-Scraping (/github/elna511/-Scraping/tree/main)
/
DStools_Scrapping_project.ipynb (/github/elna511/-Scraping/tree/main/DStools_Scrapping_project.ipynb)

In [101…

```
import requests
from bs4 import BeautifulSoup
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.cluster import KMeans
```

In [102…

```
# Scraping wikipedia website
url = "https://en.wikipedia.org/wiki/List_of_countries_by_life_expectancy"

# Get the page content
response = requests.get(url)
soup = BeautifulSoup(response.text, 'html.parser')

# Find all tables
tables = soup.find_all('table', {'class': 'wikitable'})

# List to hold DataFrames and titles
dataframes = []
titles = []

# Loop over each table and extract headers and rows
for i, table in enumerate(tables):
    headers = []
    rows_data = []

    # Get title of each table
    caption_tag = table.find('caption')
    title = caption_tag.text.strip() if caption_tag else f"Table {i + 1} (No captior
    titles.append(title)

    # Extract headers
    header_row = table.find('tr')
    for th in header_row.find_all('th'):
        headers.append(th.text.strip())

    # Extract rows
    for row in table.find_all('tr')[1:]:
        cells = row.find_all(['td', 'th'])
        row_data = [cell.text.strip() for cell in cells]
        if row_data:
            rows_data.append(row_data)

    # Create DataFrame (handle inconsistent rows)
    if all(len(r) == len(headers) for r in rows_data):
        df = pd.DataFrame(rows_data, columns=headers)
    else:
        df = pd.DataFrame(rows_data)

    dataframes.append(df)
```

In [103…

```
## saved each table in separated excel file

for i in range(len(dataframes)) :
    dataframes[i].to_excel(f"table{i+1}.xlsx", index=False, engine='openpyxl')
    print(f"{titles[i]} is saved")
```

```
UN: Estimate of life expectancy for various ages in 2023 is saved
UN: Change of life expectancy from 2019 to 2023 is saved
World Bank Group (2023) is saved
World Health Organization (2019) is saved
CIA World Factbook (2022). All, male, female, and sex gap. is saved
OECD (2022) is saved
```

Start cleaning

In [104…
```
#cleaning of table 1

sh1=pd.read_excel(r"table2.xlsx", header=1)
sh1.columns= ['Countries and territories', 'All', 'Male', 'Female', 'Sex gap', '2019
print(f"Total number of columns: {sh1.shape[1]}")
```

```
Total number of columns: 16
```

In [105…
```
sh1.head()
```

Out[105]:

	Countries and territories	All	Male	Female	Sex gap	2019	2019:2020	2020	2020:2021	2021	2021:2022	2(
0	Hong Kong, China	85.51	82.84	88.13	5.29	85.26	−0.56	84.71	0.38	85.08	−1.60	83
1	Japan	84.71	81.69	87.74	6.05	84.42	0.25	84.67	−0.12	84.55	−0.50	84
2	South Korea	84.33	81.19	87.16	5.96	83.69	−0.01	83.67	0.18	83.85	−1.12	82
3	French Polynesia	84.07	81.78	86.50	4.73	83.19	−0.74	82.46	−2.89	79.57	4.29	83
4	Andorra	84.04	82.10	86.11	4.01	84.10	−4.68	79.42	2.91	82.33	1.69	84

In [106…
```
sh1.drop('0', axis=1, inplace=True)
sh1.head()
```

Out[106]:

	Countries and territories	All	Male	Female	Sex gap	2019	2019:2020	2020	2020:2021	2021	2021:2022	2(
0	Hong Kong, China	85.51	82.84	88.13	5.29	85.26	−0.56	84.71	0.38	85.08	−1.60	83
1	Japan	84.71	81.69	87.74	6.05	84.42	0.25	84.67	−0.12	84.55	−0.50	84
2	South Korea	84.33	81.19	87.16	5.96	83.69	−0.01	83.67	0.18	83.85	−1.12	82
3	French Polynesia	84.07	81.78	86.50	4.73	83.19	−0.74	82.46	−2.89	79.57	4.29	83
4	Andorra	84.04	82.10	86.11	4.01	84.10	−4.68	79.42	2.91	82.33	1.69	84

In [107…
```
print(sh1.dtypes)
```

```
Countries and territories            object
All                                 float64
Male                                float64
Female                              float64
Sex gap                             float64
2019                                float64
2019:2020                            object
2020                                float64
2020:2021                            object
2021                                float64
2021:2022                            object
2022                                float64
2022:2023                            object
2023                                float64
Recovery from COVID-19: 2019:2023    object
dtype: object
```

In [108…

```
cols_to_convert = ['2019:2020', '2020:2021', '2021:2022','2022:2023', 'Recovery from

for col in cols_to_convert:
    sh1[col] = (sh1[col].astype(str)
                .str.replace('−', '-')
                .str.replace(',', '.')
                .str.replace(r'[^\d.-]', '', regex=True))
    sh1[col] = pd.to_numeric(sh1[col], errors='coerce')
```

In [109…

```
sh1['2019:2020'] = sh1['2019:2020'].astype(float)
sh1['2020:2021'] = sh1['2020:2021'].astype(float)
sh1['2021:2022'] = sh1['2021:2022'].astype(float)
sh1['2022:2023'] = sh1['2022:2023'].astype(float)
sh1['Recovery from COVID-19: 2019:2023'] = sh1['Recovery from COVID-19: 2019:2023'].
```

In [110…

```
numeric_cols = sh1.select_dtypes(include=['float']).columns
sh1[numeric_cols] = sh1[numeric_cols].abs()

sh1.head()
```

Out[110]:

	Countries and territories	All	Male	Female	Sex gap	2019	2019:2020	2020	2020:2021	2021	2021:2022	2(
0	Hong Kong, China	85.51	82.84	88.13	5.29	85.26	0.56	84.71	0.38	85.08	1.60	83
1	Japan	84.71	81.69	87.74	6.05	84.42	0.25	84.67	0.12	84.55	0.50	84
2	South Korea	84.33	81.19	87.16	5.96	83.69	0.01	83.67	0.18	83.85	1.12	82
3	French Polynesia	84.07	81.78	86.50	4.73	83.19	0.74	82.46	2.89	79.57	4.29	83
4	Andorra	84.04	82.10	86.11	4.01	84.10	4.68	79.42	2.91	82.33	1.69	84

In [111…

```
sh1.isnull().sum()
```

Out[111]:
```
Countries and territories            0
All                                  0
Male                                 0
Female                               0
Sex gap                              0
2019                                 0
2019:2020                            0
2020                                 0
2020:2021                            0
2021                                 0
2021:2022                            0
2022                                 0
2022:2023                            0
2023                                 0
Recovery from COVID-19: 2019:2023    0
dtype: int64
```

In [112…
```
print(sh1.duplicated().sum())
```

```
0
```

In [113…
```
sh1.dtypes
```

Out[113]:
```
Countries and territories             object
All                                  float64
Male                                 float64
Female                               float64
Sex gap                              float64
2019                                 float64
2019:2020                            float64
2020                                 float64
2020:2021                            float64
2021                                 float64
2021:2022                            float64
2022                                 float64
2022:2023                            float64
2023                                 float64
Recovery from COVID-19: 2019:2023    float64
dtype: object
```

In [114…
```
sh1.to_excel("Change of life expectancy from 2019 to 2023.xlsx", index=False)
```

In [115…
```
#cleaning of table 2

sh2=pd.read_excel(r"table4.xlsx", header=1)
sh2.columns=['Countries','All','M', 'F','FΔM','Δ2000','All.1','M.1','F.1','FΔM.1','Δ
```

In [116…
```
sh2.head()
```

Out[116]:

	Countries	All	M	F	FΔM	Δ2000	All.1	M.1	F.1	FΔM.1	...	All.2	M.2	F.2	FΔM.2
0	Japan	84.3	81.5	86.9	5.4	3.2	74.1	72.6	75.5	2.9	...	26.3	23.9	28.6	4.7
1	Switzerland	83.4	81.8	85.1	3.3	3.7	72.5	72.2	72.8	0.6	...	25.4	24.1	26.6	2.5
2	South Korea	83.3	80.3	86.1	5.8	7.1	73.1	71.3	74.7	3.4	...	25.8	23.4	27.9	4.5
3	Singapore	83.2	81.0	85.5	4.5	4.8	73.6	72.4	74.7	2.3	...	25.5	23.8	27.2	3.4
4	Spain	83.2	80.7	85.7	5.0	4.1	72.1	71.3	72.9	1.6	...	25.4	23.3	27.3	4.0

5 rows × 21 columns

In [117…
```
print(sh2.dtypes)
```

```
Countries     object
All          float64
M            float64
F            float64
FΔM           object
Δ2000         object
All.1        float64
M.1          float64
F.1          float64
FΔM.1         object
Δ2000.1       object
All.2        float64
M.2          float64
F.2          float64
FΔM.2         object
Δ2000.2       object
All.3        float64
M.3          float64
F.3          float64
FΔM.3         object
Δ2000.3       object
dtype: object
```

In [118…
```
cols_to_convert = ['FΔM','Δ2000','FΔM.1','Δ2000.1','FΔM.2','Δ2000.2','FΔM.3','Δ2000.

for col in cols_to_convert:
    sh2[col] = (sh2[col].astype(str)
                .str.replace('−', '-')
                .str.replace(',', '.')
                .str.replace(r'[^\d.-]', '', regex=True))
    sh2[col] = pd.to_numeric(sh2[col], errors='coerce')
```

In [119…
```
sh2['FΔM'] = sh2['FΔM'].astype(float)
sh2['Δ2000'] = sh2['Δ2000'].astype(float)
sh2['FΔM.1'] = sh2['FΔM.1'].astype(float)
sh2['Δ2000.1'] = sh2['Δ2000.1'].astype(float)
sh2['FΔM.2'] = sh2['FΔM.2'].astype(float)
sh2['Δ2000.2'] = sh2['Δ2000.2'].astype(float)
sh2['FΔM.3'] = sh2['FΔM.3'].astype(float)
sh2['Δ2000.3'] = sh2['Δ2000.3'].astype(float)
```

In [120…
```
print(sh2.dtypes)
```

```
Countries     object
All          float64
M            float64
F            float64
FΔM          float64
Δ2000        float64
All.1        float64
M.1          float64
F.1          float64
FΔM.1        float64
Δ2000.1      float64
All.2        float64
M.2          float64
F.2          float64
FΔM.2        float64
Δ2000.2      float64
All.3        float64
M.3          float64
F.3          float64
FΔM.3        float64
Δ2000.3      float64
dtype: object
```

In [121…

```
numeric_cols = sh2.select_dtypes(include=['float']).columns
sh2[numeric_cols] = sh2[numeric_cols].abs()

sh2.head()
```

Out[121]:

	Countries	All	M	F	FΔM	Δ2000	All.1	M.1	F.1	FΔM.1	...	All.2	M.2	F.2	FΔM.2
0	Japan	84.3	81.5	86.9	5.4	3.2	74.1	72.6	75.5	2.9	...	26.3	23.9	28.6	4.7
1	Switzerland	83.4	81.8	85.1	3.3	3.7	72.5	72.2	72.8	0.6	...	25.4	24.1	26.6	2.5
2	South Korea	83.3	80.3	86.1	5.8	7.1	73.1	71.3	74.7	3.4	...	25.8	23.4	27.9	4.5
3	Singapore	83.2	81.0	85.5	4.5	4.8	73.6	72.4	74.7	2.3	...	25.5	23.8	27.2	3.4
4	Spain	83.2	80.7	85.7	5.0	4.1	72.1	71.3	72.9	1.6	...	25.4	23.3	27.3	4.0

5 rows × 21 columns

In [122…

```
print(sh2.duplicated().sum())
sh2.isnull().sum()
```

```
0
```

Out[122]:
```
Countries    0
All          0
M            0
F            0
FΔM          0
Δ2000        0
All.1        0
M.1          0
F.1          0
FΔM.1        0
Δ2000.1      0
All.2        0
M.2          0
F.2          0
FΔM.2        0
Δ2000.2      0
All.3        0
M.3          0
F.3          0
FΔM.3        0
Δ2000.3      0
dtype: int64
```

In [123…
```
sh2.to_excel("World Health Organization (2019).xlsx", index=False)
```

In [124…
```
#cleaning of table 3

sh3=pd.read_excel(r"table5.xlsx", header=1)
sh3.head()
```

Out[124]:

	Monaco	89.60	85.70	93.49	7.79
0	Singapore	86.43	83.65	89.20	5.55
1	Macau	85.06	82.09	88.02	5.93
2	Japan	84.91	81.92	87.90	5.98
3	San Marino	83.86	81.30	86.65	5.35
4	Canada	83.80	81.52	86.21	4.69

In [125…
```
print(sh3.dtypes)
```

```
Monaco     object
89.60     float64
85.70     float64
93.49     float64
7.79      float64
dtype: object
```

In [126…
```
sh3.isnull().sum()
```

Out[126]:
```
Monaco    0
89.60     0
85.70     0
93.49     0
7.79      0
dtype: int64
```

In [127…
```
print(sh3.duplicated().sum())
```

```
0
```

In [128…
```
sh3.to_excel("CIA World Factbook (2022).xlsx", index=False)
```

In [129…
```
# cleaning of table 4

sh4=pd.read_excel(r"table3.xlsx", header=1)
sh4.columns= ['Countries and territories', 'All', 'Male', 'Female', 'Sex gap','2014'
sh4.head()
```

Out[129]:

	Countries and territories	All	Male	Female	Sex gap	2014	2014:2019	2019	2019:2020	2020	2020:2021	2
0	Hong Kong SAR, China	85.25	82.54	88.09	5.55	83.94	1.22	85.16	0.34	85.50	0.04	8
1	French Polynesia	84.07	81.78	86.50	4.73	82.15	1.04	83.19	−0.74	82.46	−2.89	7
2	Switzerland	84.06	82.30	85.90	3.60	83.20	0.71	83.90	−0.90	83.00	0.75	8
3	Japan	84.04	81.09	87.14	6.05	83.59	0.77	84.36	0.20	84.56	−0.11	8
4	Andorra	84.04	82.10	86.11	4.01	84.48	−0.39	84.10	−4.68	79.42	2.91	8

In [130…
```
sh4.drop(' ', axis=1, inplace=True)
sh4.head()
```

Out[130]:

	Countries and territories	All	Male	Female	Sex gap	2014	2014:2019	2019	2019:2020	2020	2020:2021	2
0	Hong Kong SAR, China	85.25	82.54	88.09	5.55	83.94	1.22	85.16	0.34	85.50	0.04	8
1	French Polynesia	84.07	81.78	86.50	4.73	82.15	1.04	83.19	−0.74	82.46	−2.89	7
2	Switzerland	84.06	82.30	85.90	3.60	83.20	0.71	83.90	−0.90	83.00	0.75	8
3	Japan	84.04	81.09	87.14	6.05	83.59	0.77	84.36	0.20	84.56	−0.11	8
4	Andorra	84.04	82.10	86.11	4.01	84.48	−0.39	84.10	−4.68	79.42	2.91	8

In [131…
```
print(sh4.dtypes)
```

```
Countries and territories            object
All                                 float64
Male                                float64
Female                              float64
Sex gap                             float64
2014                                float64
2014:2019                            object
2019                                float64
2019:2020                            object
2020                                float64
2020:2021                            object
2021                                float64
2021:2022                            object
2022                                float64
2022:2023                            object
2023                                float64
recovery from COVID-19: 2019:2022    object
dtype: object
```

In [132…

```
cols_to_convert = ['All', 'Male', 'Female', 'Sex gap', '2014', '2014:2019', '2019',

for col in cols_to_convert:
    sh4[col] = (sh4[col].astype(str)
                .str.replace('−', '-')
                .str.replace(',', '.')
                .str.replace(r'[^\d.-]', '', regex=True))
    sh4[col] = pd.to_numeric(sh4[col], errors='coerce')
```

In [133…

```
sh4['All'] = sh4['All'].astype(float)
sh4['Male'] = sh4['Male'].astype(float)
sh4['Female'] = sh4['Female'].astype(float)
sh4['Sex gap'] = sh4['Sex gap'].astype(float)
sh4['2014'] = sh4['2014'].astype(float)
sh4['2014:2019'] = sh4['2014:2019'].astype(float)
sh4['2019'] = sh4['2019'].astype(float)
sh4['2019:2020'] = sh4['2019:2020'].astype(float)
sh4['2020'] = sh4['2020'].astype(float)
sh4['2020:2021'] = sh4['2020:2021'].astype(float)
sh4['2021:2022'] = sh4['2021:2022'].astype(float)
sh4['2022'] = sh4['2022'].astype(float)
sh4['2022:2023'] = sh4['2022:2023'].astype(float)
sh4['2023'] = sh4['2023'].astype(float)
sh4['recovery from COVID-19: 2019:2022'] = sh4['recovery from COVID-19: 2019:2022'].
print(sh4.dtypes)
```

```
Countries and territories            object
All                                 float64
Male                                float64
Female                              float64
Sex gap                             float64
2014                                float64
2014:2019                           float64
2019                                float64
2019:2020                           float64
2020                                float64
2020:2021                           float64
2021                                float64
2021:2022                           float64
2022                                float64
2022:2023                           float64
2023                                float64
recovery from COVID-19: 2019:2022   float64
dtype: object
```

In [134…

```
numeric_cols = sh4.select_dtypes(include=['float']).columns
sh4[numeric_cols] = sh4[numeric_cols].abs()

sh4.head()
```

Out[134]:

	Countries and territories	All	Male	Female	Sex gap	2014	2014:2019	2019	2019:2020	2020	2020:2021	2
0	Hong Kong SAR, China	85.25	82.54	88.09	5.55	83.94	1.22	85.16	0.34	85.50	0.04	8
1	French Polynesia	84.07	81.78	86.50	4.73	82.15	1.04	83.19	0.74	82.46	2.89	7
2	Switzerland	84.06	82.30	85.90	3.60	83.20	0.71	83.90	0.90	83.00	0.75	8
3	Japan	84.04	81.09	87.14	6.05	83.59	0.77	84.36	0.20	84.56	0.11	8
4	Andorra	84.04	82.10	86.11	4.01	84.48	0.39	84.10	4.68	79.42	2.91	8

In [135…

```
sh4.isnull().sum()
```

Out[135]:
```
Countries and territories            0
All                                  0
Male                                 0
Female                               0
Sex gap                              0
2014                                 0
2014:2019                            0
2019                                 0
2019:2020                            0
2020                                 0
2020:2021                            0
2021                                 0
2021:2022                            0
2022                                 0
2022:2023                            0
2023                                 0
recovery from COVID-19: 2019:2022    0
dtype: int64
```

In [136…
```
columns_to_fill = [
    "All", "Male", "Female", "Sex gap",
    "2014", "2014:2019", "2019", "2019:2020",
    "2020", "2020:2021", "2021:2022", "2022",
    "recovery from COVID-19: 2019:2022"
]

for col in columns_to_fill:
    sh4[col] = sh4[col].fillna(sh4[col].mean())

sh4.isnull().sum()
```

Out[136]:
```
Countries and territories            0
All                                  0
Male                                 0
Female                               0
Sex gap                              0
2014                                 0
2014:2019                            0
2019                                 0
2019:2020                            0
2020                                 0
2020:2021                            0
2021                                 0
2021:2022                            0
2022                                 0
2022:2023                            0
2023                                 0
recovery from COVID-19: 2019:2022    0
dtype: int64
```

In [137…
```
print(sh4.duplicated().sum())
```

```
0
```

In [183…
```
sh4.to_excel("World Bank Group (2022).xlsx", index=False)
```

In [139…
```
# cleaning of table 5

sh5=pd.read_excel(r"table1.xlsx", header=1)
sh5.columns= ['Locations','at birth','bonus0→15','at 15','bonus15→65','at 65','bonus
```

In [140…
```
sh5.head()
```

Out[140]:

	Locations	at birth	bonus0→15	at 15	bonus15→65	at 65	bonus65→80	at 80	at birth.1	at 15.1	…
0	Hong Kong	85.51	0.21	70.72	2.47	23.19	3.27	11.45	82.84	68.06	…
1	Japan	84.71	0.24	69.96	2.54	22.49	3.45	10.95	81.69	66.93	…
2	South Korea	84.33	0.30	69.63	1.69	21.32	4.14	10.45	81.19	66.51	…
3	French Polynesia	84.07	0.58	69.65	1.85	21.50	3.72	10.23	81.78	67.37	…
4	Andorra	84.04	0.58	69.62	1.85	21.47	3.72	10.19	82.10	67.68	…

5 rows × 21 columns

In [141…
```
sh5.drop(' ', axis=1, inplace=True)
```

In [142…
```
print(sh5.dtypes)
```

```
Locations      object
at birth      float64
bonus0→15     float64
at 15         float64
bonus15→65    float64
at 65         float64
bonus65→80    float64
at 80         float64
at birth.1    float64
at 15.1       float64
at 65.1       float64
80.1          float64
at birth.2    float64
at 15.2       float64
at 65.2       float64
at 80.2       float64
at birth.3    float64
at 15.3       float64
at 65.3       float64
at 80.3        object
dtype: object
```

In [143…
```
cols_to_convert = ['at 80']

for col in cols_to_convert:
    sh5[col] = (sh5[col].astype(str)
                .str.replace('−', '-')
                .str.replace(',', '.')
                .str.replace(r'[^\d.-]', '', regex=True))
    sh5[col] = pd.to_numeric(sh5[col], errors='coerce')
```

In [144…
```
sh5['at 80'] = sh5['at 80'].astype(float)
```

In [145…
```
numeric_cols = sh5.select_dtypes(include=['float']).columns
sh5[numeric_cols] = sh5[numeric_cols].abs()

sh5.head()
```

Out[145]:

	Locations	at birth	bonus0→15	at 15	bonus15→65	at 65	bonus65→80	at 80	at birth.1	at 15.1	6
0	Hong Kong	85.51	0.21	70.72	2.47	23.19	3.27	11.45	82.84	68.06	21
1	Japan	84.71	0.24	69.96	2.54	22.49	3.45	10.95	81.69	66.93	19
2	South Korea	84.33	0.30	69.63	1.69	21.32	4.14	10.45	81.19	66.51	18
3	French Polynesia	84.07	0.58	69.65	1.85	21.50	3.72	10.23	81.78	67.37	19
4	Andorra	84.04	0.58	69.62	1.85	21.47	3.72	10.19	82.10	67.68	19

In [146…
```
sh5.isnull().sum()
```

Out[146]:
```
Locations     0
at birth      0
bonus0→15     0
at 15         0
bonus15→65    0
at 65         0
bonus65→80    0
at 80         0
at birth.1    0
at 15.1       0
at 65.1       0
80.1          0
at birth.2    0
at 15.2       0
at 65.2       0
at 80.2       0
at birth.3    0
at 15.3       0
at 65.3       0
at 80.3       0
dtype: int64
```

In [147…
```
print(sh5.duplicated().sum())
```

```
0
```

In [148…
```
sh5.to_excel("Estimate of life expectancy for various ages in 2023.xlsx", index=Fals
```

In [149…
```
#cleaning of table 6

sh6=pd.read_excel(r"table6.xlsx")
sh6.head()
```

Out[149]:

	Country	2022overall	2022male	2022female	2022FΔM	2019	2019→2020	2020	2020→202
0	Japan	—	—	—	—	84.4	0.2	84.6	−0.
1	Switzerland	83.5	81.6	85.4	3.8	84.0	−0.9	83.1	0.
2	Spain	83.2	80.4	85.9	5.5	84.0	−1.6	82.4	0.
3	Italy	83.0	80.9	85.0	4.1	83.6	−1.3	82.3	0.
4	South Korea	—	—	—	—	83.3	0.2	83.5	0.

In [150…
```
print(sh6.dtypes)
```

```
Country         object
2022overall     object
2022male        object
2022female      object
2022FΔM         object
2019           float64
2019→2020       object
2020            object
2020→2021       object
2021            object
2021→2022       object
2022            object
2019→2022       object
dtype: object
```

In [151…
```
cols_to_convert = ['2022overall','2022male','2022female','2022FΔM','2019→2020','2020

for col in cols_to_convert:
    sh6[col] = (sh6[col].astype(str)
                .str.replace('−', '-')
                .str.replace(',', '.')
                .str.replace(r'[^\d.-]', '', regex=True))
    sh6[col] = pd.to_numeric(sh6[col], errors='coerce')
```

In [152…
```
sh6['2022overall'] = sh6['2022overall'].astype(float)
sh6['2022male'] = sh6['2022male'].astype(float)
sh6['2022female'] = sh6['2022female'].astype(float)
sh6['2022FΔM'] = sh6['2022FΔM'].astype(float)
sh6['2019→2020'] = sh6['2019→2020'].astype(float)
sh6['2020'] = sh6['2020'].astype(float)
sh6['2020→2021'] = sh6['2020→2021'].astype(float)
sh6['2021'] = sh6['2021'].astype(float)
sh6['2021→2022'] = sh6['2021→2022'].astype(float)
sh6['2022'] = sh6['2022'].astype(float)
sh6['2019→2022'] = sh6['2019→2022'].astype(float)
```

In [153…
```
print(sh6.dtypes)
```

```
Country         object
2022overall    float64
2022male       float64
2022female     float64
2022FΔM        float64
2019           float64
2019→2020      float64
2020           float64
2020→2021      float64
2021           float64
2021→2022      float64
2022           float64
2019→2022      float64
dtype: object
```

In [154…
```
sh6.isnull().sum()
```

Out[154]:
```
Country         0
2022overall    11
2022male       12
2022female     12
2022FΔM        12
2019            0
2019→2020       2
2020            2
2020→2021       3
2021            3
2021→2022      11
2022           11
2019→2022      11
dtype: int64
```

In [155…
```
columns_to_fill = [
    "2022overall", "2022male", "2022female", "2022FΔM",
    "2019→2020", "2020", "2020→2021", "2021",
    "2021→2022", "2022", "2019→2022",
]

for col in columns_to_fill:
    sh6[col] = sh6[col].fillna(sh6[col].mean())
```

In [156…
```
sh6.isnull().sum()
```

Out[156]:
```
Country        0
2022overall    0
2022male       0
2022female     0
2022FΔM        0
2019           0
2019→2020      0
2020           0
2020→2021      0
2021           0
2021→2022      0
2022           0
2019→2022      0
dtype: int64
```

In [157…
```
print(sh6.duplicated().sum())
```

```
0
```

In [158…
```
sh6.to_excel("OECD (2022).xlsx", index=False)
```

In [159…
```
import re
from IPython.display import display
# Specify each file path and the column name containing country names
files_info = [
    {"file_path": "CIA World Factbook (2022).xlsx", "column_name": "Monaco"},
    {"file_path": "Change of life expectancy from 2019 to 2023.xlsx", "column_name":
    {"file_path": "Estimate of life expectancy for various ages in 2023.xlsx", "colu
    {"file_path": "OECD (2022).xlsx", "column_name": "Country"},
    {"file_path": "World Bank Group (2022).xlsx", "column_name": "Countries and terr
    {"file_path": "World Health Organization (2019).xlsx", "column_name": "Countries
]

multi_word_counts = []  # To store count of multi-word countries per file
for idx, info in enumerate(files_info, 1):
    file_path = info["file_path"]
    column_name = info["column_name"]
    df = pd.read_excel(file_path)
    countries = df[column_name].dropna().tolist()
    multi_word_countries = [country for country in countries if re.search(r'\s', str
    # Display the result in a table
    print(f"\n File {idx}: {file_path}")
    print(f"Countries with more than one word:")
    result_df = pd.DataFrame(multi_word_countries, columns=["Multi Word Countries"])
    display(result_df)
    # Append the count of multi-word countries to the list
    multi_word_counts.append(len(multi_word_countries))

# Plot the result
file_names = [f"File {idx}" for idx in range(1, len(files_info) + 1)]
plt.bar(file_names, multi_word_counts)
plt.xlabel("Files")
plt.ylabel("Number of Multi-Word Countries")
plt.title("Multi-Word Countries Count per File")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```

```
 File 1: CIA World Factbook (2022).xlsx
Countries with more than one word:
```

	Multi Word Countries
0	San Marino
1	Hong Kong
2	South Korea
3	New Zealand
4	Cayman Islands
...	...
56	South Sudan
57	Sierra Leone
58	Central African Republic
59	World (2020)
60	European Union (2021)

61 rows × 1 columns

```
 File 2: Change of life expectancy from 2019 to 2023.xlsx
Countries with more than one word:
```

	Multi Word Countries
0	Hong Kong, China
1	South Korea
2	French Polynesia
3	Macao, China
4	United Arab Emirates
5	New Zealand
6	Puerto Rico
7	United Kingdom
8	Isle of Man
9	Costa Rica
10	Cayman Islands
11	Faroe Islands
12	United States
13	New Caledonia
14	Saudi Arabia
15	Bosnia and Herzegovina
16	Antigua and Barbuda
17	Sri Lanka
18	North Macedonia
19	French Guiana
20	Cabo Verde
21	US Virgin Islands
22	Dominican Republic
23	North Korea
24	Trinidad and Tobago
25	Saint Lucia
26	El Salvador
27	Western Sahara
28	Saint Vincent and the Grenadines
29	Solomon Islands
30	Sao Tome and Principe
31	F.S. Micronesia
32	South Africa
33	Papua New Guinea
34	Congo, Rep.
35	Equatorial Guinea

	Multi Word Countries
36	Cote d'Ivoire
37	DR Congo
38	Sierra Leone
39	Burkina Faso
40	South Sudan

```
 File 3: Estimate of life expectancy for various ages in 2023.xlsx
Countries with more than one word:
```

	Multi Word Countries
0	Hong Kong
1	South Korea
2	French Polynesia
3	United Arab Emirates
4	New Zealand
5	Puerto Rico
6	United Kingdom
7	Isle of Man
8	Costa Rica
9	Cayman Islands
10	Faroe Islands
11	Czech Republic
12	United States
13	New Caledonia
14	Saudi Arabia
15	Bosnia and Herzegovina
16	Antigua and Barbuda
17	Sri Lanka
18	North Macedonia
19	French Guiana
20	Cape Verde
21	U.S. Virgin Islands
22	Dominican Republic
23	North Korea
24	Trinidad and Tobago
25	Saint Lucia
26	El Salvador
27	Western Sahara
28	Saint Vincent and the Grenadines
29	Solomon Islands
30	São Tomé and Príncipe
31	South Africa
32	Papua New Guinea
33	Equatorial Guinea
34	Ivory Coast
35	DR Congo

	Multi Word Countries
36	Sierra Leone
37	Burkina Faso
38	South Sudan
39	Central African Republic

```
 File 4: OECD (2022).xlsx
Countries with more than one word:
```

	Multi Word Countries
0	South Korea
1	New Zealand
2	United Kingdom
3	Costa Rica
4	South Africa

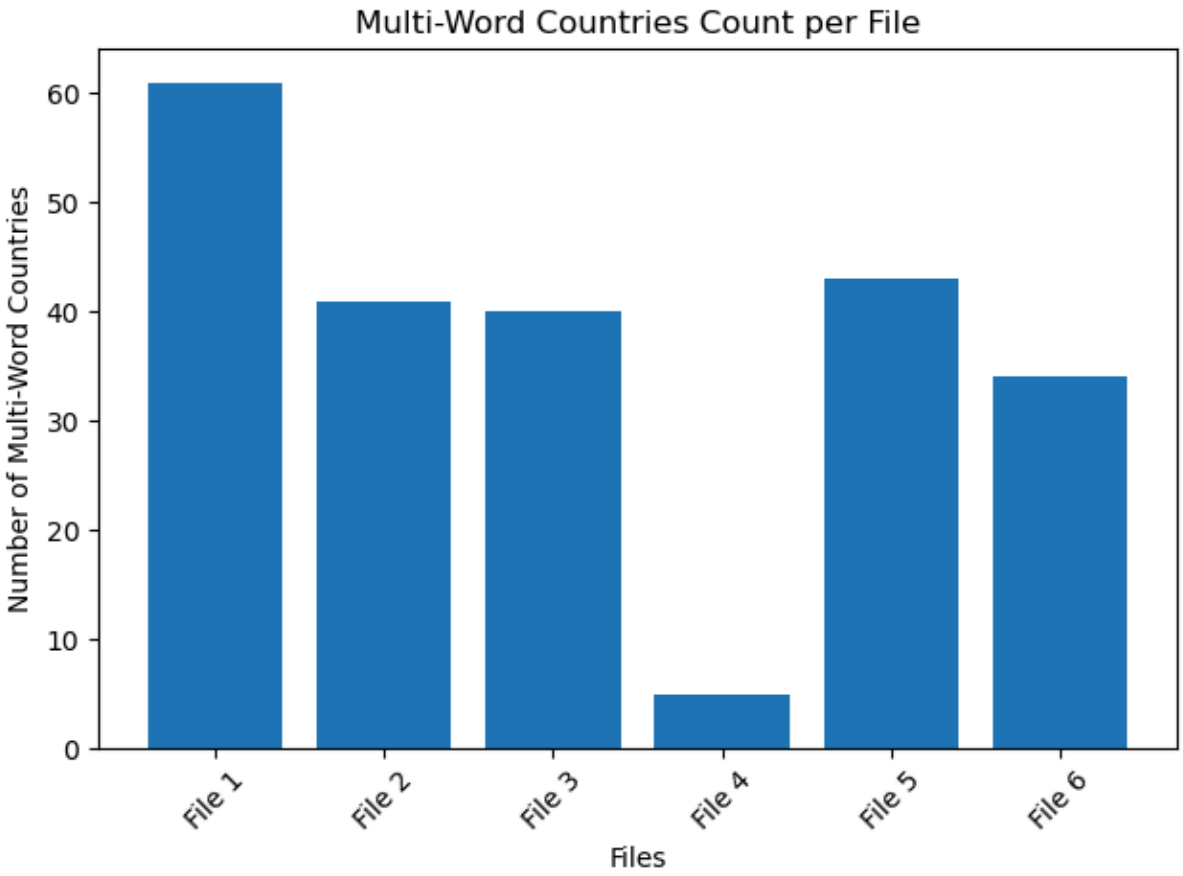
```
 File 5: World Bank Group (2022).xlsx
Countries with more than one word:
```

	Multi Word Countries
0	Hong Kong SAR, China
1	French Polynesia
2	South Korea
3	Macao SAR, China
4	Faroe Islands
5	New Zealand
6	United Arab Emirates
7	Puerto Rico
8	United Kingdom
9	Channel Islands
10	Isle of Man
11	Costa Rica
12	Virgin Islands (U.S.)
13	Cayman Islands
14	Northern Mariana Islands
15	New Caledonia
16	Saudi Arabia
17	Bosnia and Herzegovina
18	Antigua and Barbuda
19	Sri Lanka
20	Sint Maarten
21	Cabo Verde
22	North Macedonia
23	Dominican Republic
24	North Korea
25	Trinidad and Tobago
26	Caribbean small states
27	St. Lucia
28	El Salvador
29	St. Vincent and the Grenadines
30	Solomon Islands
31	Sao Tome and Principe
32	Pacific island small states
33	South Africa
34	Papua New Guinea
35	Congo, Rep.

	Multi Word Countries
36	Equatorial Guinea
37	Cote d'Ivoire
38	DR Congo
39	Sierra Leone
40	Burkina Faso
41	South Sudan
42	Central African Republic

```
 File 6: World Health Organization (2019).xlsx
Countries with more than one word:
```

	Multi Word Countries
0	South Korea
1	New Zealand
2	United Kingdom
3	Costa Rica
4	Czech Republic
5	United States of America
6	Sri Lanka
7	Bosnia and Herzegovina
8	Antigua and Barbuda
9	Trinidad and Tobago
10	United Arab Emirates
11	El Salvador
12	North Macedonia
13	Brunei Darussalam
14	Saint Lucia
15	Saudi Arabia
16	Cabo Verde
17	Viet Nam
18	Saint Vincent and the Grenadines
19	Dominican Republic
20	North Korea
21	Sao Tome and Principe
22	Papua New Guinea
23	South Africa
24	Solomon Islands
25	Congo, Republic of
26	Federated States of Micronesia
27	Côte d'Ivoire
28	South Sudan
29	Burkina Faso
30	Congo, Democratic Republic of
31	Equatorial Guinea
32	Sierra Leone
33	Central African Republic



start of analysis

In [160…

```
sh1 = pd.read_excel(r"Change of life expectancy from 2019 to 2023.xlsx")
print(sh1.dtypes)
pd.DataFrame(sh1)
```

```
Countries and territories            object
All                                 float64
Male                                float64
Female                              float64
Sex gap                             float64
2019                                float64
2019:2020                           float64
2020                                float64
2020:2021                           float64
2021                                float64
2021:2022                           float64
2022                                float64
2022:2023                           float64
2023                                float64
Recovery from COVID-19: 2019:2023   float64
dtype: object
```

Out[160]:

	Countries and territories	All	Male	Female	Sex gap	2019	2019:2020	2020	2020:2021	2021	2021:2022
0	Hong Kong, China	85.51	82.84	88.13	5.29	85.26	0.56	84.71	0.38	85.08	1.60
1	Japan	84.71	81.69	87.74	6.05	84.42	0.25	84.67	0.12	84.55	0.50
2	South Korea	84.33	81.19	87.16	5.96	83.69	0.01	83.67	0.18	83.85	1.12
3	French Polynesia	84.07	81.78	86.50	4.73	83.19	0.74	82.46	2.89	79.57	4.29
4	Andorra	84.04	82.10	86.11	4.01	84.10	4.68	79.42	2.91	82.33	1.69
...	...	...	...	...	...	...	...	...	...	...	...
206	South Sudan	57.62	54.64	60.63	5.99	58.13	0.48	57.65	0.60	57.05	0.16
207	CAR	57.41	55.26	59.29	4.03	31.53	19.07	50.60	10.32	40.28	21.46
208	Lesotho	57.38	54.62	60.01	5.39	55.25	0.12	55.13	0.92	54.21	2.60
209	Chad	55.07	53.20	57.01	3.82	52.99	0.09	53.08	0.05	53.14	1.39
210	Nigeria	54.46	54.18	54.74	0.57	53.01	0.06	53.07	0.38	53.45	0.62

211 rows × 15 columns

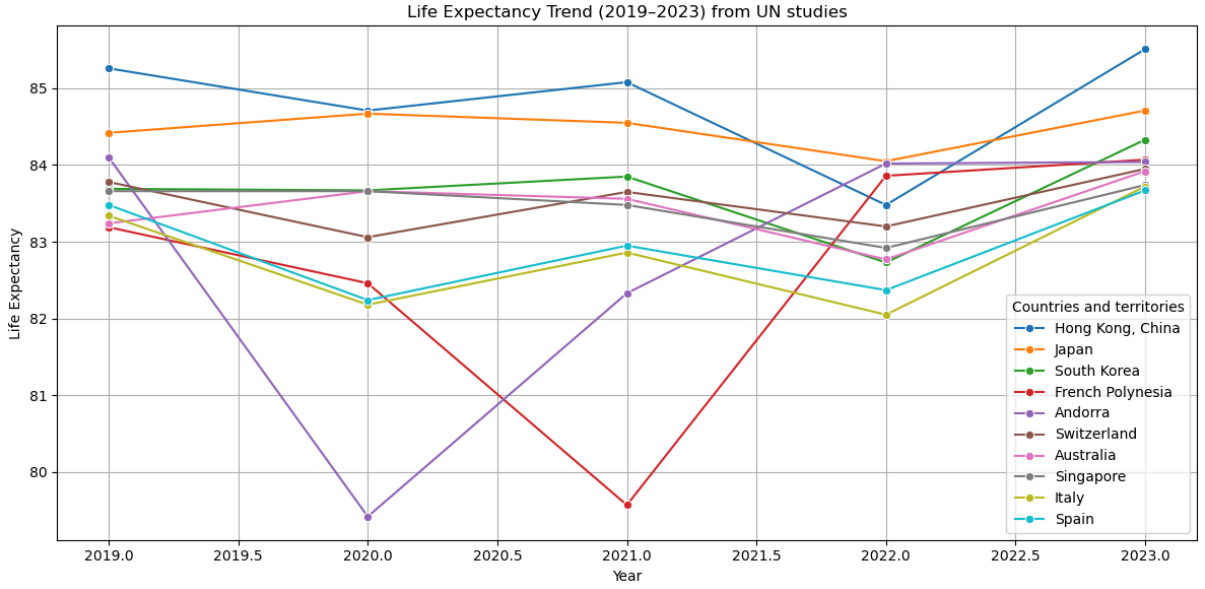
In [161…

```
top5_2023 = sh1[['Countries and territories', '2023']].sort_values(by='2023', ascend
print(top5_2023)
top5_names = pd.DataFrame(top5_2023['Countries and territories'].tolist())
print(top5_names)
```

```
  Countries and territories   2023
0          Hong Kong, China  85.51
1                     Japan  84.71
2               South Korea  84.33
3          French Polynesia  84.07
4                   Andorra  84.04
                  0
0  Hong Kong, China
1             Japan
2       South Korea
3  French Polynesia
4           Andorra
```

In [162…

```
years = ['2019', '2020', '2021', '2022', '2023']

# convert into Long Format
df_long = sh1.melt(id_vars=['Countries and territories'],
                   value_vars=years,
                   var_name='Year',
                   value_name='Life Expectancy')

# convert year into integet
df_long['Year'] = df_long['Year'].astype(int)

# the top 5 countries
top5 = sh1[['Countries and territories', '2023']].sort_values(by='2023', ascending=F
top5_names = top5['Countries and territories'].tolist()

df_top5 = df_long[df_long['Countries and territories'].isin(top5_names)]

# the time line
plt.figure(figsize=(12,6))
sns.lineplot(data=df_top5, x='Year', y='Life Expectancy', hue='Countries and territc
plt.title("Life Expectancy Trend (2019–2023) from UN studies")
plt.grid(True)
plt.tight_layout()
plt.show()
```



In [163…

```
## the countries with high recovery after COVID-19

Fully_Recovered_UN = sh1[sh1[ "Recovery from COVID-19: 2019:2023"]>np.mean(sh1[ "Rec
print(f"Countries with high recovery rates = {Fully_Recovered_UN[ "Recovery from COV
Fully_Recovered_UN[["Countries and territories","Recovery from COVID-19: 2019:2023"]
```

```
Countries with high recovery rates = 62 country
```

Out[163]:

	Countries and territories	Recovery from COVID-19: 2019:2023
10	Réunion	1.23
25	Bermuda	1.06
42	Maldives	1.33
47	Cayman Islands	1.31
53	Panama	1.08
...	...	...
205	Somalia	1.57
207	CAR	25.88
208	Lesotho	2.13
209	Chad	2.08
210	Nigeria	1.45

62 rows × 2 columns

In [164…

```
## the countries with low recovery after COVID-19

Not_Recovered_UN =sh1[sh1[ "Recovery from COVID-19: 2019:2023"]<np.mean(sh1[ "Recove
print(f"Countries with low recovery rates = {Not_Recovered_UN[ "Recovery from COVID-
Not_Recovered_UN[["Countries and territories","Recovery from COVID-19: 2019:2023"]]
```

```
Countries with low recovery rates = 149 country
```

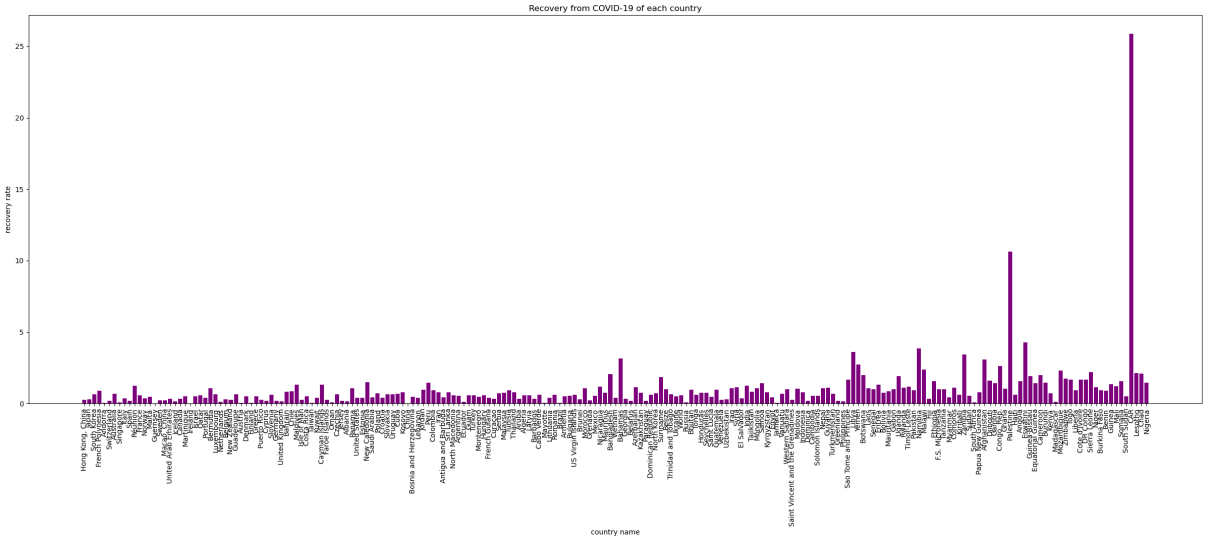
Out[164]:

	Countries and territories	Recovery from COVID-19: 2019:2023
0	Hong Kong, China	0.25
1	Japan	0.29
2	South Korea	0.64
3	French Polynesia	0.88
4	Andorra	0.06
...	...	...
192	Madagascar	0.13
196	Liberia	0.93
201	Burkina Faso	0.91
202	Benin	0.89
206	South Sudan	0.51

149 rows × 2 columns

In [165…

```
plt.figure(figsize=(30,10))
plt.bar(x=sh1["Countries and territories"] , height=sh1["Recovery from COVID-19: 201
plt.title("Recovery from COVID-19 of each country")
plt.xlabel("country name")
plt.ylabel("recovery rate")
plt.xticks(rotation=90)
plt.show()
```



In [166…
```
sh4= pd.read_excel(r"World Bank Group (2022).xlsx")
sh4
```

Out[166]:

	Countries and territories	All	Male	Female	Sex gap	2014	2014:2019	2019	2019:2020	2020	2020:2021
0	Hong Kong SAR, China	85.25	82.54	88.09	5.55	83.94	1.22	85.16	0.34	85.50	0.04
1	French Polynesia	84.07	81.78	86.50	4.73	82.15	1.04	83.19	0.74	82.46	2.89
2	Switzerland	84.06	82.30	85.90	3.60	83.20	0.71	83.90	0.90	83.00	0.75
3	Japan	84.04	81.09	87.14	6.05	83.59	0.77	84.36	0.20	84.56	0.11
4	Andorra	84.04	82.10	86.11	4.01	84.48	0.39	84.10	4.68	79.42	2.91
…	…	…	…	…	…	…	…	…	…	…	…
201	South Sudan	57.62	54.64	60.63	5.99	45.62	12.50	58.13	0.48	57.65	0.60
202	Central African Republic	57.41	55.26	59.29	4.03	40.27	8.73	31.53	19.07	50.60	10.32
203	Lesotho	57.38	54.62	60.01	5.39	50.79	4.46	55.25	0.12	55.13	0.92
204	Chad	55.07	53.20	57.01	3.82	51.14	1.85	52.99	0.09	53.08	0.05
205	Nigeria	54.46	54.18	54.74	0.57	51.94	1.07	53.01	0.06	53.07	0.38

206 rows × 17 columns

In [167…
```
## countries with the highest Wiggle from2019 to 2022
sh4["2014:2022"]= sh4["2014"] - sh4["2022"]
sh4[["Countries and territories","2014:2022"]]. sort_values(by=("2014:2022") , ascer
```

Out[167]:

	Countries and territories	2014:2022
202	Central African Republic	21.45
91	Brunei	1.94
19	United Arab Emirates	1.50
56	USA	1.41
46	Oman	1.12
105	Paraguay	1.10
92	North Macedonia	1.03
81	Thailand	0.99
42	Costa Rica	0.91
32	Cyprus	0.91

In [168…

```
## the countries with high recovery after COVID-19

Fully_Recovered_World_Bank_Group = sh4[sh4[ "recovery from COVID-19: 2019:2022"]>np.
print(f"Countries with high recovery rates = {Fully_Recovered_World_Bank_Group["recc
Fully_Recovered_World_Bank_Group[["Countries and territories","recovery from COVID-1
```

```
Countries with high recovery rates = 62 country
```

Out[168]:

	Countries and territories	recovery from COVID-19: 2019:2022
12	Kuwait	1.22
25	Bermuda	1.06
40	Maldives	1.33
45	Cayman Islands	1.31
49	Panama	1.08

In [169…

```
## the countries with low recovery after COVID-19

Not_Recovered_World_Bank_Group = sh4[sh4[ "recovery from COVID-19: 2019:2022"]<np.me
print(f"Countries with low recovery rates ={Not_Recovered_World_Bank_Group[ "recover
Not_Recovered_World_Bank_Group[["Countries and territories","recovery from COVID-19:
```

```
Countries with low recovery rates =144 country
```

Out[169]:

	Countries and territories	recovery from COVID-19: 2019:2022
0	Hong Kong SAR, China	0.09
1	French Polynesia	0.88
2	Switzerland	0.15
3	Japan	0.32
4	Andorra	0.06
...	...	...
187	Madagascar	0.13
191	Liberia	0.93
196	Burkina Faso	0.91
197	Benin	0.89
201	South Sudan	0.51

144 rows × 2 columns

In [170…

```
print("Countries with the largest sex gap according to World Bank Group studies :")
sh4[[ "Countries and territories","Sex gap" ]].sort_values(by=("Sex gap"),ascending
```

```
Countries with the largest sex gap according to World Bank Group studies :
```

Out[170]:

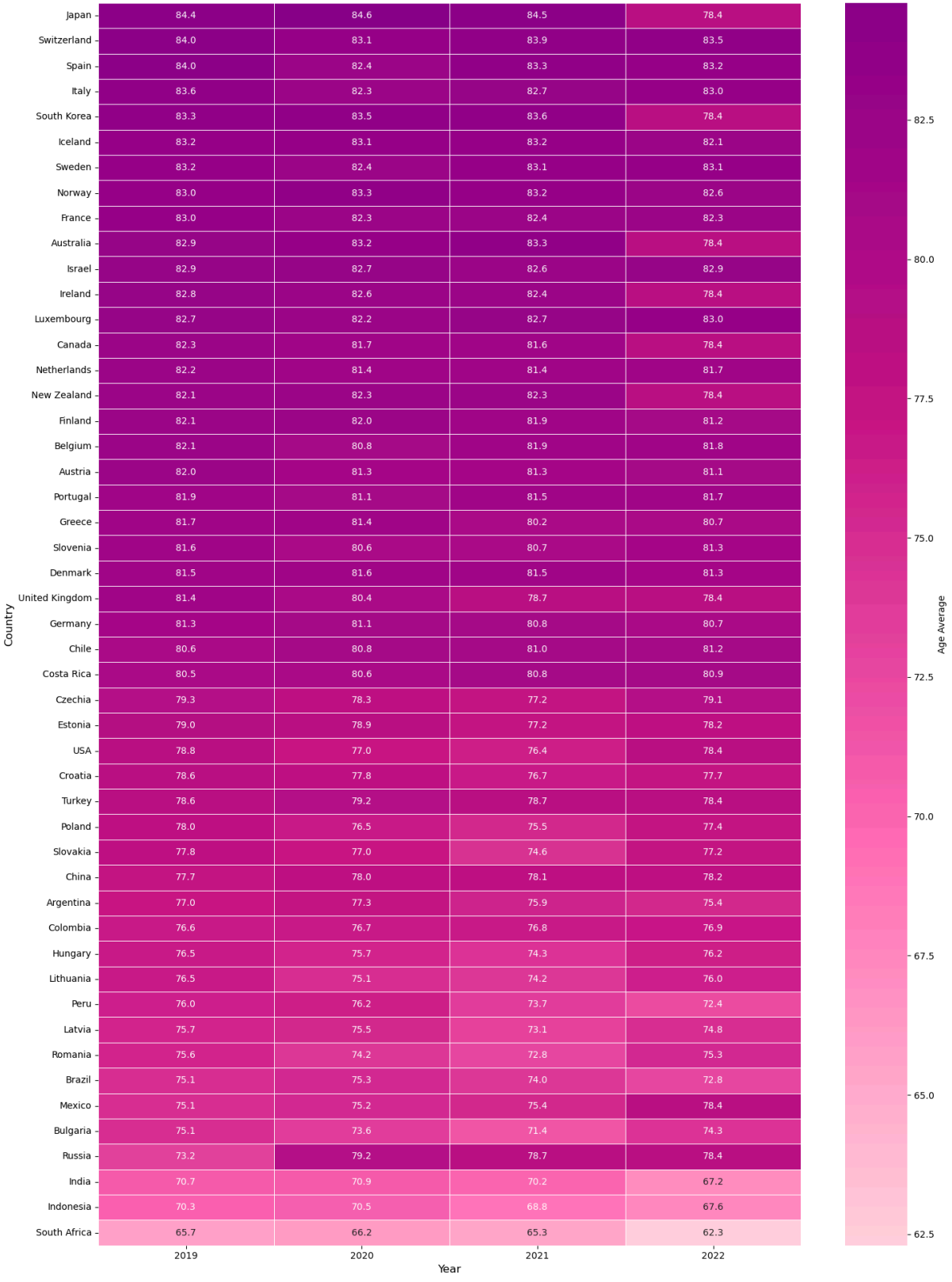
	Countries and territories	Sex gap
111	Ukraine	13.30
178	Palestine	11.81
114	Russia	10.69
90	Latvia	10.00
101	Georgia	9.54
104	Belarus	9.53
99	Vietnam	9.39
125	Mongolia	9.23
75	Lithuania	9.20
54	Estonia	9.00

Continue of Analysis

In [171…

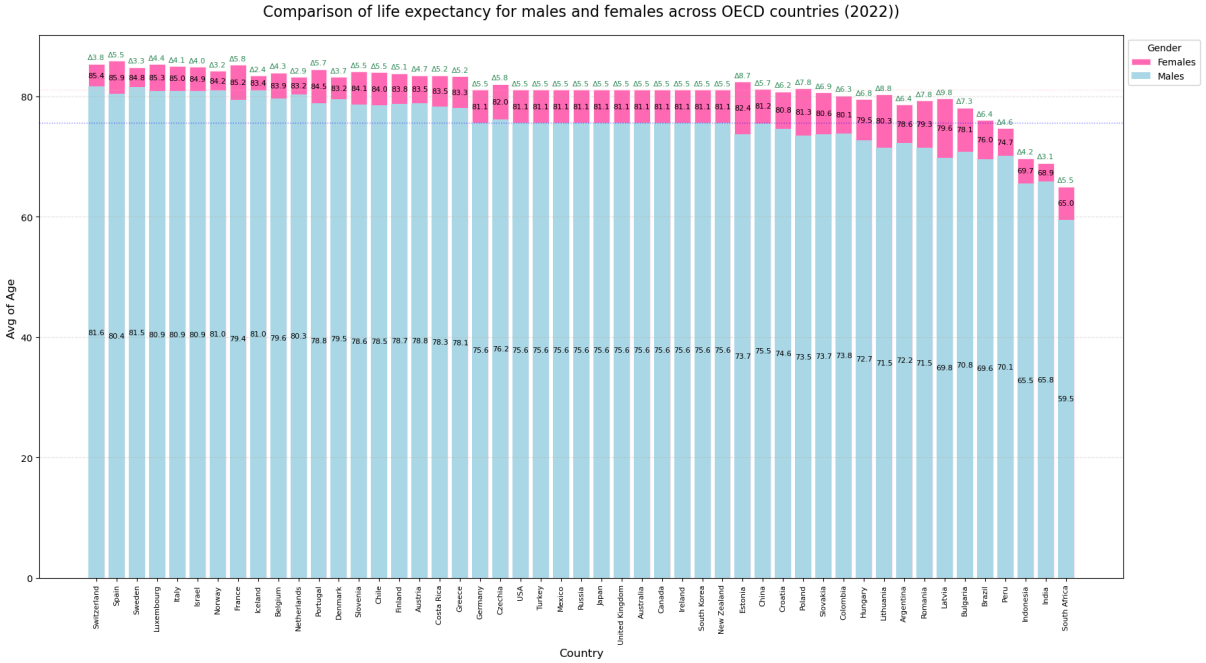
```
#(OECD sheet)
from matplotlib.colors import LinearSegmentedColormap
import plotly.express as px

# HeatMap to show the avg of ages of each country over years

df = pd.read_excel("OECD (2022).xlsx")
years = ['2019', '2020', '2021', '2022'] # select columns
data = df[['Country'] + years]
data.set_index('Country', inplace=True)
colors = ["#FFD1DC", "#FF69B4", "#C71585", "#8B008B"]  # create color pink
cmap = LinearSegmentedColormap.from_list("pink_gradient", colors)
plt.figure(figsize=(15, 20)) # create plot
sns.heatmap(data,
            annot=True,
            fmt=".1f",
            cmap=cmap,
            linewidths=0.5,
            cbar_kws={'label': 'Age Average'})
plt.title(' Aveg of Ages 2019->2022', fontsize=16, pad=20) # add titles
plt.xlabel('Year', fontsize=12)
plt.ylabel('Country', fontsize=12)
plt.xticks(fontsize=10)
plt.yticks(fontsize=10)
plt.tight_layout()
plt.show()
```

Aveg of Ages 2019->2022



In [172…

```
#Stacked bar plot for the gap between each gender
df_sorted = df.sort_values('2022overall', ascending=False) # arrange countries deper
countries = df_sorted['Country'].values
male = df_sorted['2022male'].values
female = df_sorted['2022female'].values
plt.figure(figsize=(18, 10)) # create plots

#create stacked bars
bars = plt.bar(countries, female, color='#FF69B4', label='Females')
plt.bar(countries, male, color='#ADD8E6', label='Males')
for bar in bars:# add lines
    bar.set_edgecolor('white')
    bar.set_linewidth(0.5)
for i, (m, f) in enumerate(zip(male, female)): # add values and values of gaps
    plt.text(i, m/2, f'{m:.1f}', ha='center', va='center', color='black', fontsize=8
    plt.text(i, m + (f-m)/2, f'{f:.1f}', ha='center', va='center', color='black', fc
    gap = f - m  #calculate gap
    plt.text(i, f + 0.5, f'Δ{gap:.1f}', ha='center', va='bottom', color='#2E8B57', f

plt.title('Comparison of life expectancy for males and females across OECD countries
plt.xlabel('Country', fontsize=12)
plt.ylabel('Avg of Age ', fontsize=12)
plt.xticks(rotation=90, fontsize=8)
plt.yticks(fontsize=10)
plt.grid(axis='y', linestyle='--', alpha=0.3)
plt.legend(title='Gender', bbox_to_anchor=(1, 1), loc='upper left')
avg_male = df['2022male'].mean() #line of mean of the year
avg_female = df['2022female'].mean()
plt.axhline(avg_male, color='blue', linestyle=':', linewidth=1, alpha=0.5)
plt.axhline(avg_female, color='pink', linestyle=':', linewidth=1, alpha=0.5)
plt.tight_layout()
plt.show()
```

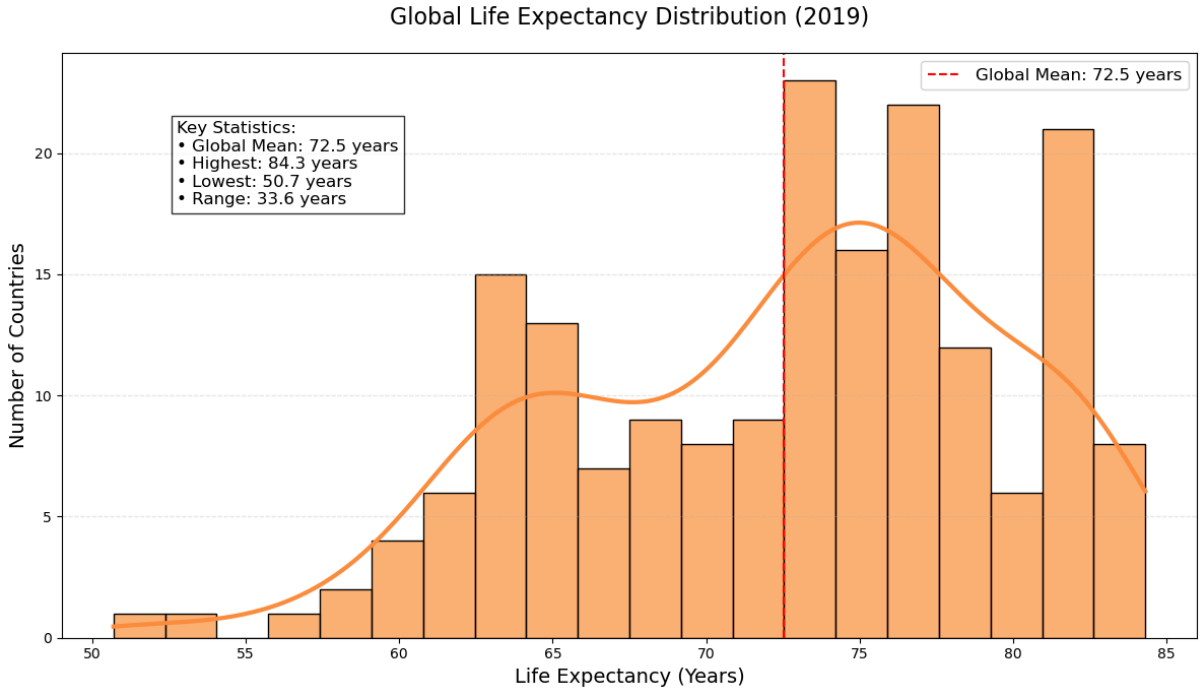


In [173…

```
# analysis on (World Health Organization table)
# create a world map to show the countries of best health care and the worst
df = pd.read_excel("World Health Organization (2019).xlsx")
df_clean = df.dropna(subset=['All']).copy()
df_clean = df_clean.rename(columns={'Countries': 'Country'})
orange_palette = ["#FFF5EB", "#FEE6CE", "#FDD0A2", "#FDAE6B", "#FD8D3C", "#F16913",
fig = px.choropleth(df_clean,
                    locations="Country",
                    locationmode="country names",
                    color="All",
                    hover_name="Country",
                    hover_data=["All", "Δ2000"],
                    color_continuous_scale=orange_palette,
                    range_color=(50, 85),
                    title="<b>(2019) خريطة متوسط العمر العالمي</b><br><sup>(غامق) إلى الأعلى (ج
                    labels={'All': 'متوسط العمر'})
fig.update_layout(geo=dict(showframe=False,
                           showcoastlines=True,
                           projection_type='natural earth'),
                  margin=dict(l=0, r=0, t=50, b=0))
fig.show()
```

In [174…

```
# histogram to show the distribution of avg of ages
df_clean = df.rename(columns={'Countries': 'Country'}).dropna(subset=['All'])
plt.figure(figsize=(12, 7))
# Plot distribution with KDE
ax = sns.histplot(data=df_clean, x='All', bins=20,
                  kde=True, color='#FD8D3C',
                  alpha=0.7, line_kws={'lw': 3})
global_mean = df_clean['All'].mean() # add line of global mean
plt.axvline(global_mean, color='red', linestyle='--',
           label=f'Global Mean: {global_mean:.1f} years')
plt.title('Global Life Expectancy Distribution (2019)', fontsize=16, pad=20)
plt.xlabel('Life Expectancy (Years)', fontsize=14)
plt.ylabel('Number of Countries', fontsize=14)
plt.legend(fontsize=12)
plt.grid(axis='y', linestyle='--', alpha=0.3)
# Add statistics box
stats_text = f"""Key Statistics:
• Global Mean: {global_mean:.1f} years
• Highest: {df_clean['All'].max():.1f} years
• Lowest: {df_clean['All'].min():.1f} years
• Range: {df_clean['All'].max()-df_clean['All'].min():.1f} years"""
plt.gcf().text(0.15, 0.7, stats_text,
              bbox=dict(facecolor='white', alpha=0.8),
              fontsize=12)
plt.tight_layout()
plt.show()
```



Start making relationships between the tables

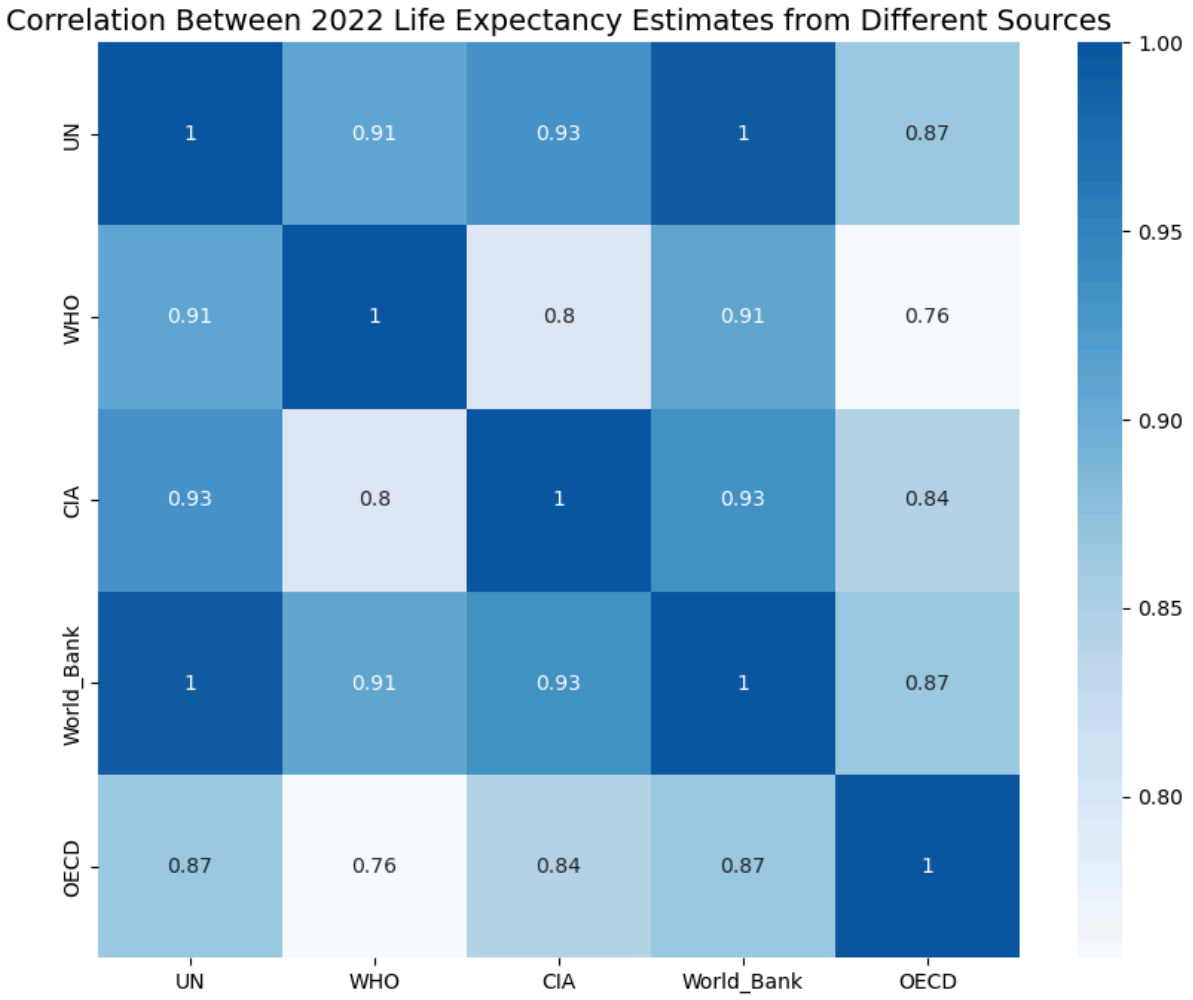
In [175…

```
# Merging 2022 Life Expectancy Data from Multiple Sources (UN, WHO, CIA, World Bank,

# Rename columns for each source and prepare the 2022 data
un_2022 = sh1[['Countries and territories', '2022']].rename(columns={'Countries and
who_2022 = sh2[['Countries', 'All.2']].rename(columns={'Countries': 'Country', 'All.
cia_2022 = sh3[[sh3.columns[0], sh3.columns[1]]].rename(columns={sh3.columns[0]: 'Co
wb_2022 = sh4[['Countries and territories', '2022']].rename(columns={'Countries and
oecd_2022 = sh6[['Country', '2022']].rename(columns={'2022': 'OECD'})

# Merge all data sources on Country column
all_2022 = un_2022
for df in [who_2022, cia_2022, wb_2022, oecd_2022]:
    all_2022 = pd.merge(all_2022, df, on='Country', how='outer')

# Drop rows with any missing values
all_2022 = all_2022.dropna()

print("2022 data from all sources: ")
print(all_2022.head(10))
```

```
2022 data from all sources:
       Country     UN   WHO    CIA  World_Bank       OECD
8    Argentina  75.81  21.1  78.31       75.81  75.400000
11   Australia  82.77  25.6  83.09       83.20  78.376316
12     Austria  81.30  24.1  82.27       81.30  81.100000
19     Belgium  81.16  24.0  81.86       81.75  81.800000
27      Brazil  74.87  21.9  75.92       74.87  72.800000
31    Bulgaria  74.03  19.8  75.57       74.16  74.300000
39      Canada  81.25  25.2  83.80       81.25  78.376316
45       Chile  79.18  24.3  79.79       79.18  81.200000
47    Colombia  76.51  24.0  74.89       76.51  76.900000
53  Costa Rica  79.32  25.0  79.64       79.32  80.900000
```

In [176…

```
# heatmap shows the degree of correlation between different sources reporting 2022 l

# Drop rows with too many missing values && keep rows with at least all but 2 columr
clean_2022 = all_2022.dropna(thresh=len(all_2022.columns) - 2)

# Create a correlation matrix between numeric columns
corr_matrix = clean_2022.drop('Country', axis=1).corr()

# Plot the heatmap showing correlations between life expectancy estimates
plt.figure(figsize=(10, 8))
sns.heatmap(corr_matrix, annot=True, cmap='Blues', center=0.9)
plt.title('Correlation Between 2022 Life Expectancy Estimates from Different Sources
plt.show()
```



In [177…

```
# Filtering Countries with High Recovery Rates in Life Expectancy and Checking for F

# Merge data from two sources on country names
merged_data = pd.merge(
    sh1[['Countries and territories', '2019', '2023', 'Recovery from COVID-19: 2019:
    sh4[['Countries and territories', '2019', 'recovery from COVID-19: 2019:2022']],
    on='Countries and territories',
    how='inner'
)

# Filter countries with high recovery in life expectancy , more than 90%
high_recovery = merged_data[merged_data['Recovery from COVID-19: 2019:2023'] > 0.9]

# Add a boolean column indicating if 2023 life expectancy reached or surpassed 2019
high_recovery['Recovered_to_2019_or_higher'] = high_recovery['2023'] >= high_recover

high_recovery[['Countries and territories', '2019_x', '2023',
               'Recovery from COVID-19: 2019:2023', 'Recovered_to_2019_or_higher']]
```

```
C:\Users\original\AppData\Local\Temp\ipykernel_3912\2658718187.py:15: SettingWithCo
pyWarning:


A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/
user_guide/indexing.html#returning-a-view-versus-a-copy
```

Out[177]:

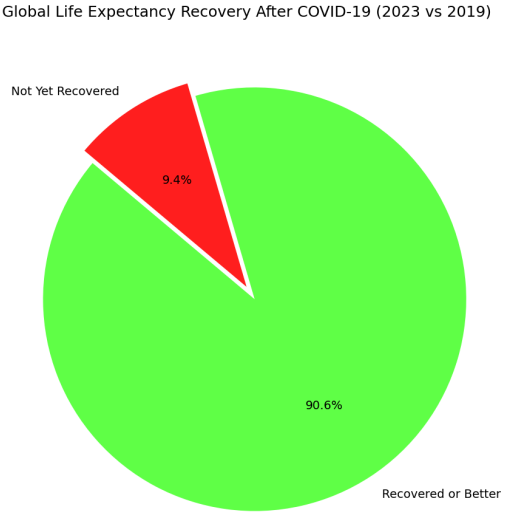
	Countries and territories	2019_x	2023	Recovery from COVID-19: 2019:2023	Recovered_to_2019_or_higher
20	Bermuda	81.25	82.31	1.06	True
36	Maldives	79.71	81.04	1.33	True
40	Cayman Islands	79.05	80.36	1.31	True
45	Panama	78.51	79.59	1.08	True
47	New Caledonia	77.26	78.77	1.50	True
...	...	...	...	...	...
186	Mali	59.22	60.44	1.22	True
187	Somalia	57.25	58.82	1.57	True
189	Lesotho	55.25	57.38	2.13	True
190	Chad	52.99	55.07	2.08	True
191	Nigeria	53.01	54.46	1.45	True

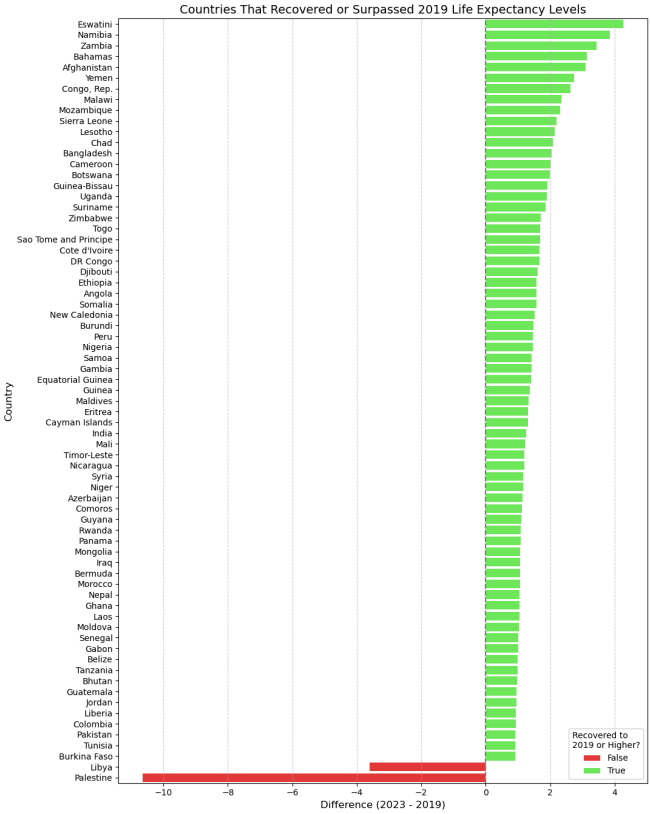
71 rows × 5 columns

In [178…

```
# Create subplots for pie chart and bar chart
fig, ax = plt.subplots(1, 2, figsize=(20, 14))

# Classify countries based on they've recovered to 2019 levels or not
recovered_countries = merged_data[merged_data['2023'] >= merged_data['2019_x']]
not_recovered_countries = merged_data[merged_data['2023'] < merged_data['2019_x']]

# Calculate the percentage of recovered countries
total = len(merged_data)
recovered_pct = (len(recovered_countries) / total) * 100
not_recovered_pct = 100 - recovered_pct

# Set the overall figure title
fig.suptitle("Global Life Expectancy Recovery After COVID-19", fontsize=22, fontweig

# Pie Chart: Show proportion of recovered vs not recovered countries
labels = ['Recovered or Better', 'Not Yet Recovered']
sizes = [recovered_pct, not_recovered_pct]
colors = ['#60ff47', '#ff1f1f']
explode = (0.07, 0)  # Slightly explode the recovered slice

ax[0].pie(
    sizes,
    explode=explode,
    labels=labels,
    colors=colors,
    autopct='%1.1f%%',
    startangle=140,
    textprops={'fontsize': 14}
)
ax[0].set_title("Global Life Expectancy Recovery After COVID-19 (2023 vs 2019)", for

# Bar Chart: Show countries and how much they recovered or not
plot_data = high_recovery.copy()
plot_data['Difference'] = plot_data['2023'] - plot_data['2019_x']
plot_data = plot_data.sort_values(by='Difference', ascending=False)

sns.barplot(
    data=plot_data,
    x='Difference',
    y='Countries and territories',
    hue='Recovered_to_2019_or_higher',
    dodge=False,
    palette={True: '#60ff47', False: '#ff1f1f'},
    ax=ax[1]
)

ax[1].set_title("Countries That Recovered or Surpassed 2019 Life Expectancy Levels",
ax[1].set_xlabel('Difference (2023 - 2019)', fontsize=12)
ax[1].set_ylabel('Country', fontsize=12)
ax[1].axvline(0, color='gray', linestyle='--')
ax[1].legend(title='Recovered to \n2019 or Higher?', loc='lower right')
ax[1].grid(True, axis='x', linestyle='--', alpha=0.6)

plt.tight_layout()
plt.show()
```

Global Life Expectancy Recovery After COVID-19

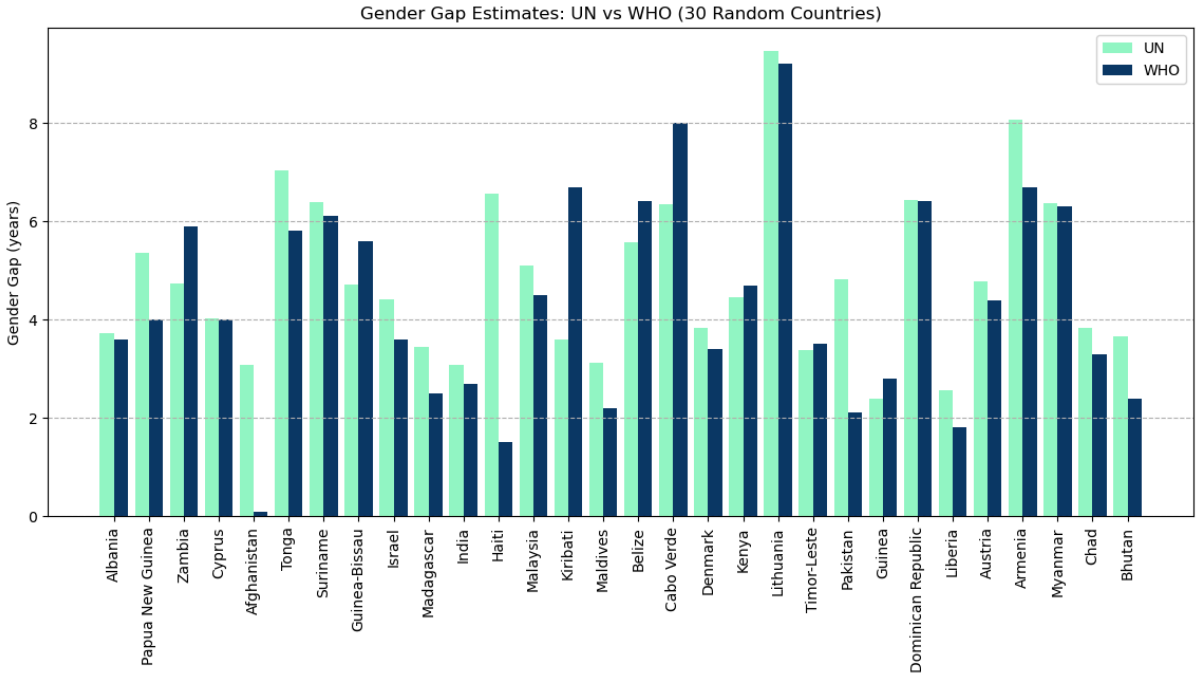




In [179…

```
# Comparing Gender Gap Estimates in Life Expectancy from UN and WHO Across 30 Random

# Extract the common countries between the two datasets
common_countries = set(sh1['Countries and territories']).intersection(set(sh2['Count
common_countries = sorted(common_countries)

# Extract the sex gap values from both UN and WHO datasets for common countries
results = []
for country in common_countries:
    un_gap = sh1.loc[sh1['Countries and territories'] == country, 'Sex gap'].values[
    who_gap = sh2.loc[sh2['Countries'] == country, 'FΔM'].values[0]
    results.append({'Country': country, 'UN (Sex gap)': un_gap, 'WHO (FΔM)': who_gap

#Convert it into a DataFrame
df = pd.DataFrame(results)

#Select a random sample of 30 countries for visualization
random_gap = df.sample(30)
print(random_gap[['Country', 'UN (Sex gap)', 'WHO (FΔM)']])

plt.figure(figsize=(14, 6))
x = np.arange(len(random_gap['Country']))

# Bar plot for UN data
plt.bar(x - 0.2, random_gap['UN (Sex gap)'], 0.4, label='UN', color='#95f9c3')

# Bar plot for WHO data
plt.bar(x + 0.2, random_gap['WHO (FΔM)'], 0.4, label='WHO', color='#0b3866')

# Customize x-axis
plt.xticks(x, random_gap['Country'], rotation=90)

# Add title and labels
plt.title('Gender Gap Estimates: UN vs WHO (30 Random Countries)')
plt.ylabel('Gender Gap (years)')

# Add legend and grid
plt.legend()
plt.grid(axis='y', linestyle='--')

plt.show()
```

	Country	UN (Sex gap)	WHO (FΔM)
1	Albania	3.72	3.6
119	Papua New Guinea	5.35	4.0
173	Zambia	4.74	5.9
38	Cyprus	4.03	4.0
0	Afghanistan	3.07	0.1
158	Tonga	7.04	5.8
149	Suriname	6.38	6.1
62	Guinea-Bissau	4.71	5.6
73	Israel	4.41	3.6
91	Madagascar	3.44	2.5
68	India	3.08	2.7
64	Haiti	6.57	1.5
93	Malaysia	5.10	4.5
80	Kiribati	3.59	6.7
94	Maldives	3.13	2.2
16	Belize	5.57	6.4
26	Cabo Verde	6.35	8.0
39	Denmark	3.84	3.4
79	Kenya	4.46	4.7
89	Lithuania	9.46	9.2
156	Timor-Leste	3.37	3.5
117	Pakistan	4.83	2.1
61	Guinea	2.38	2.8
41	Dominican Republic	6.44	6.4
87	Liberia	2.57	1.8
8	Austria	4.78	4.4
6	Armenia	8.07	6.7
105	Myanmar	6.37	6.3
30	Chad	3.82	3.3
18	Bhutan	3.66	2.4



In [180…

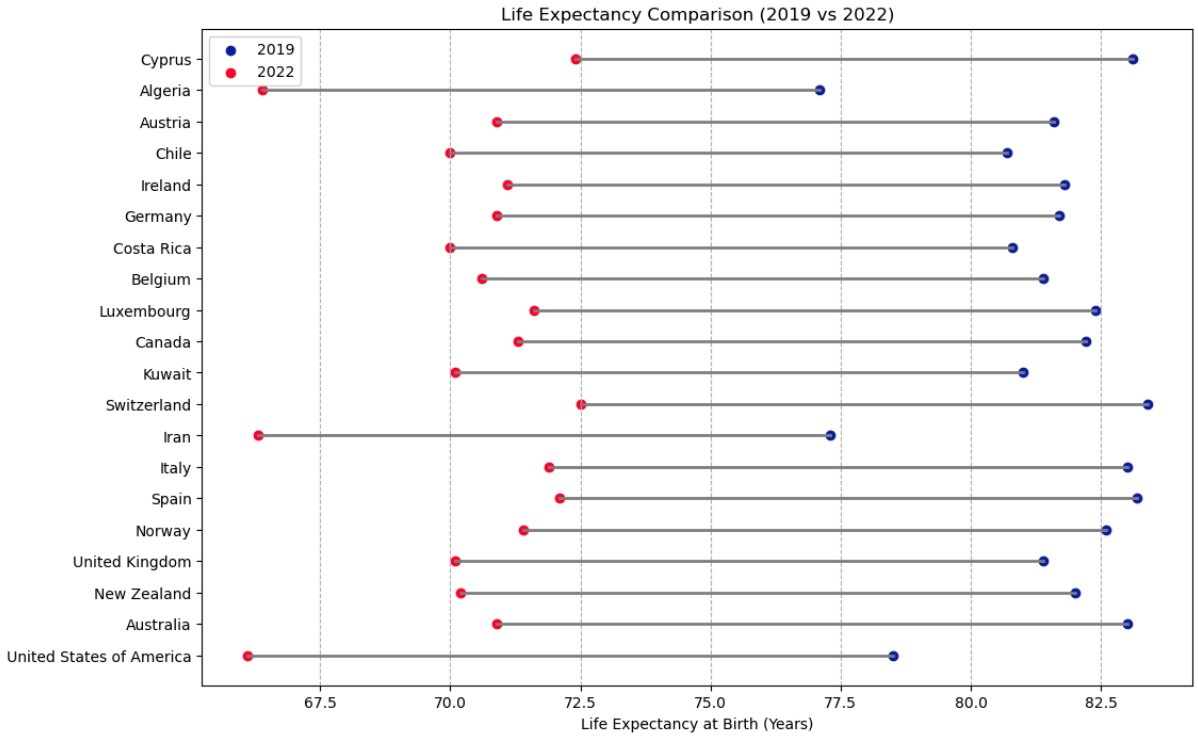
```
#Calculating and Ranking the Countries Most Affected by COVID-19 in Terms of Life Ex

# Select and rename relevant columns from the dataframe
covid_impact = sh2[['Countries', 'All', 'All.1']].rename(
    columns={
        'All': 'At_Birth_2019',
        'All.1': 'At_Birth_2022'
    }
)

# Calculate the decline in life expectancy between 2019 and 2022
covid_impact['Decline'] = covid_impact['At_Birth_2019'] - covid_impact['At_Birth_202

# Sort countries by the amount of decline (highest first) and select top 20
top_decline = covid_impact.sort_values('Decline', ascending=False).head(20)

# Display it
top_decline.sort_values('Decline', ascending=False).head(20)
```

Out[180]:

	Countries	At_Birth_2019	At_Birth_2022	Decline
39	United States of America	78.5	66.1	12.4
7	Australia	83.0	70.9	12.1
15	New Zealand	82.0	70.2	11.8
24	United Kingdom	81.4	70.1	11.3
9	Norway	82.6	71.4	11.2
4	Spain	83.2	72.1	11.1
6	Italy	83.0	71.9	11.1
48	Iran	77.3	66.3	11.0
28	Kuwait	81.0	70.1	10.9
14	Canada	82.2	71.3	10.9
1	Switzerland	83.4	72.5	10.9
12	Luxembourg	82.4	71.6	10.8
23	Belgium	81.4	70.6	10.8
29	Costa Rica	80.8	70.0	10.8
19	Germany	81.7	70.9	10.8
18	Ireland	81.8	71.1	10.7
30	Chile	80.7	70.0	10.7
22	Austria	81.6	70.9	10.7
51	Algeria	77.1	66.4	10.7
5	Cyprus	83.1	72.4	10.7

In [181…

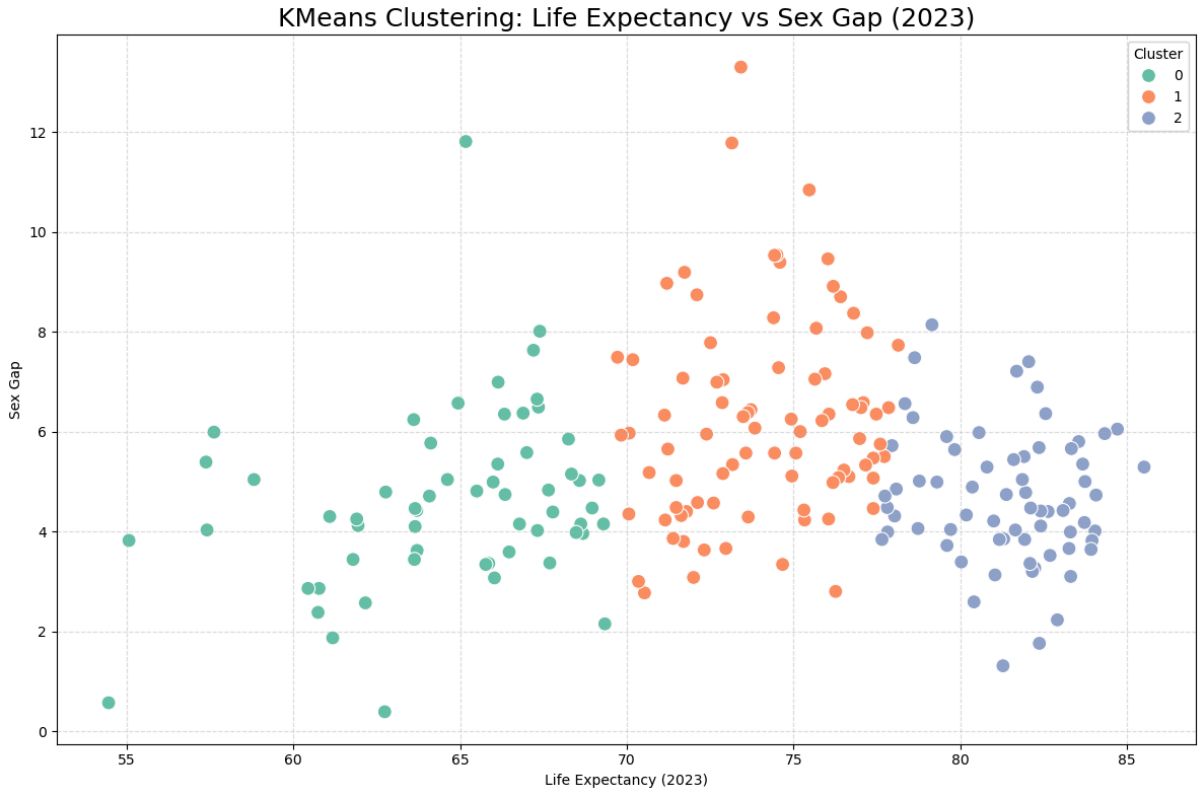
```
# Visualizing the Largest Declines in Life Expectancy at Birth (2019 vs 2022)

plt.figure(figsize=(12, 8))
for i in range(len(top_decline)):
    plt.plot([top_decline['At_Birth_2019'].iloc[i], top_decline['At_Birth_2022'].ilc
    plt.scatter(top_decline['At_Birth_2019'].iloc[i], i, color='#0d21a1', label='201
    plt.scatter(top_decline['At_Birth_2022'].iloc[i], i, color='#ff002b', label='202
# Set y-axis labels to country names
plt.yticks(range(len(top_decline)), top_decline['Countries'])
plt.xlabel('Life Expectancy at Birth (Years)')
plt.title('Life Expectancy Comparison (2019 vs 2022)')
plt.grid(axis='x', linestyle='--')
plt.legend()
plt.show()
```



In [182…

```
# Clustering Countries Based on Life Expectancy, COVID-19 Recovery, and Sex Gap (KMe

cluster_data = sh1[['2023', 'Recovery from COVID-19: 2019:2023', 'Sex gap']]
kmeans = KMeans(n_clusters=3)
# Visualize the clusters
sh1['Cluster'] = kmeans.fit_predict(cluster_data)
plt.figure(figsize=(12, 8))
sns.scatterplot(data=sh1, x='2023', y='Sex gap', hue='Cluster', palette='Set2', s=10
plt.title('KMeans Clustering: Life Expectancy vs Sex Gap (2023)', fontsize=18)
plt.xlabel('Life Expectancy (2023)')
plt.ylabel('Sex Gap')
plt.grid(True, linestyle='--', alpha=0.4)
plt.legend(title='Cluster')
plt.tight_layout()
plt.show()
# Group countries by cluster and display the results
clusters = sh1[['Countries and territories', 'Cluster']]
cluster_groups = clusters.groupby('Cluster')['Countries and territories'].apply(list

cluster_df = pd.DataFrame({f'Cluster {i}': pd.Series(countries)
                           for i, countries in cluster_groups.items()})
display(cluster_df)
```

```
C:\Users\original\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: User
Warning:

KMeans is known to have a memory leak on Windows with MKL, when there are less chun
ks than available threads. You can avoid it by setting the environment variable OMP
_NUM_THREADS=1.
```



	Cluster 0	Cluster 1	Cluster 2
0	Libya	Uruguay	Hong Kong, China
1	Yemen	Bosnia and Herzegovina	Japan
2	Botswana	Colombia	South Korea
3	Laos	Antigua and Barbuda	French Polynesia
4	Senegal	Sri Lanka	Andorra
...	...	...	...
79	NaN	Guyana	NaN
80	NaN	Turkmenistan	NaN
81	NaN	Greenland	NaN
82	NaN	Philippines	NaN
83	NaN	Sao Tome and Principe	NaN

84 rows × 3 columns

Store the result into MongoDB

In [184…
```
t1=pd.read_excel(r"Change of life expectancy from 2019 to 2023.xlsx", header=0)
t2=pd.read_excel(r"World Health Organization (2019).xlsx", header=0)
t3=pd.read_excel(r"CIA World Factbook (2022).xlsx", header=0)
t4=pd.read_excel(r"World Bank Group (2022).xlsx", header=0)
t5=pd.read_excel(r"Estimate of life expectancy for various ages in 2023.xlsx", heade
t6=pd.read_excel(r"OECD (2022).xlsx", header=0)
```

In [99]:
```
pip install pymongo
```

```
Requirement already satisfied: pymongo in c:\users\original\anaconda3\lib\site-pack
ages (4.12.0)
Requirement already satisfied: dnspython<3.0.0,>=1.16.0 in c:\users\original\anacon
da3\lib\site-packages (from pymongo) (2.7.0)
Note: you may need to restart the kernel to use updated packages.
```

In [187…

```
# Import required modules
from pymongo import MongoClient
from pymongo.errors import ConnectionFailure, BulkWriteError

try:

    # Local MongoDB connection
    client = MongoClient("mongodb://localhost:27017/", serverSelectionTimeoutMS=5000
    db = client["LifeExpectancyDB"]

    # Test connection by sending a ping
    client.admin.command('ping')
    print("Successfully connected to MongoDB.")

    # List of tables to store with their collection names
    tables = [
        (t1, "Change from 2019 to 2023"),
        (t2, "World Health Organization (2019)"),
        (t3, "CIA World Factbook (2022)"),
        (t4, "World Bank Group (2022)"),
        (t5, "Estimate of life expectancy for various ages in 2023"),
        (t6, "OECD (2022)")
    ]

    # Loop through each table and store in MongoDB
    for df, name in tables:
        try:
            # Convert column names to strings to ensure compatibility
            df.columns = df.columns.map(str)

            # Convert DataFrame to dictionary records
            data = df.to_dict("records")

            # Get or create the collection
            collection = db[name]

            # Insert all records into MongoDB
            collection.insert_many(data)
            print(f"Stored {len(data)} records in collection: {name}")

        except BulkWriteError as e:

            # Handle bulk write errors
            print(f"Error inserting data into {name}: {e.details['writeErrors']}")

        except Exception as e:

            # Handle any other unexpected errors
            print(f"Unexpected error with {name}: {str(e)}")

except ConnectionFailure as e:

    # Handle connection failures
    print(f"Could not connect to MongoDB: {str(e)}")

except Exception as e:

    # Handle any other unexpected errors
    print(f"Unexpected error: {str(e)}")

finally:
```

```
    # Ensure connection is closed even if errors occur
    client.close()
```

```
Successfully connected to MongoDB.
Stored 211 records in collection: Change from 2019 to 2023
Stored 184 records in collection: World Health Organization (2019)
Stored 228 records in collection: CIA World Factbook (2022)
Stored 206 records in collection: World Bank Group (2022)
Stored 211 records in collection: Estimate of life expectancy for various ages in 2
023
Stored 49 records in collection: OECD (2022)
```