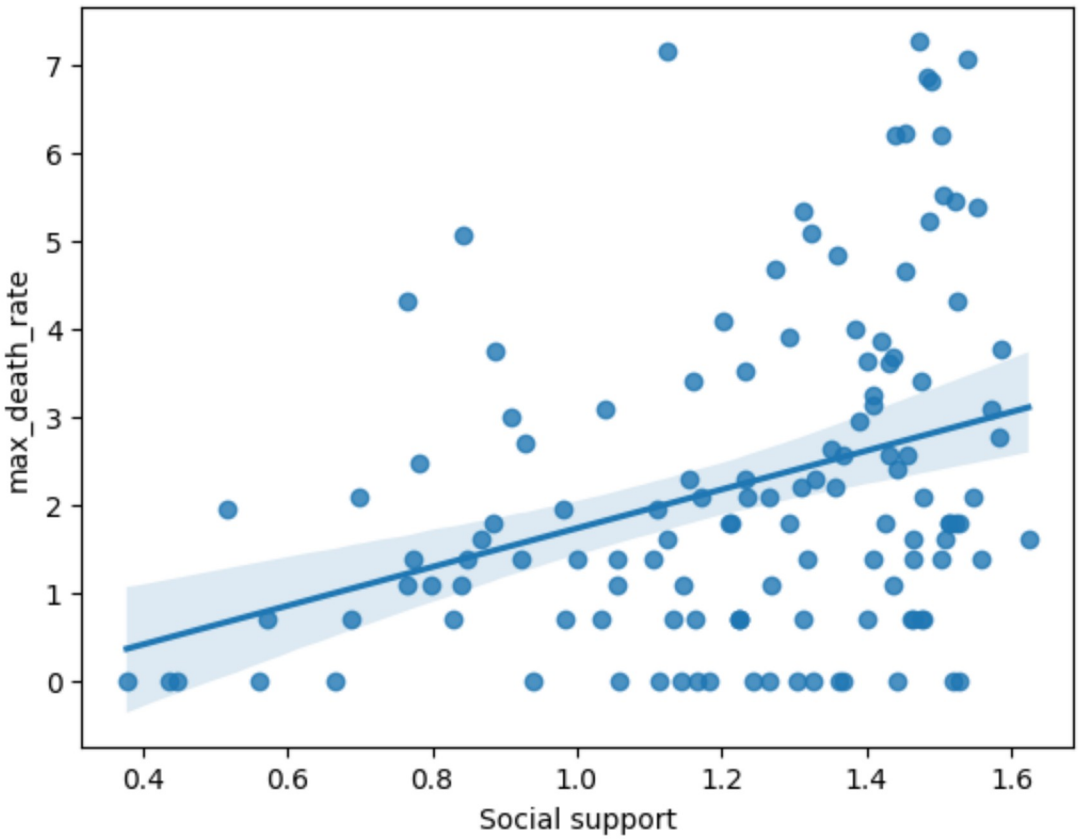
	max_infection_rate	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices	max_death_rate
Afghanistan	232	0.350	0.517	0.361	0.000	7
Albania	34	0.947	0.848	0.874	0.383	4
Algeria	199	1.002	1.160	0.785	0.086	30
Argentina	291	1.092	1.432	0.881	0.471	13
Armenia	134	0.850	1.055	0.815	0.283	3

In [545...

```
mask = y > 0
sns.regplot(x=x[mask], y=np.log(y[mask]))
```

Out[545...

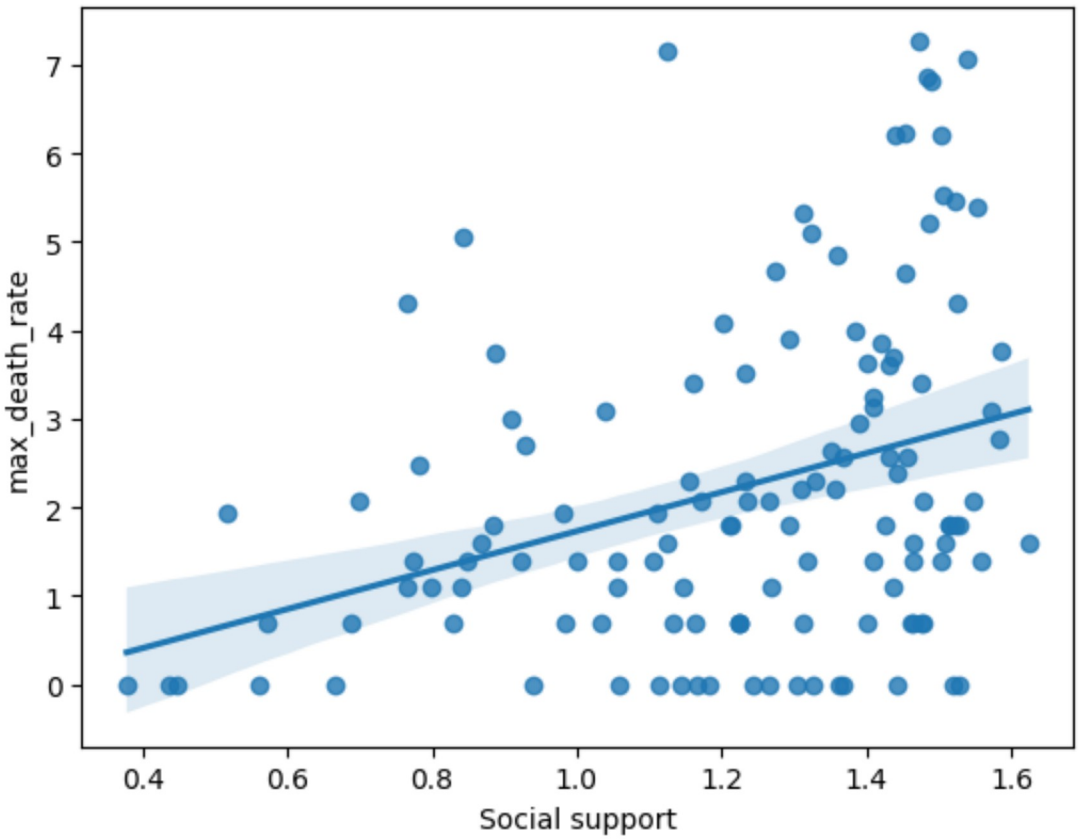
```
<Axes: xlabel='Social support', ylabel='max_death_rate'>
```



Task 8.2: Plotting Social Support vs. Maximum Death Rate

In [546…
```
x = combined_data['Social support']
y = combined_data['max_death_rate']
sns.regplot(x=x[mask], y=np.log(y[mask]))
```

Out[546…
```
<Axes: xlabel='Social support', ylabel='max_death_rate'>
```



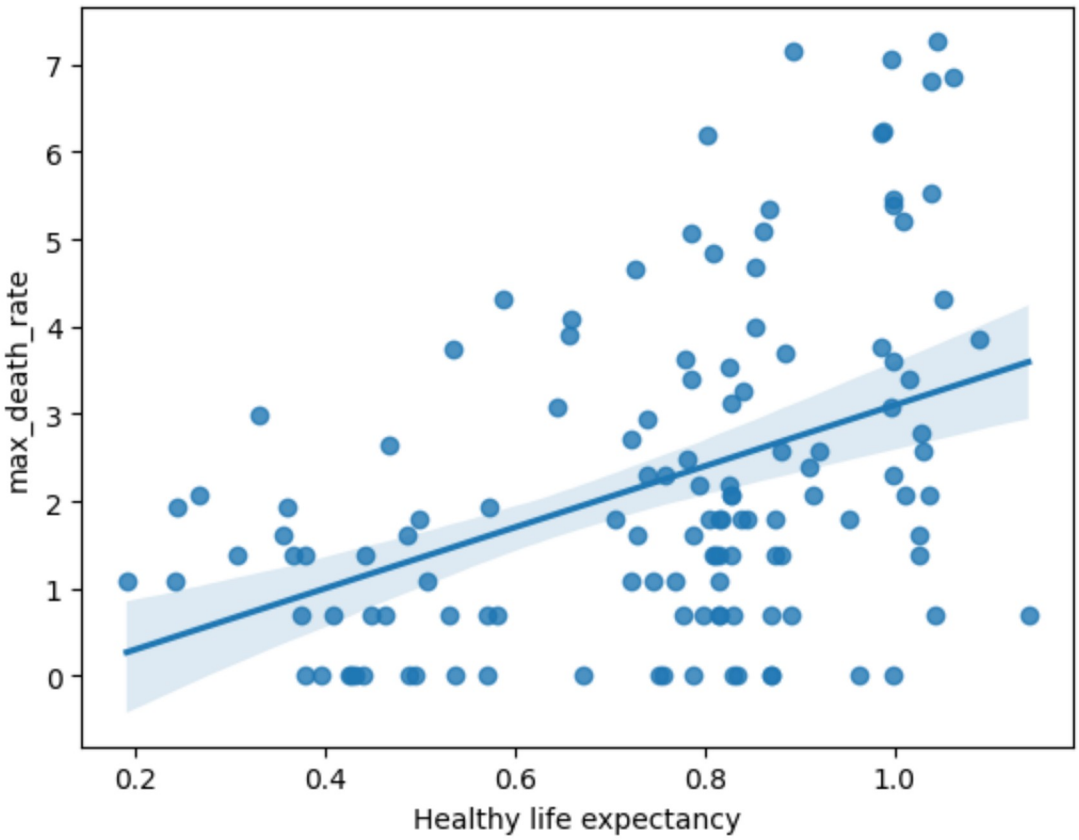
Task 8.3: Plotting Healthy Life Expectancy vs. Maximum Death Rate

In [547…

```
x = combined_data['Healthy life expectancy']
y = combined_data['max_death_rate']
sns.regplot(x=x[mask], y=np.log(y[mask]))
```

Out[547…

```
<Axes: xlabel='Healthy life expectancy', ylabel='max_death_rate'>
```

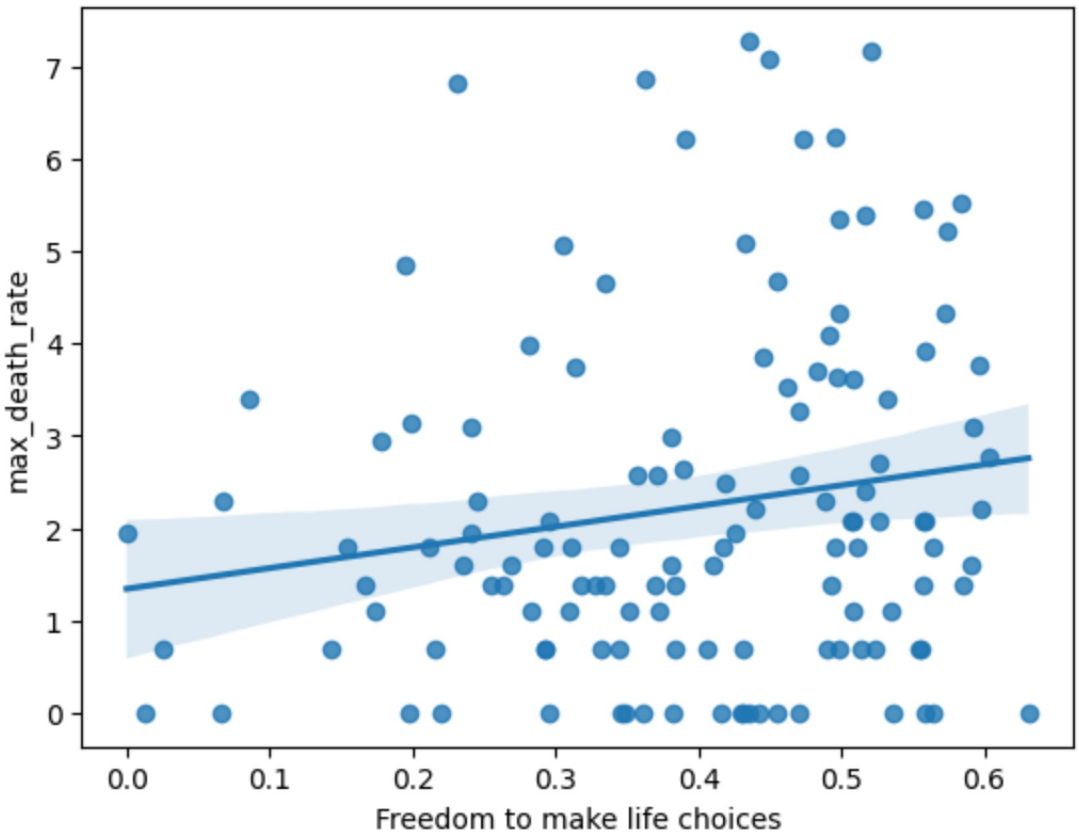


Task 8.4: Plotting Freedom to Make Life Choices vs. Maximum Death Rate

In [548…

```
x = combined_data['Freedom to make life choices']
y = combined_data['max_death_rate']
sns.regplot(x=x[mask], y=np.log(y[mask]))
```

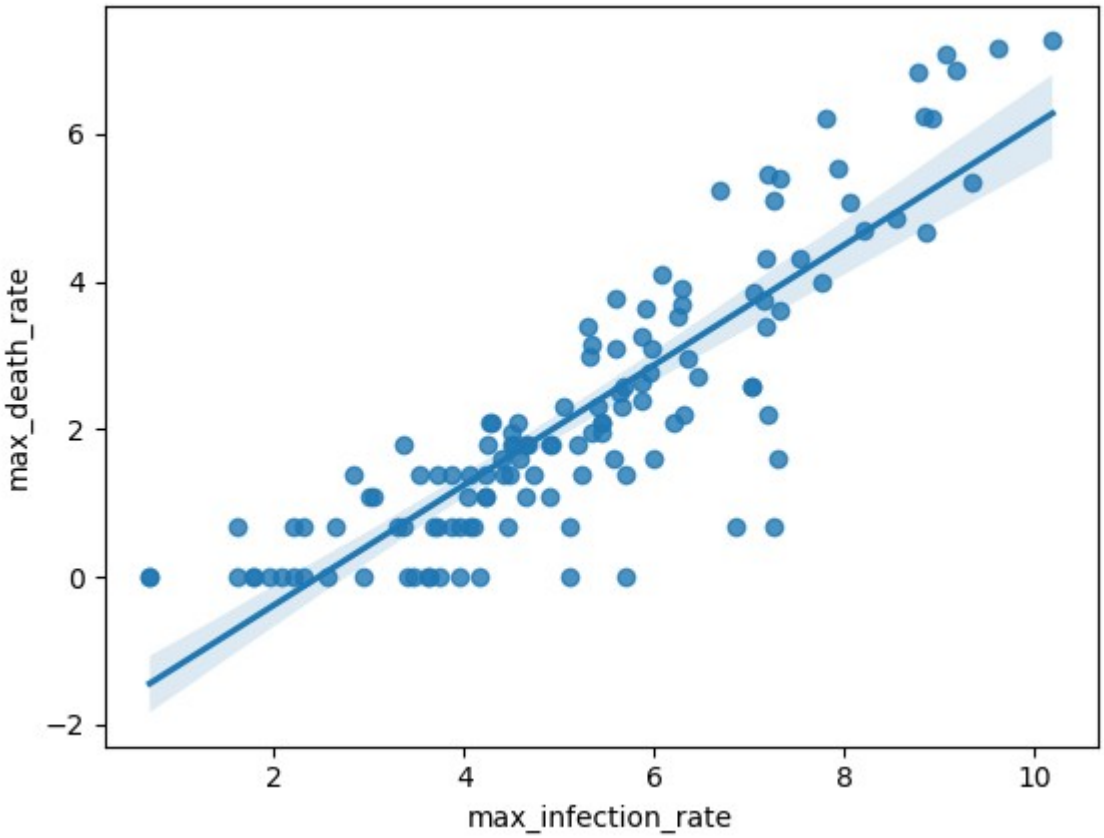
Out[548… <Axes: xlabel='Freedom to make life choices', ylabel='max_death_rate'>



Task 8.5: Plotting Maximum Infection Rate vs. Maximum Death Rate

In [549…
```
x = combined_data['max_infection_rate']
y = combined_data['max_death_rate']
sns.regplot(x=np.log(x[mask]), y=np.log(y[mask]))
```

Out[549… `<Axes: xlabel='max_infection_rate', ylabel='max_death_rate'>`


max_death_rate
max_infection_rate
6
4
2
0
−2
2
4
6
8
10