```python
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import plotly.graph_objects as go
import warnings
warnings.filterwarnings("ignore")

df=pd.read_csv('Downloads/Dataset-3/
API_AG.YLD.CREL.KG_DS2_en_csv_v2_5734359.csv',skiprows=4)
pd.set_option('display.max_columns', None)

df
```

```
                    Country Name Country Code
Indicator Name  \
0                          Aruba          ABW  Cereal yield (kg per
hectare)
1     Africa Eastern and Southern       AFE  Cereal yield (kg per
hectare)
2                    Afghanistan          AFG  Cereal yield (kg per
hectare)
3     Africa Western and Central       AFW  Cereal yield (kg per
hectare)
4                         Angola          AGO  Cereal yield (kg per
hectare)
..                           ...          ...
...
261                       Kosovo          XKX  Cereal yield (kg per
hectare)
262                 Yemen, Rep.          YEM  Cereal yield (kg per
hectare)
263                South Africa          ZAF  Cereal yield (kg per
hectare)
264                      Zambia          ZMB  Cereal yield (kg per
hectare)
265                    Zimbabwe          ZWE  Cereal yield (kg per
hectare)

      Indicator Code  1960        1961         1962         1963
1964  \
0    AG.YLD.CREL.KG   NaN         NaN          NaN          NaN
NaN
1    AG.YLD.CREL.KG   NaN    924.111737   931.506715   934.015106
879.750864
2    AG.YLD.CREL.KG   NaN   1115.100000  1079.000000   985.800000
1082.800000
3    AG.YLD.CREL.KG   NaN    675.354816   702.244456   698.032526
691.134187
4    AG.YLD.CREL.KG   NaN    828.000000   830.300000   798.400000
875.800000
```

```
..              ...    ...           ...           ...           ...
...
261  AG.YLD.CREL.KG    NaN           NaN           NaN           NaN
NaN
262  AG.YLD.CREL.KG    NaN    782.500000    780.700000    771.800000
776.100000
263  AG.YLD.CREL.KG    NaN   1099.100000   1142.100000   1128.000000
913.900000
264  AG.YLD.CREL.KG    NaN    822.200000    801.400000    706.900000
788.900000
265  AG.YLD.CREL.KG    NaN    919.700000    905.900000    822.500000
820.500000

              1965          1966          1967          1968
1969   \
0              NaN           NaN           NaN           NaN           NaN

1       869.584522    879.866016   1114.832401    898.701754    939.727379

2      1098.900000   1012.300000   1224.500000   1287.500000   1310.400000

3       658.343442    643.872508    684.305251    666.783773    654.672297

4       932.000000    824.300000    814.600000    805.700000    898.900000

..              ...           ...           ...           ...           ...

261             NaN           NaN           NaN           NaN           NaN

262      773.600000    777.000000    794.200000    793.600000    810.200000

263      911.400000   1010.400000   1725.600000   1006.000000   1041.100000

264      823.500000    878.000000    869.600000    785.200000    774.000000

265      930.800000    937.800000   1294.500000   1020.200000   1145.300000

              1970          1971          1972          1973
1974   \
0              NaN           NaN           NaN           NaN           NaN

1       948.875277   1071.235978   1109.947359    934.093597   1172.235204

2      1105.100000    976.200000   1006.900000   1279.600000   1301.900000

3       691.007034    692.217958    639.250116    643.442962    829.809827

4       911.300000    805.700000    780.300000    764.000000    712.600000

..              ...           ...           ...           ...           ...
```

261	NaN	NaN	NaN	NaN	NaN
262	780.800000	853.700000	787.100000	843.700000	799.800000
263	1187.000000	1498.200000	1593.900000	1007.500000	1875.800000
264	624.400000	876.300000	1007.100000	838.700000	967.700000
265	942.300000	1391.900000	1637.000000	961.300000	1485.500000

	1975	1976	1977	1978	1979 \
0	NaN	NaN	NaN	NaN	NaN
1	1145.856206	1152.636595	1210.787749	1204.166972	1163.160711
2	1316.400000	1362.400000	1224.000000	1291.900000	1323.700000
3	818.881204	691.397061	744.443096	777.074924	788.769830
4	773.900000	775.500000	603.100000	667.100000	509.200000
..	...	...	...	...	...
261	NaN	NaN	NaN	NaN	NaN
262	951.000000	823.200000	883.300000	956.500000	997.300000
263	1624.400000	1391.500000	1752.000000	1876.200000	1609.600000
264	1311.100000	1375.700000	1504.700000	1515.400000	1529.100000
265	1360.200000	1394.100000	1475.900000	1378.900000	1144.200000

	1980	1981	1982	1983	1984 \
0	NaN	NaN	NaN	NaN	NaN
1	1249.357753	1424.456923	1174.466303	1011.588120	955.877752
2	1349.000000	1338.300000	1330.200000	1355.600000	1334.100000
3	806.518354	947.038376	928.138782	884.168968	879.971652
4	617.900000	451.100000	450.600000	484.600000	466.000000
..	...	...	...	...	...
261	NaN	NaN	NaN	NaN	NaN

262	1016.500000	1099.000000	961.400000	526.400000	533.100000
263	2017.300000	2680.300000	1659.800000	960.200000	1083.900000
264	1567.500000	1930.600000	1572.100000	1651.200000	1646.100000
265	1186.100000	1749.600000	1139.600000	633.600000	790.400000

	1985	1986	1987	1988	1989 \
0	NaN	NaN	NaN	NaN	NaN
1	1128.351128	1131.606141	1115.385583	1175.534875	1289.994937
2	1331.700000	1314.000000	1359.800000	1285.700000	1237.600000
3	958.694722	950.656788	944.714113	1005.191079	964.380631
4	449.100000	379.800000	381.200000	332.400000	277.400000
..	...	...	...	...	...
261	NaN	NaN	NaN	NaN	NaN
262	518.300000	804.000000	840.200000	970.500000	1005.000000
263	1575.900000	1589.400000	1628.700000	1671.500000	2281.900000
264	1842.800000	1930.600000	1610.300000	2457.400000	1717.300000
265	1868.800000	1694.300000	853.800000	1591.400000	1509.600000

	1990	1991	1992	1993	1994 \
0	NaN	NaN	NaN	NaN	NaN
1	1251.759818	1219.500386	904.475438	1259.234733	1156.659252
2	1200.600000	1160.400000	1097.800000	1132.900000	1140.400000
3	875.010968	918.348590	907.545476	928.994807	902.460919
4	320.900000	417.500000	397.100000	268.000000	298.400000
..	...	...	...	...	...
261	NaN	NaN	NaN	NaN	NaN
262	907.700000	699.700000	1110.300000	1109.300000	1091.600000

263	1877.300000	1986.100000	944.700000	2160.100000	2585.000000
264	1351.900000	1640.600000	763.100000	2302.900000	1417.500000
265	1625.400000	1336.000000	412.100000	1502.000000	1134.500000

	1995	1996	1997	1998	1999 \
0	NaN	NaN	NaN	NaN	NaN
1	1026.064988	1266.686048	1127.372993	1144.539675	1194.561288
2	1214.500000	1204.400000	1348.800000	1388.000000	1285.700000
3	962.049581	987.244047	966.849057	998.367950	1032.232193
4	401.500000	653.100000	567.400000	701.600000	620.400000
..	...	...	...	...	...
261	NaN	NaN	NaN	NaN	NaN
262	1105.000000	937.100000	895.400000	1081.500000	1111.200000
263	1419.200000	2490.200000	2271.800000	2181.700000	2191.400000
264	1331.400000	1911.700000	1413.400000	1211.200000	1323.600000
265	548.200000	1258.700000	1054.200000	1016.600000	1069.000000

	2000	2001	2002	2003	2004 \
0	NaN	NaN	NaN	NaN	NaN
1	1292.940827	1262.516195	1264.754676	1150.277792	1296.359914
2	806.300000	1006.700000	1669.800000	1458.000000	1334.800000
3	971.626509	1001.998260	1011.113025	1075.369185	1089.556369
4	564.400000	585.400000	627.200000	646.100000	491.700000
..	...	...	...	...	...
261	NaN	NaN	NaN	NaN	NaN
262	1085.000000	1064.300000	943.800000	785.200000	715.200000
263	2765.900000	2424.100000	2772.600000	2536.800000	2777.900000

264	1682.300000	1403.700000	1629.600000	1721.200000	1825.300000
265	1159.500000	1193.900000	539.100000	795.300000	1205.900000

	2005	2006	2007	2008	2009 \
0	NaN	NaN	NaN	NaN	NaN
1	1173.906294	1295.647119	1325.012891	1348.157815	1425.771203
2	1790.400000	1551.700000	1915.300000	1455.400000	2040.700000
3	1143.374680	1180.559127	1107.140662	1231.758342	1192.054140
4	583.400000	445.900000	464.300000	652.700000	571.400000
..	...	...	...	...	...
261	NaN	NaN	NaN	NaN	NaN
262	713.100000	930.200000	1019.500000	939.100000	995.200000
263	3309.600000	3141.000000	2790.300000	4063.200000	4405.500000
264	1905.400000	2145.900000	2258.600000	2188.000000	2072.200000
265	653.800000	934.200000	806.700000	309.700000	452.400000

	2010	2011	2012	2013	2014 \
0	NaN	NaN	NaN	NaN	NaN
1	1553.204407	1492.710513	1650.256751	1533.952962	1636.009730
2	2011.100000	1659.900000	2029.600000	2048.500000	2017.500000
3	1186.055616	1063.100621	1189.862011	1113.771455	1226.442299
4	629.300000	662.400000	552.000000	814.400000	888.200000
..	...	...	...	...	...
261	NaN	NaN	NaN	NaN	NaN
262	1092.400000	1022.500000	1064.400000	1008.200000	962.700000
263	4150.400000	4017.000000	4243.500000	4043.000000	4899.600000
264	2540.900000	2745.100000	2708.800000	2552.700000	2774.900000

```
265    733.400000    587.400000    695.700000    668.500000    831.400000


              2015          2016          2017          2018
2019  \
0               NaN           NaN           NaN           NaN           NaN

1       1616.362162   1490.807738   1764.116707   1728.295922   1717.894885

2       2132.200000   1980.400000   2022.500000   2162.000000   2113.400000

3       1268.162021   1314.142638   1287.720920   1334.535720   1343.462790

4        982.400000    865.400000    806.200000    941.400000    958.800000

..              ...           ...           ...           ...           ...

261             NaN           NaN           NaN           NaN           NaN

262      784.200000    687.000000    699.000000    682.800000    864.900000

263     3348.400000   3623.100000   5331.800000   4652.100000   4101.400000

264     3026.400000   2432.200000   2489.900000   2168.100000   2400.400000

265      557.500000    435.100000   1203.300000   1254.300000    748.000000


              2020          2021  2022  Unnamed: 67
0               NaN           NaN   NaN          NaN
1       1838.762607   1840.899744   NaN          NaN
2       1979.900000   2154.700000   NaN          NaN
3       1381.643141   1341.959411   NaN          NaN
4        992.500000   1000.300000   NaN          NaN
..              ...           ...   ...          ...
261             NaN           NaN   NaN          NaN
262      861.100000    791.800000   NaN          NaN
263     5120.600000   5124.700000   NaN          NaN
264     2481.600000   2525.000000   NaN          NaN
265     1148.600000   1545.200000   NaN          NaN

[266 rows x 68 columns]

df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 266 entries, 0 to 265
Data columns (total 68 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
```

```
0    Country Name     266 non-null    object
1    Country Code     266 non-null    object
2    Indicator Name   266 non-null    object
3    Indicator Code   266 non-null    object
4    1960             0 non-null      float64
5    1961             188 non-null    float64
6    1962             188 non-null    float64
7    1963             188 non-null    float64
8    1964             188 non-null    float64
9    1965             188 non-null    float64
10   1966             189 non-null    float64
11   1967             189 non-null    float64
12   1968             190 non-null    float64
13   1969             190 non-null    float64
14   1970             190 non-null    float64
15   1971             191 non-null    float64
16   1972             191 non-null    float64
17   1973             191 non-null    float64
18   1974             191 non-null    float64
19   1975             191 non-null    float64
20   1976             191 non-null    float64
21   1977             192 non-null    float64
22   1978             192 non-null    float64
23   1979             192 non-null    float64
24   1980             191 non-null    float64
25   1981             192 non-null    float64
26   1982             192 non-null    float64
27   1983             192 non-null    float64
28   1984             192 non-null    float64
29   1985             192 non-null    float64
30   1986             192 non-null    float64
31   1987             191 non-null    float64
32   1988             191 non-null    float64
33   1989             191 non-null    float64
34   1990             192 non-null    float64
35   1991             198 non-null    float64
36   1992             217 non-null    float64
37   1993             220 non-null    float64
38   1994             221 non-null    float64
39   1995             221 non-null    float64
40   1996             221 non-null    float64
41   1997             222 non-null    float64
42   1998             222 non-null    float64
43   1999             222 non-null    float64
44   2000             224 non-null    float64
45   2001             224 non-null    float64
46   2002             224 non-null    float64
47   2003             224 non-null    float64
48   2004             224 non-null    float64
```

```
 49   2005                224 non-null     float64
 50   2006                225 non-null     float64
 51   2007                226 non-null     float64
 52   2008                226 non-null     float64
 53   2009                226 non-null     float64
 54   2010                226 non-null     float64
 55   2011                226 non-null     float64
 56   2012                227 non-null     float64
 57   2013                227 non-null     float64
 58   2014                227 non-null     float64
 59   2015                228 non-null     float64
 60   2016                228 non-null     float64
 61   2017                228 non-null     float64
 62   2018                227 non-null     float64
 63   2019                227 non-null     float64
 64   2020                227 non-null     float64
 65   2021                227 non-null     float64
 66   2022                0 non-null       float64
 67   Unnamed: 67         0 non-null       float64
dtypes: float64(64), object(4)
memory usage: 141.4+ KB
```

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

```
Country Name        0
Country Code        0
Indicator Name      0
Indicator Code      0
1960              266
                 ...
2019               39
2020               39
2021               39
2022              266
Unnamed: 67       266
Length: 68, dtype: int64
```

```
categorical_feature=[feature for feature in df.columns if
df[feature].dtype=='O']
numerical_feature=[feature for feature in df.columns if
df[feature].dtype!='O']

plt.figure(figsize=(16,10))
for i in numerical_feature:
    sns.distplot(df[i])
```
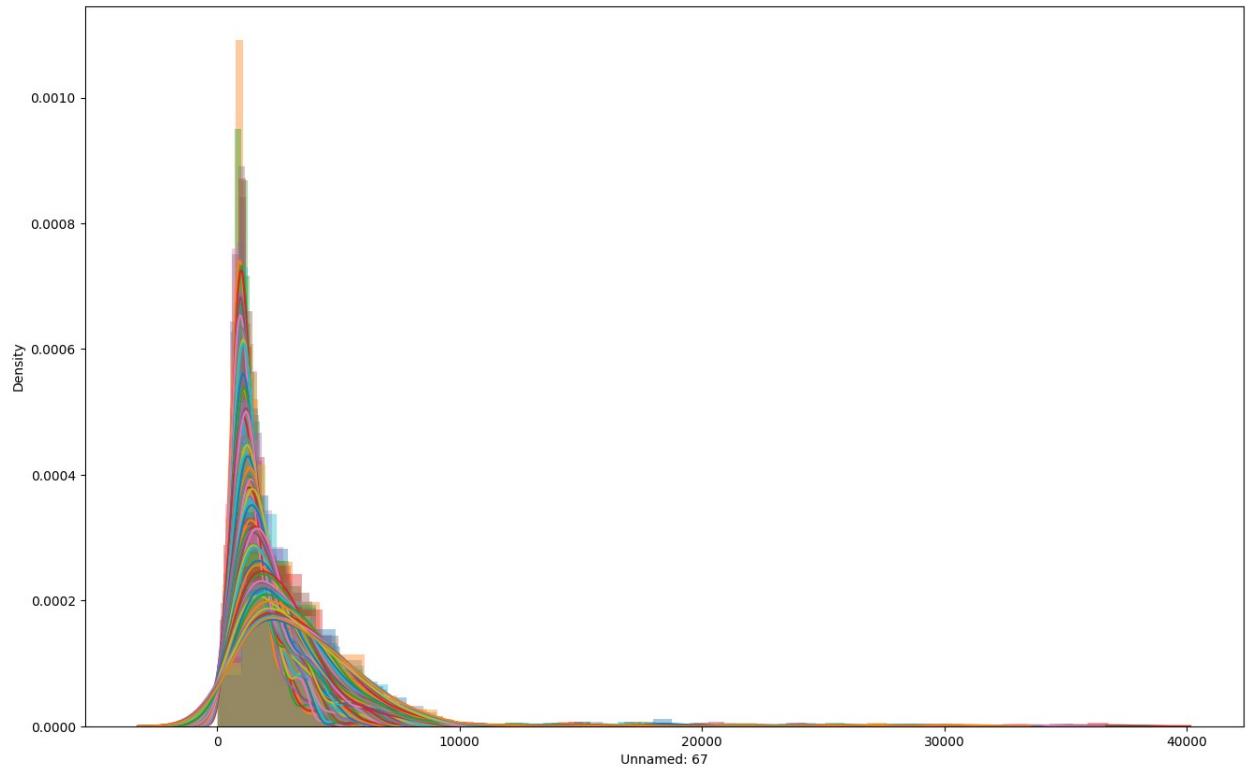
```
for i in numerical_feature:
    df[i]=df[i].fillna(df[i].median())

df[numerical_feature].isnull().sum()

1960            266
1961              0
1962              0
1963              0
1964              0
              ...
2019              0
2020              0
2021              0
2022            266
Unnamed: 67     266
Length: 64, dtype: int64
```

Task 1.1 : Visualisation of choropleth

choropleth maps representing the world greenhouse gas emissionfor the years 2000

```python
def GHG_2019():
    custom_color_scale = [[0, '#0000ff'], [1, '#00ff00']]
    fig = go.Figure(data=go.Choropleth(
        locations = df['Country Code'],
        z = df['2019'],
        text = df['Country Name'],
        colorscale=custom_color_scale,
        colorbar_title = 'Total GHG emission',
        zmin= 0,
        zmax=15000000))
    fig.update_layout(title_text='World Greenhouse Gas emission in 2019',

geo=dict(showframe=True,showcoastlines=True,projection_type='equirectangular'))
    fig.show()

GHG_2019()
```

{"config":{"plotlyServerURL":"https://plot.ly"},"data":[{"colorbar":
{"title":{"text":"Total GHG emission"}},"colorscale":[[0,"#0000ff"],
[1,"#00ff00"]],"locations":
["ABW","AFE","AFG","AFW","AGO","ALB","AND","ARB","ARE","ARG","ARM","AS
M","ATG","AUS","AUT","AZE","BDI","BEL","BEN","BFA","BGD","BGR","BHR","
BHS","BIH","BLR","BLZ","BMU","BOL","BRA","BRB","BRN","BTN","BWA","CAF"
,"CAN","CEB","CHE","CHI","CHL","CHN","CIV","CMR","COD","COG","COL","CO
M","CPV","CRI","CSS","CUB","CUW","CYM","CYP","CZE","DEU","DJI","DMA","
DNK","DOM","DZA","EAP","EAR","EAS","ECA","ECS","ECU","EGY","EMU","ERI"
,"ESP","EST","ETH","EUU","FCS","FIN","FJI","FRA","FRO","FSM","GAB","GB
R","GEO","GHA","GIB","GIN","GMB","GNB","GNQ","GRC","GRD","GRL","GTM","
GUM","GUY","HIC","HKG","HND","HPC","HRV","HTI","HUN","IBD","IBT","IDA"
,"IDB","IDN","IDX","IMN","IND","INX","IRL","IRN","IRQ","ISL","ISR","IT
A","JAM","JOR","JPN","KAZ","KEN","KGZ","KHM","KIR","KNA","KOR","KWT","
LAC","LAO","LBN","LBR","LBY","LCA","LCN","LDC","LIC","LIE","LKA","LMC"
,"LMY","LSO","LTE","LTU","LUX","LVA","MAC","MAF","MAR","MCO","MDA","MD
G","MDV","MEA","MEX","MHL","MIC","MKD","MLI","MLT","MMR","MNA","MNE","
MNG","MNP","MOZ","MRT","MUS","MWI","MYS","NAC","NAM","NCL","NER","NGA"
,"NIC","NLD","NOR","NPL","NRU","NZL","OED","OMN","OSS","PAK","PAN","PE
R","PHL","PLW","PNG","POL","PRE","PRI","PRK","PRT","PRY","PSE","PSS","
PST","PYF","QAT","ROU","RUS","RWA","SAS","SAU","SDN","SEN","SGP","SLB"
,"SLE","SLV","SMR","SOM","SRB","SSA","SSD","SSF","SST","STP","SUR","SV
K","SVN","SWE","SWZ","SXM","SYC","SYR","TCA","TCD","TEA","TEC","TGO","
THA","TJK","TKM","TLA","TLS","TMN","TON","TSA","TSS","TTO","TUN","TUR"
,"TUV","TZA","UGA","UKR","UMC","URY","USA","UZB","VCT","VEN","VGB","VI
```

R","VNM","VUT","WLD","WSM","XKX","YEM","ZAF","ZMB","ZWE"],"text":
["Aruba","Africa Eastern and Southern","Afghanistan","Africa Western
and Central","Angola","Albania","Andorra","Arab World","United Arab
Emirates","Argentina","Armenia","American Samoa","Antigua and
Barbuda","Australia","Austria","Azerbaijan","Burundi","Belgium","Benin
","Burkina Faso","Bangladesh","Bulgaria","Bahrain","Bahamas,
The","Bosnia and
Herzegovina","Belarus","Belize","Bermuda","Bolivia","Brazil","Barbados
","Brunei Darussalam","Bhutan","Botswana","Central African
Republic","Canada","Central Europe and the
Baltics","Switzerland","Channel Islands","Chile","China","Cote
d'Ivoire","Cameroon","Congo, Dem. Rep.","Congo,
Rep.","Colombia","Comoros","Cabo Verde","Costa Rica","Caribbean small
states","Cuba","Curacao","Cayman
Islands","Cyprus","Czechia","Germany","Djibouti","Dominica","Denmark",
"Dominican Republic","Algeria","East Asia & Pacific (excluding high
income)","Early-demographic dividend","East Asia & Pacific","Europe &
Central Asia (excluding high income)","Europe & Central
Asia","Ecuador","Egypt, Arab Rep.","Euro
area","Eritrea","Spain","Estonia","Ethiopia","European Union","Fragile
and conflict affected situations","Finland","Fiji","France","Faroe
Islands","Micronesia, Fed. Sts.","Gabon","United
Kingdom","Georgia","Ghana","Gibraltar","Guinea","Gambia, The","Guinea-
Bissau","Equatorial
Guinea","Greece","Grenada","Greenland","Guatemala","Guam","Guyana","Hi
gh income","Hong Kong SAR, China","Honduras","Heavily indebted poor
countries (HIPC)","Croatia","Haiti","Hungary","IBRD only","IDA & IBRD
total","IDA total","IDA blend","Indonesia","IDA only","Isle of
Man","India","Not classified","Ireland","Iran, Islamic
Rep.","Iraq","Iceland","Israel","Italy","Jamaica","Jordan","Japan","Ka
zakhstan","Kenya","Kyrgyz Republic","Cambodia","Kiribati","St. Kitts
and Nevis","Korea, Rep.","Kuwait","Latin America & Caribbean
(excluding high income)","Lao PDR","Lebanon","Liberia","Libya","St.
Lucia","Latin America & Caribbean","Least developed countries: UN
classification","Low income","Liechtenstein","Sri Lanka","Lower middle
income","Low & middle income","Lesotho","Late-demographic
dividend","Lithuania","Luxembourg","Latvia","Macao SAR, China","St.
Martin (French
part)","Morocco","Monaco","Moldova","Madagascar","Maldives","Middle
East & North Africa","Mexico","Marshall Islands","Middle
income","North Macedonia","Mali","Malta","Myanmar","Middle East &
North Africa (excluding high
income)","Montenegro","Mongolia","Northern Mariana
Islands","Mozambique","Mauritania","Mauritius","Malawi","Malaysia","No
rth America","Namibia","New
Caledonia","Niger","Nigeria","Nicaragua","Netherlands","Norway","Nepal
","Nauru","New Zealand","OECD members","Oman","Other small
states","Pakistan","Panama","Peru","Philippines","Palau","Papua New
Guinea","Poland","Pre-demographic dividend","Puerto Rico","Korea, Dem.

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choropleth maps representing the world greenhouse gas emissionfor the years 2010

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    fig.update_layout(title_text='World GHG(Greenhouse Gas) emission
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states","Cuba","Curacao","Cayman

Islands","Cyprus","Czechia","Germany","Djibouti","Dominica","Denmark","Dominican Republic","Algeria","East Asia & Pacific (excluding high income)","Early-demographic dividend","East Asia & Pacific","Europe & Central Asia (excluding high income)","Europe & Central Asia","Ecuador","Egypt, Arab Rep.","Euro area","Eritrea","Spain","Estonia","Ethiopia","European Union","Fragile and conflict affected situations","Finland","Fiji","France","Faroe Islands","Micronesia, Fed. Sts.","Gabon","United Kingdom","Georgia","Ghana","Gibraltar","Guinea","Gambia, The","Guinea-Bissau","Equatorial Guinea","Greece","Grenada","Greenland","Guatemala","Guam","Guyana","High income","Hong Kong SAR, China","Honduras","Heavily indebted poor countries (HIPC)","Croatia","Haiti","Hungary","IBRD only","IDA & IBRD total","IDA total","IDA blend","Indonesia","IDA only","Isle of Man","India","Not classified","Ireland","Iran, Islamic Rep.","Iraq","Iceland","Israel","Italy","Jamaica","Jordan","Japan","Kazakhstan","Kenya","Kyrgyz Republic","Cambodia","Kiribati","St. Kitts and Nevis","Korea, Rep.","Kuwait","Latin America & Caribbean (excluding high income)","Lao PDR","Lebanon","Liberia","Libya","St. Lucia","Latin America & Caribbean","Least developed countries: UN classification","Low income","Liechtenstein","Sri Lanka","Lower middle income","Low & middle income","Lesotho","Late-demographic dividend","Lithuania","Luxembourg","Latvia","Macao SAR, China","St. Martin (French part)","Morocco","Monaco","Moldova","Madagascar","Maldives","Middle East & North Africa","Mexico","Marshall Islands","Middle income","North Macedonia","Mali","Malta","Myanmar","Middle East & North Africa (excluding high income)","Montenegro","Mongolia","Northern Mariana Islands","Mozambique","Mauritania","Mauritius","Malawi","Malaysia","North America","Namibia","New Caledonia","Niger","Nigeria","Nicaragua","Netherlands","Norway","Nepal","Nauru","New Zealand","OECD members","Oman","Other small states","Pakistan","Panama","Peru","Philippines","Palau","Papua New Guinea","Poland","Pre-demographic dividend","Puerto Rico","Korea, Dem. People's Rep.","Portugal","Paraguay","West Bank and Gaza","Pacific island small states","Post-demographic dividend","French Polynesia","Qatar","Romania","Russian Federation","Rwanda","South Asia","Saudi Arabia","Sudan","Senegal","Singapore","Solomon Islands","Sierra Leone","El Salvador","San Marino","Somalia","Serbia","Sub-Saharan Africa (excluding high income)","South Sudan","Sub-Saharan Africa","Small states","Sao Tome and Principe","Suriname","Slovak Republic","Slovenia","Sweden","Eswatini","Sint Maarten (Dutch part)","Seychelles","Syrian Arab Republic","Turks and Caicos Islands","Chad","East Asia & Pacific (IDA & IBRD countries)","Europe & Central Asia (IDA & IBRD countries)","Togo","Thailand","Tajikistan","Turkmenistan","Latin America & the Caribbean (IDA & IBRD countries)","Timor-Leste","Middle

East & North Africa (IDA & IBRD countries)","Tonga","South Asia (IDA & IBRD)","Sub-Saharan Africa (IDA & IBRD countries)","Trinidad and Tobago","Tunisia","Turkiye","Tuvalu","Tanzania","Uganda","Ukraine","Upper middle income","Uruguay","United States","Uzbekistan","St. Vincent and the Grenadines","Venezuela, RB","British Virgin Islands","Virgin Islands (U.S.)","Vietnam","Vanuatu","World","Samoa","Kosovo","Yemen, Rep.","South Africa","Zambia","Zimbabwe"],"type":"choropleth","z":[3341.5,1838.76260700617,1979.9,1381.64314050038,992.5,5209.2,3341.5,1868.54481144476,25980.3,5213.1,2055.8,3341.5,3800,1650.7,7386.4,3227.3,1261.7,8430.6,1432.8,1261.7,4902.1,4373.4,3341.5,8408.6,6050.7,3539.9,3526.3,3341.5,2024,5255.7,2818,2944.2,3439.5,1034.7,859,4095.4,4754.23590815757,6978,3341.5,6245.8,6314.2,2231.7,1665.8,879.9,883.7,5069.2,1392.5,15.7,4030.4,3738.0951508632,2572.3,3341.5,3341.5,2368.5,6042.7,7133.3,2000,1662.5,6926.3,4653.7,1520.4,5555.81268710137,3644.92510114558,5210.63186809519,3051.18142061153,3931.53309531615,3914.7,7166.5,5851.3228680359,640,4501.5,4411.5,2861.3,5462.69486652694,2017.03858473123,3589.3,3665.7,6384.2,3341.5,1699,1588.6,6241,2646.5,2405.6,3341.5,1323.7,501.9,1334,3341.5,4197.1,998,3341.5,2201.2,3341.5,3666.2,5926.92629088142,2049,1893.3,1511.26868495084,6992.4,1301.1,6659.1,4213.69942148722,3690.97313861118,2204.66968522015,2372.49616476294,5293.3,2147.52345997576,3341.5,3407,3341.5,7124.8,1653,2582.3,4858,3835.1,5626.5,1114.3,2146.1,6472.9,1288.6,1842.6,3260.4,3481.5,3341.5,3341.5,6212,13393.1,4738.1446818875,4014.3,2371.5,1162.5,672.9,3341.5,4741.13581342457,2106.38504871714,1456.13889145198,3341.5,4746.8,3351.34445489681,3673.2815339556,433.3,4679.91706825269,4734.2,5736.8,4662.8,3341.5,3341.5,747.4,3341.5,1893.6,2469.1,2337.8,2237.16649885126,3806.5,3341.5,3991.33525324573,3664.2,1686,3341.5,3651.7,2203.6827047516,3260,1218.6,3341.5,672.1,1321.8,8942.5,2004.4,3706.4,7211.62698489896,429.5,8689.9,560.2,1666.9,2223.7,7919.9,4683.8,3196.3,3341.5,9039.3,5699.72324879829,18835.1,1710.27756882331,3353.5,3377.4,4557.2,3769.4,3341.5,4755.9,4691.7,1386.25055304251,2869.1,3495.7,4881.3,4706.5,2244.6,2418.52997334222,5865.72068953796,3341.5,7124.6,3398.6,2905.4,1459.2,3511.22268227473,4856.9,489.6,1821.6,3341.5,1889.4,1633.2,2732,3341.5,502.5,6559.4,1605.74073921235,885.5,1605.74073921235,2005.97479925217,2013.5,4319.1,6129.8,7385.5,5994.4,1287,3341.5,3341.5,1832.3,3341.5,867.1,5573.70303562615,3196.09338343992,1160,3013.7,3484.7,2191.4,4748.41032415251,2658.5,2203.64698174597,3341.5,3511.22268227473,1605.74073921235,1520.3,1325.8,3341.5,3341.5,1698.4,2587,4293.4,4634.0956056386,4964.1,8145.3,4481.1,29241.4,4034.8,3341.5,3341.5,5797.3,609.7,4116.42759713755,3341.5,3341.5,861.1,5120.6,2481.6,1148.6],"zmax":15000000,"zmin":0}],"layout":{"geo":{"projection":{"type":"equirectangular"},"showcoastlines":true,"showframe":true},"template":{"data":{"bar":[{"error_x":{"color":"#2a3f5f"},"error_y":{"color":"#2a3f5f"},"marker":{"line":{"color":"#E5ECF6","width":0.5},"pattern":{"fillmode":"overlay","size":10,"solidity":0.2}},"type":"bar"}],"barpolar":[{"marker":{"line":{"color":"#E5ECF6","width":0.5},"pattern":{"fillmode":"overlay","size":10,"solidity":0.2}},"type":"barpolar"}],"carpet":[{"aaxis":

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Task 1.2.1 - Analysis of geospatial datasets

reading population dataset

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df_population=pd.read_csv('Downloads/Dataset-3/
API_SP.POP.TOTL_DS2_en_csv_v2_4485025.csv',skiprows=4)
df_population
```

	Country Name	Country Code	Indicator Name	\
0	Aruba	ABW	Population, total	
1	Africa Eastern and Southern	AFE	Population, total	
2	Afghanistan	AFG	Population, total	
3	Africa Western and Central	AFW	Population, total	
4	Angola	AGO	Population, total	
..	...	...	...	
261	Kosovo	XKX	Population, total	
262	Yemen, Rep.	YEM	Population, total	
263	South Africa	ZAF	Population, total	
264	Zambia	ZMB	Population, total	
265	Zimbabwe	ZWE	Population, total	

	Indicator Code	1960	1961	1962	1963
0	SP.POP.TOTL	54208.0	55434.0	56234.0	56699.0

1	SP.POP.TOTL	130836765.0	134159786.0	137614644.0	141202036.0
2	SP.POP.TOTL	8996967.0	9169406.0	9351442.0	9543200.0
3	SP.POP.TOTL	96396419.0	98407221.0	100506960.0	102691339.0
4	SP.POP.TOTL	5454938.0	5531451.0	5608499.0	5679409.0
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261	SP.POP.TOTL	947000.0	966000.0	994000.0	1022000.0
262	SP.POP.TOTL	5315351.0	5393034.0	5473671.0	5556767.0
263	SP.POP.TOTL	17099836.0	17524533.0	17965733.0	18423157.0
264	SP.POP.TOTL	3070780.0	3164330.0	3260645.0	3360099.0
265	SP.POP.TOTL	3776679.0	3905038.0	4039209.0	4178726.0

	1964	1965	1966	1967	1968 \
0	57029.0	57357.0	57702.0	58044.0	58377.0
1	144920186.0	148769974.0	152752671.0	156876454.0	161156430.0
2	9744772.0	9956318.0	10174840.0	10399936.0	10637064.0
3	104953470.0	107289875.0	109701811.0	112195950.0	114781116.0
4	5734995.0	5770573.0	5781305.0	5774440.0	5771973.0
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261	1050000.0	1078000.0	1106000.0	1135000.0	1163000.0
262	5641598.0	5727745.0	5816241.0	5907873.0	6001858.0
263	18896303.0	19384838.0	19888259.0	20406863.0	20942147.0
264	3463211.0	3570466.0	3681953.0	3797877.0	3918872.0
265	4322854.0	4471178.0	4623340.0	4779825.0	4941901.0

	1969	1970	1971	1972	1973 \
0	58734.0	59070.0	59442.0	59849.0	60236.0
1	165611760.0	170257189.0	175100167.0	180141148.0	185376550.0

2	10893772.0	11173654.0	11475450.0	11791222.0	12108963.0
3	117468741.0	120269044.0	123184308.0	126218502.0	129384954.0
4	5803677.0	5890360.0	6041239.0	6248965.0	6497283.0
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261	1191000.0	1219000.0	1247000.0	1278000.0	1308000.0
262	6097042.0	6193379.0	6290367.0	6390573.0	6500809.0
263	21496075.0	22069783.0	22665265.0	23281517.0	23913090.0
264	4045740.0	4179062.0	4319226.0	4466170.0	4619549.0
265	5111326.0	5289312.0	5476978.0	5673914.0	5877725.0

	1974	1975	1976	1977	1978 \
0	60527.0	60653.0	60586.0	60366.0	60102.0
1	190800796.0	196409937.0	202205766.0	208193045.0	214368393.0
2	12412960.0	12689164.0	12943093.0	13171294.0	13341199.0
3	132699537.0	136173544.0	139813171.0	143615715.0	147571063.0
4	6761623.0	7023994.0	7279630.0	7533814.0	7790774.0
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261	1339000.0	1369000.0	1400000.0	1430000.0	1460000.0
262	6630003.0	6784699.0	6967944.0	7178672.0	7414167.0
263	24552540.0	25195184.0	25836890.0	26480915.0	27138966.0
264	4778716.0	4943279.0	5112823.0	5287544.0	5468259.0
265	6085078.0	6293875.0	6502566.0	6712825.0	6929663.0

	1979	1980	1981	1982	1983 \
0	59972.0	60097.0	60561.0	61341.0	62213.0
1	220740384.0	227305945.0	234058404.0	240999134.0	248146290.0
2	13411060.0	13356500.0	13171679.0	12882518.0	12537732.0

3	151663853.0	155882270.0	160223588.0	164689764.0	169279422.0
4	8058112.0	8341290.0	8640478.0	8952971.0	9278104.0
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261	1491000.0	1521000.0	1552000.0	1582000.0	1614000.0
262	7669699.0	7941903.0	8231905.0	8541605.0	8869363.0
263	27827325.0	28556771.0	29333095.0	30150448.0	30993762.0
264	5656145.0	5851818.0	6055361.0	6265869.0	6481907.0
265	7160021.0	7408630.0	7675582.0	7958239.0	8254746.0

	1984	1985	1986	1987	1988 \
0	62826.0	63024.0	62645.0	61838.0	61072.0
1	255530063.0	263161451.0	271050065.0	279184536.0	287524258.0
2	12204306.0	11938204.0	11736177.0	11604538.0	11618008.0
3	173991851.0	178826553.0	183785612.0	188868567.0	194070079.0
4	9614756.0	9961993.0	10320116.0	10689247.0	11068051.0
..	...	...	...	...	...
261	1647000.0	1682000.0	1717000.0	1753000.0	1791000.0
262	9213078.0	9572170.0	9941102.0	10322044.0	10730864.0
263	31841588.0	32678876.0	33495956.0	34297727.0	35100905.0
264	6701547.0	6923148.0	7146965.0	7372835.0	7598270.0
265	8562259.0	8877489.0	9200150.0	9527202.0	9849129.0

	1989	1990	1991	1992	1993 \
0	61033.0	62152.0	64623.0	68240.0	72495.0
1	296024639.0	304648010.0	313394693.0	322270073.0	331265579.0
2	11868873.0	12412311.0	13299016.0	14485543.0	15816601.0
3	199382783.0	204803865.0	210332267.0	215976366.0	221754806.0

4	11454784.0	11848385.0	12248901.0	12657361.0	13075044.0
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261	1827000.0	1862000.0	1898000.0	1932000.0	1965000.0
262	11189185.0	11709987.0	12302127.0	12954157.0	13634082.0
263	35930056.0	36800507.0	37718952.0	38672611.0	39633754.0
264	7820199.0	8036849.0	8246662.0	8451346.0	8656484.0
265	10153852.0	10432409.0	10681008.0	10900511.0	11092775.0

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0	76705.0	80324.0	83211.0	85450.0	87280.0
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2	17075728.0	18110662.0	18853444.0	19357126.0	19737770.0
3	227692136.0	233807627.0	240114179.0	246613750.0	253302310.0
4	13503753.0	13945205.0	14400722.0	14871572.0	15359600.0
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262	14297617.0	14913313.0	15469274.0	15975676.0	16450306.0
263	40564061.0	41435761.0	42241007.0	42987456.0	43682259.0
264	8869745.0	9096608.0	9339740.0	9597610.0	9866474.0
265	11261752.0	11410721.0	11541215.0	11653254.0	11747079.0

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1	387977990.0	398113044.0	408522129.0	419223717.0	430246635.0
2	20170847.0	20779957.0	21606992.0	22600774.0	23680871.0
3	260170348.0	267214544.0	274433894.0	281842480.0	289469530.0
4	15866871.0	16395477.0	16945753.0	17519418.0	18121477.0

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264	10140564.0	10415942.0	10692197.0	10971704.0	11256740.0
265	11822722.0	11881482.0	11923906.0	11954293.0	11982219.0

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0	98744.0	100028.0	100830.0	101226.0	101362.0
1	441630149.0	453404076.0	465581372.0	478166911.0	491173160.0
2	24726689.0	25654274.0	26433058.0	27100542.0	27722281.0
3	297353098.0	305520588.0	313985474.0	322741656.0	331772330.0
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263	47291610.0	47880595.0	48489464.0	49119766.0	49779472.0
264	11550641.0	11856244.0	12173518.0	12502958.0	12848531.0
265	12019911.0	12076697.0	12155496.0	12255920.0	12379553.0

	2009	2010	2011	2012	2013 \
0	101452.0	101665.0	102050.0	102565.0	103165.0
1	504604672.0	518468229.0	532760424.0	547482863.0	562601578.0
2	28394806.0	29185511.0	30117411.0	31161378.0	32269592.0
3	341050537.0	350556886.0	360285439.0	370243017.0	380437896.0
4	22514275.0	23356247.0	24220660.0	25107925.0	26015786.0
..	...	...	...	...	...

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261      1761474.0      1775680.0      1791000.0      1807106.0      1818117.0

262     22516464.0     23154854.0     23807586.0     24473176.0     25147112.0

263     50477013.0     51216967.0     52003759.0     52832659.0     53687125.0

264     13215142.0     13605986.0     14023199.0     14465148.0     14926551.0

265     12526964.0     12697728.0     12894323.0     13115149.0     13350378.0


              2014           2015           2016           2017
2018   \
0          103776.0       104339.0       104865.0       105361.0       105846.0

1       578075373.0    593871847.0    609978946.0    626392880.0    643090131.0

2        33370804.0     34413603.0     35383028.0     36296111.0     37171922.0

3       390882979.0    401586651.0    412551299.0    423769930.0    435229381.0

4        26941773.0     27884380.0     28842482.0     29816769.0     30809787.0

..            ...            ...            ...            ...            ...

261       1812771.0      1788196.0      1777557.0      1791003.0      1797085.0

262      25823488.0     26497881.0     27168210.0     27834811.0     28498683.0

263      54544184.0     55386369.0     56207649.0     57009751.0     57792520.0

264      15399793.0     15879370.0     16363449.0     16853608.0     17351714.0

265      13586710.0     13814642.0     14030338.0     14236599.0     14438812.0


              2019           2020           2021  Unnamed: 66
0          106310.0       106766.0       107195.0          NaN
1       660046272.0    677243299.0    694665117.0          NaN
2        38041757.0     38928341.0     39835428.0          NaN
3       446911598.0    458803476.0    470898870.0          NaN
4        31825299.0     32866268.0     33933611.0          NaN
..            ...            ...            ...          ...
261       1788878.0      1790133.0      1806279.0          NaN
262      29161922.0     29825968.0     30490639.0          NaN
263      58558267.0     59308690.0     60041996.0          NaN
264      17861034.0     18383956.0     18920657.0          NaN
265      14645473.0     14862927.0     15092171.0          NaN

[266 rows x 67 columns]
```

```
df_population.isnull().sum()

Country Name         0
Country Code         0
Indicator Name       0
Indicator Code       0
1960                 2
              ...
2018                 2
2019                 2
2020                 2
2021                 2
Unnamed: 66        266
Length: 67, dtype: int64

numerical_feature_pop=[feature for feature in df_population.columns if
df_population[feature].dtype!='O']
categorical_feature_pop=[feature for feature in df_population.columns
if df_population[feature].dtype=='O']
```

creating distplot for numerical feature

```
plt.figure(figsize=(16,10))
for i in numerical_feature_pop:
    sns.distplot(df_population[i])
```
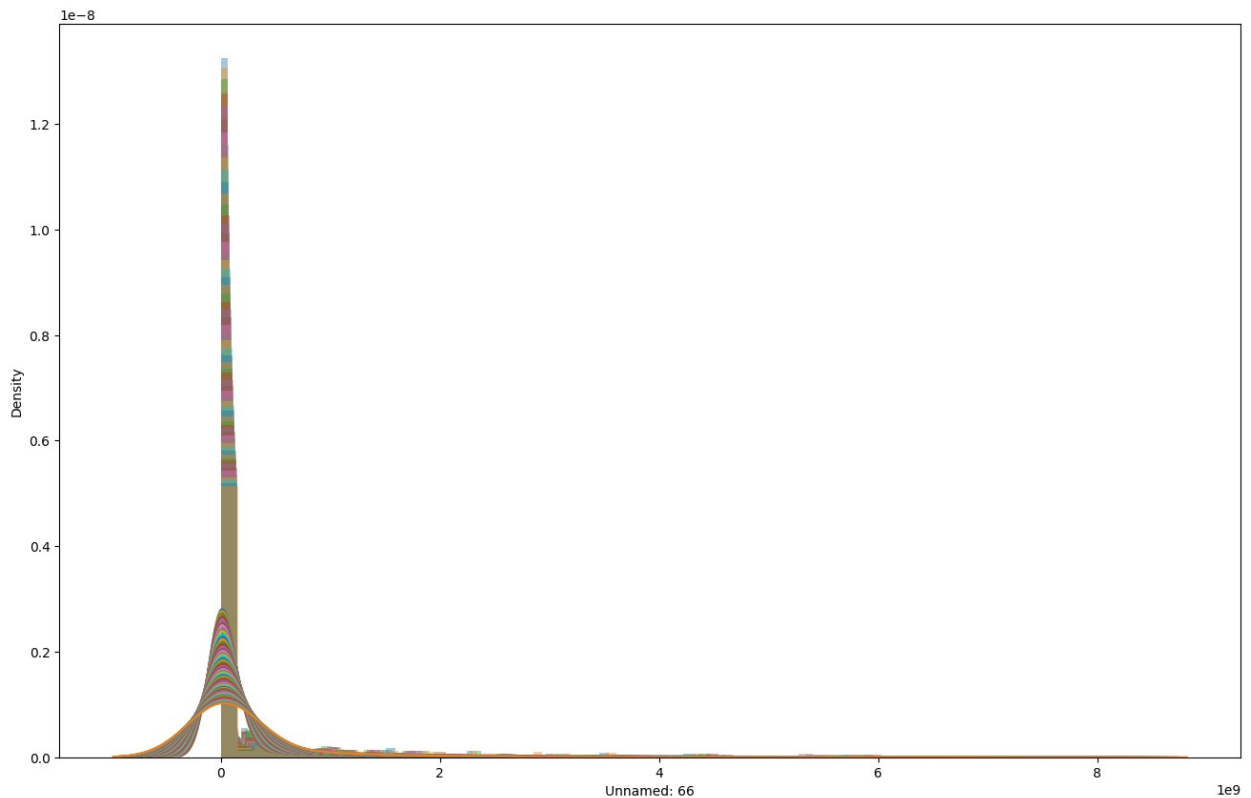
```
for i in numerical_feature_pop:

df_population[i]=df_population[i].fillna(df_population[i].median())
```

Task 1.2.1: For the year 2021, generate choropleth maps of greenhouse gas emissionfor only the countries having populations less than 67326569.Very briefly interpret the generated map.

```python
def ghg_less():
    # Extract the year 2021 greenhouse gas emissions data
    ghg_2021 =df[['Country Name', 'Country Code', '2021']]

    # Extract the countries with populations less than 67326569
    pop_2021 = df_population[['Country Name', 'Country Code', '2021']]
    small_pop = pop_2021[pop_2021['2021'] < 67326569]['Country Code']

    ghg_2021_small_pop = ghg_2021[ghg_2021['Country
Code'].isin(small_pop)]
    fig = go.Figure(data=go.Choropleth(
        locations=ghg_2021_small_pop['Country Code'],
        z=ghg_2021_small_pop['2021'],
        text=ghg_2021_small_pop['Country Name'],
        colorscale='RdYlBu_r',
        colorbar_title='Total GHG emission',
    ))

    fig.update_layout(
        title_text='World total GHG(Greenhouse Gas) emission in 2021
for countries with populations less than 67326569',
        geo=dict(showframe=True, showcoastlines=True,
projection_type='equirectangular')
    )

    fig.show()
ghg_less()
```

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countries with populations less than 67326569"}}}

Task 1.2.2

```python
def ghg_greater():
    # Extract the year 2021 greenhouse gas emissions data
    ghg_2021 =df[['Country Name', 'Country Code', '2021']]

    # Extract the countries with populations greater than 331893745
    pop_2021 = df_population[['Country Name', 'Country Code', '2021']]
    large_pop = pop_2021[pop_2021['2021'] > 331893745]['Country Code']

    ghg_2021_large_pop = ghg_2021[ghg_2021['Country
Code'].isin(large_pop)]

    fig = go.Figure(data=go.Choropleth(
        locations=ghg_2021_large_pop['Country Code'],
        z=ghg_2021_large_pop['2021'],
        text=ghg_2021_large_pop['Country Name'],
        colorscale='RdYlBu_r',
        colorbar_title='Total GHG emission'))

    fig.update_layout(title_text='World total GHG(Greenhouse Gas)
emission in 2021 for countries with populations greater than
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        geo=dict(showframe=True, showcoastlines=True,
projection_type='equirectangular'))

    fig.show()

ghg_greater()
```

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countries with populations greater than 331893745"}}}

Task 1.2.3

```python
def ghg_between():
    # Extract the year 2021 greenhouse gas emissions data
    ghg_2021 = df[['Country Name', 'Country Code', '2021']]
    # Extract the countries with populations between 10269022 and
80890450

    pop_2021 = df_population[['Country Name', 'Country Code', '2021']]
    pop_min = 10269022
    pop_max = 1393409034
    mid_pop = pop_2021[(pop_2021['2021'] >= pop_min) &
(pop_2021['2021'] <= pop_max)]['Country Code']

    ghg_2021_mid_pop = ghg_2021[ghg_2021['Country
Code'].isin(mid_pop)]

    ghg_2021_mid_pop = ghg_2021[ghg_2021['Country
Code'].isin(mid_pop)]

    fig = go.Figure(data=go.Choropleth(
        locations=ghg_2021_mid_pop['Country Code'],
        z=ghg_2021_mid_pop['2021'],
        text=ghg_2021_mid_pop['Country Name'],
```

```python
        colorscale='YlOrRd',
        colorbar_title='Total GHG emission',))

    fig.update_layout(
        title_text='World total GHG(Greenhouse Gas) emission in 2021
for countries with populations between 10269022 and 1393409034',
        geo=dict(showframe=True, showcoastlines=True,
projection_type='equirectangular'))

    fig.show()
ghg_between()
```

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Task 1.2.4

```python
# Extracting country name which have the highest population in  year
2021.
def scatterplot():
    CountryName = df_population['Country
Name'].loc[df_population['2021'].idxmax()]
    df_country = df[df['Country Name'] == CountryName]
    a = df_country[['2011', '2012', '2013', '2014', '2015', '2016',
'2017', '2018', '2019', '2020', '2021']]
    rows = a.iloc[0]
    pc_data = [0,]
    for i in range(len(rows)-1):
        pc_data.append(((rows[i+1] - rows[i]) / rows[i]) * 100)
    x = ['2011', '2012', '2013', '2014', '2015', '2016', '2017',
'2018', '2019', '2020', '2021']
    y = pc_data
    plt.figure(figsize=(15, 8))
    plt.xlabel('Year')
    plt.ylabel('Percentage changes %')
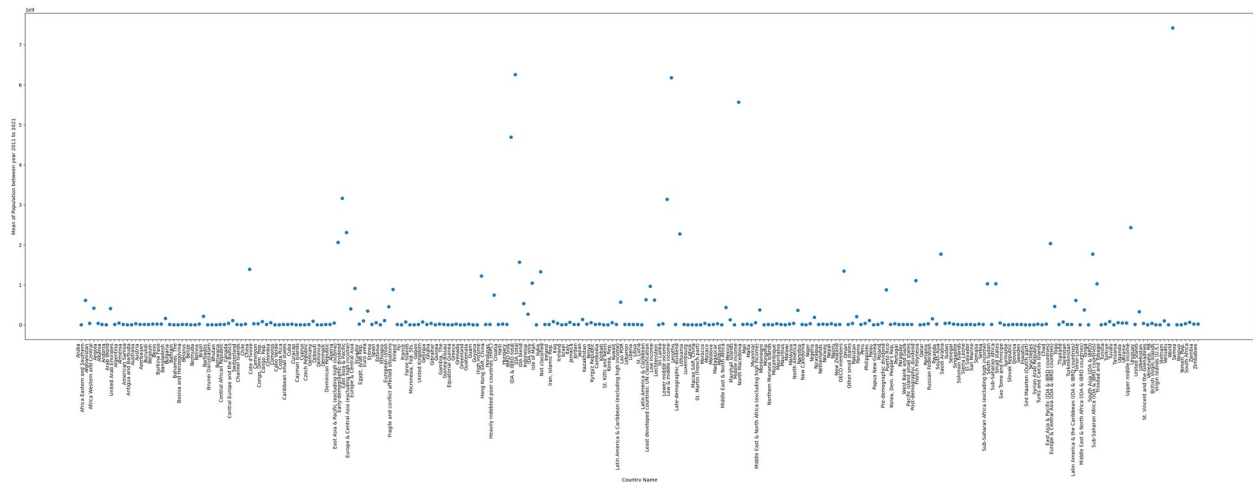    plt.scatter(x, y)
    plt.plot(x, y)

scatterplot()
```
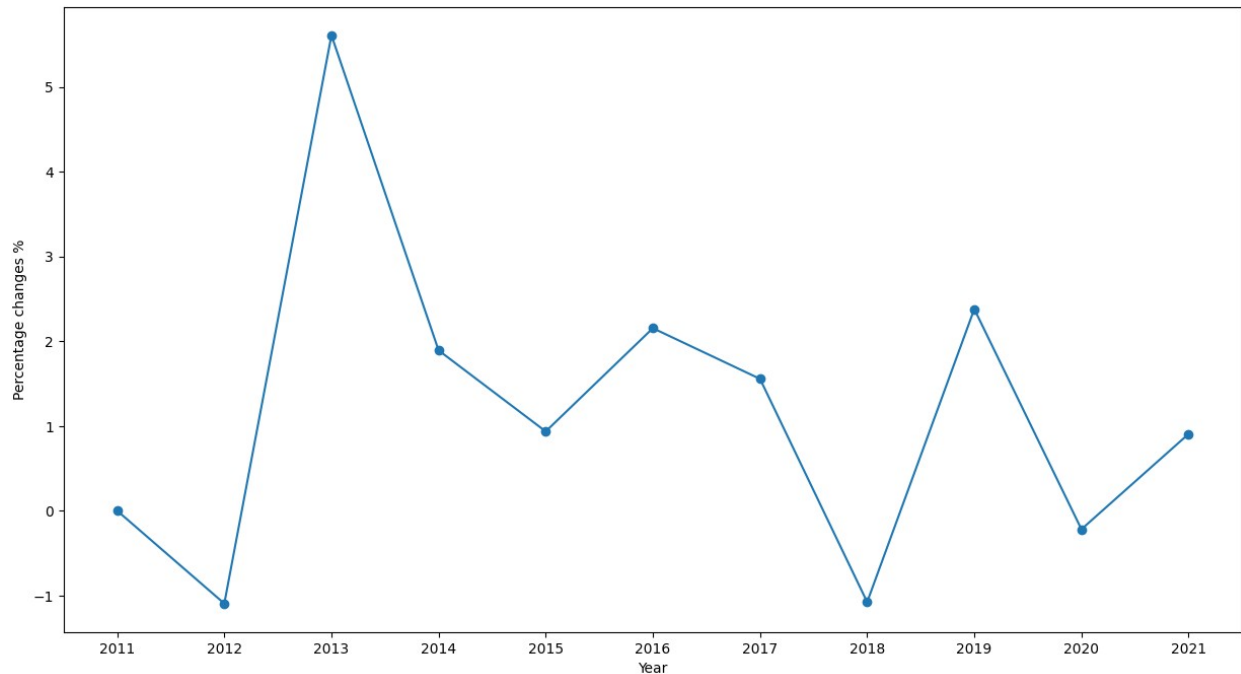
Task 1.2.5

```python
# calculating mean population of each country  and mean greenhouse
emission
means_of_pop =
df_population[['2011','2012','2013','2014','2015','2016','2017','2018'
,'2019','2020','2021']].mean(axis=1)
means_of_ghg =
df[['2011','2012','2013','2014','2015','2016','2017','2018','2019','20
20','2021']].mean(axis=1)
CName_ghg = df['Country Name']
CName_pop = df_population['Country Name']

plt.figure(figsize=(45,12))
plt.xlabel('Country Name')
plt.ylabel('Mean of Population between year 2011 to 2021')
plt.scatter(CName_pop, means_of_pop)
plt.xticks(rotation=90, ha='right')  # You can adjust the rotation
angle as needed
plt.show()
```

```
plt.figure(figsize=(45,12))
plt.xlabel('Country Name')
plt.ylabel('Mean of Population between year 2011 to 2021')
plt.scatter(CName_pop,means_of_pop)
plt.xticks(rotation=90, ha='right')
plt.show()
```