Class project: VARIATION IN MATERNAL AND CHILD CARE IN THE CARRIBEAN REGION

Introduction

The Caribbean is a diverse region with a complex history and rich natural environment, however the region is facing a healthcare crisis- a double burden of chronic and infectious diseases. This syndemic disease burden falls most heavily on the marginalized, and in these countries that is typically women of the urban and rural poor. A long history of colonialism has created a culture entrenched with patriacharal structures that limits women's access to education and job advancement. Women while being overworked and underpaid are expected to fulfill all the responsibility of caring for the home and all dependents. These structures cause significant stress and wear on the body, often leading to poor health outcomes in Caribbean women, a group with a large proportion having one or more chronic diseases. A cycle of poverty is thus perpetuated. This issue is even further compounded in pregnant people, which in turns complicates the health of newborns. The systemic and cultural issues that lead to varying health outcomes in child-bearing people differ between Caribbean countries, and can be attritubed to factors like wealth and healthcare policy. This projects examines the interaction between maternal and child health indicators in 16 Caribbean countries, and the degree to which these interactions are influenced by government policy and country income. This will be analyzed on a per decade basis starting with 1995 then 2005 and 2015.

Research Question: To what extent do GDP per capita and Policy impact maternal child indicators across Caribbean countries?

Data in the "CaribIndicators" csv file contains indicators from 1990-2018 there are 3 indicators of maternal child health along with other data on country background:

1. Anaemia prevalence in pregnant women (%) = Prev_Anae
2. Average Maternal Mortality (per 100,000 births) = Avg_MMR
3. Neonatal mortality (per 1000 births) = Neonat_MR
4. GDP per capita (in 2017 $USD dollars) = GdpCap
5. World Bank Development Index = IncomeGroup
6. Country Female Population = FemPop
7. Number of women of Child-bearing age (thousands)= Wrep_age15_49

Data in "Mat_ChildPolicyCaribb" is a set of boolean values which state whether since the 1990s these countries have certain healthcare policies dedicated to child and maternal care:

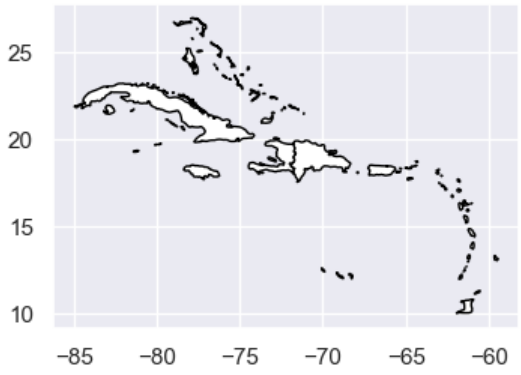
1. Policy on childbirth conditions: Childbirth
2. Policy on a Midwife/other professional being present: Midwife
3. Maternal and Child Postnatal care: MCHPost
4. Free health care for new borns: NewBrn_Free

Both data sets were retrieved from the UNICEF DATA WAREHOUSE (https://data.unicef.org/resources/data_explorer/unicef_f/?ag=UNICEF&df=GLOBAL_DATAFLOW&ver=1.0&dq=.CME_TMM0+CME_PND+CME_MRM0..&startPeriod=2016&endPeriod=2022)

Various global analysis of the data can be found under carious indicator categories on the Unicef website, here is the page with analyses done with neonatal mortality: https://data.unicef.org/topic/child-survival/neonatal-mortality/ ks to other analyses

The Map of Main Caribbean Islands

In [16]:
```
from Ctrends import carib
carib.plot(color= "white", edgecolor= "black", figsize = (4, 8));
```



DATA RANGLING AND MERGING DATA TO ELUCIDATE YEARS FOR COMPARISON

Here I created a dataframe called countrytrends that consist of background on country context (Female Population, GDP, Woman of Reproductive Age) that has no rows with missing data from 1990-2018. In the mch_95/05/15 dataframes I merged data from indicators and the policy datasets for 1995, 2005 and 2015. This is order to tell changes between each decade, and how GDP and policy might influence the maternal and child health indicators. These tables also contain no rows with missing data.

In [2]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import geopandas as gpd
import plotly.express as px
```

In [4]:
```
#cleaning data for interactive background information
import Drangle
from Drangle import countrytrends
countrytrends.tail(3)
```

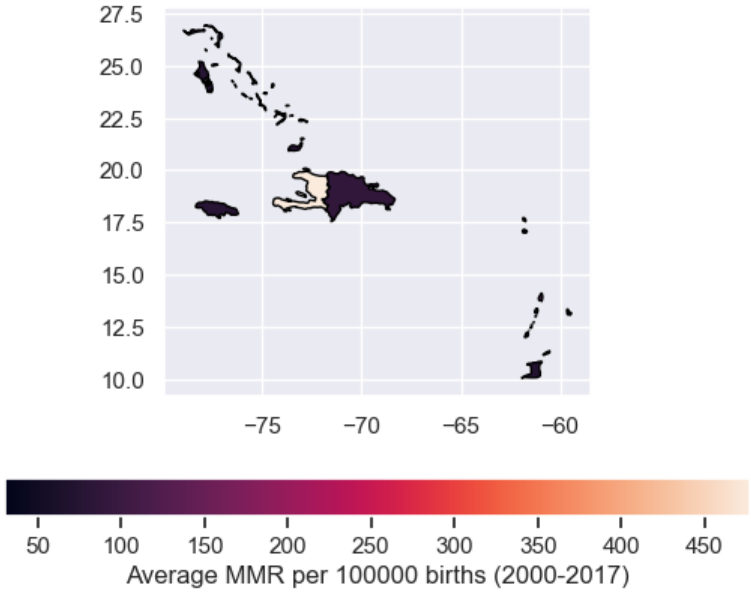
Out[4]:

	Year	Country	FemPop	GdpCap	Wrep_age15_49	IncomeGroup	Avg_MMR
460	2015	Trinidad and Tobago	740581	29053.33	355.087	High income	68.0
461	2016	Trinidad and Tobago	745609	27281.86	353.942	High income	68.0
462	2017	Trinidad and Tobago	750569	26342.62	353.315	High income	67.0

In [5]:
```
#getting Data for the 3 main years
from Drangle import mch_95,mch_05,mch_15
```

Visualize the data: Caribbean Context and Trends in Indicators

In [17]:
```
#Maps Showing Caribbean Island and Cholorpleth Map Showing MMR in the Caribbean region
from Ctrends import economic
economic.plot(column = 'AvgMMR', legend = True, edgecolor= "black",
                    legend_kwds={'label': "Average MMR per 100000 births (2000-2017)",
                                 'orientation': "horizontal"});
```



This is a chloropleth map shows the average GDP for major Caribbean Islands in the countrytrends data set. Mainland Caribbean countries were not included and Cuba were not included in plot due to missing data. Most Caribbean countries are Middle Income countries.

In [18]:
```
#Tracking Changes in  Maternal Mortality in the Region
from Ctrends import Women_Gdp
Women_Gdp.show()
```

This interactive plot shows the annual Average Maternal Mortality (/ 100 thousands births) and how it has changed with GDP per capita between 200-2017. The sizes of the points correspond to the proportion of the population that is female. Although majority of countries have seen an increasing GDP, the MMR has remained fairly constant. In fact most countries are way above the global target of 70 maternal deaths/ 100000 births.

Maternal Indicators -1995

In [7]:
```
mch_95.head(2)
```

Out[7]:

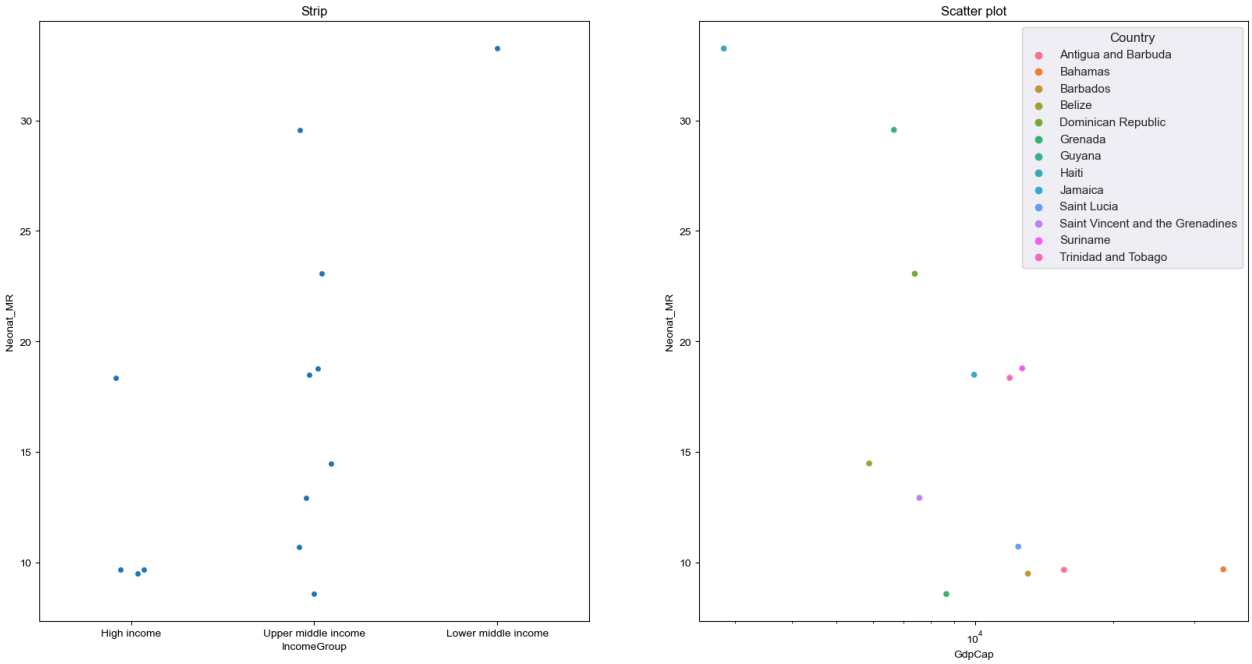
	Year	Country	FemPop	IncomeGroup	GdpCap	Wrep_age15_49	Neonat_MR	Childbirth	Midwife	MCHPost	NewBrn_Free
0	1995	Antigua and Barbuda	35805	High income	15628.32	19.512	9.68383	True	False	True	True
1	1995	Bahamas	152618	High income	34716.54	76.858	9.70188	False	False	False	True

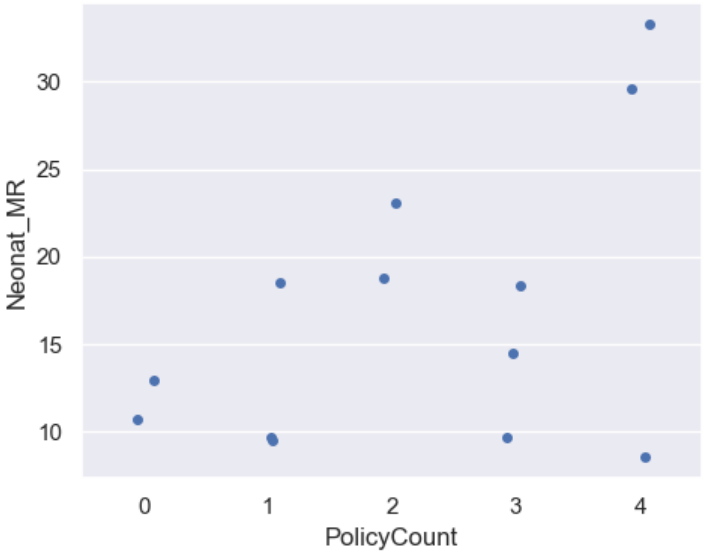
In [8]:
```
#Investigating Economic impact on Neonatal Mortality
fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(18, 6))
# Line plot
sns.stripplot(y ="Neonat_MR",x= "IncomeGroup", data=mch_95, ax=axes[0])
axes[0].set_title("Neonatal Mortality for Country Income")
# Scatter plot
sns.scatterplot(x="GdpCap", y="Neonat_MR", hue="Country", data=mch_95, ax=axes[1])
axes[1].set_title("Neonatal Mortality and GDP/capita")
# Set overall title and adjust spacing
fig.suptitle("Neonatal Mortality(per 1000 births) and Economic Indicators", fontsize=14)
```

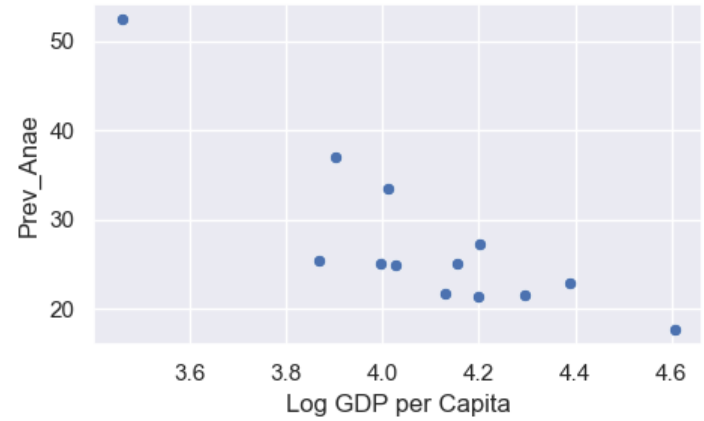
Out[8]:
```
Text(0.5, 0.98, 'Neonatal Mortality(per 1000 births) and Economic Indicators')
```

The Only Data available for 1995 was Neonatal mortality rate. The visualizations aim to show the correlation between deaths amongst new born and Income. The strip plot clearly groups most countries as Upper Middle Income, and in that category there seems to be more complex interactions. This is more clearly seen in the scatterplot where a slight trend among Upper Middle Income countries suggesting that richer countries have lower neonatals deaths.

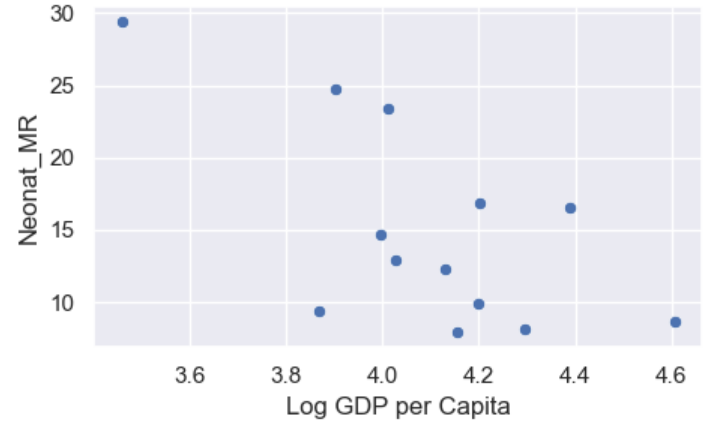
In [9]:
```
#Investigating Impact of Maternal and Child Policy on Neonatal Mortality
from mch_policy import add_bool_pol_column,Neo95,plot_strip_subplots
display(plot_strip_subplots(Neo95,["Neonat_MR"]))
display(plot_strip_subplots(Neo95,["GdpCap"]))
```

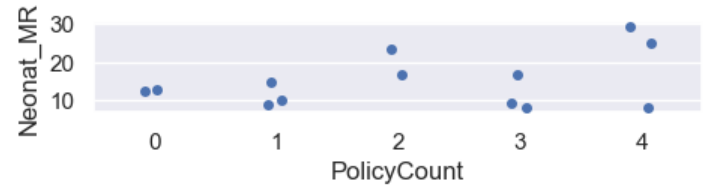

Two Subplots: Strip and Scatter
Strip
Neonat_MR
30
25
20
15
10
High income
Upper middle income
Lower middle income
IncomeGroup
Scatter plot
Country
Antigua and Barbuda
Bahamas
Barbados
Belize
Dominican Republic
Grenada
Guyana
Haiti
Jamaica
Saint Lucia
Saint Vincent and the Grenadines
Suriname
Trinidad and Tobago
10^4
GdpCap

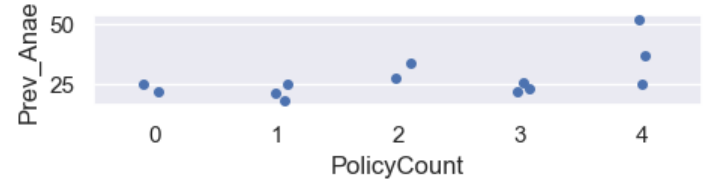

Neonat_MR
30
25
20
15
10
0
1
2
3
4
PolicyCount


Prev_Anae
50
40
30
20
3.6
3.8
4.0
4.2
4.4
4.6
Log GDP per Capita

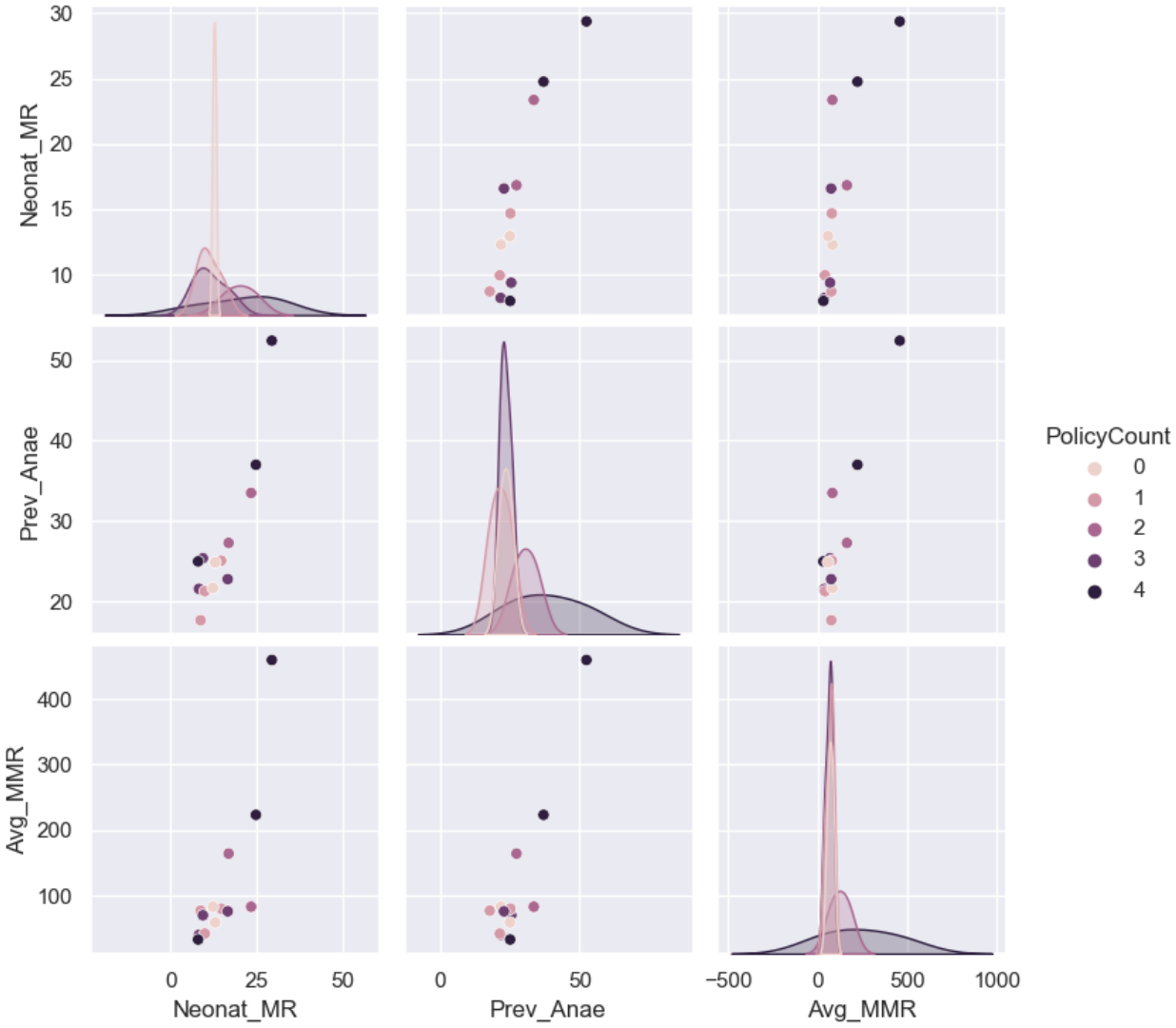

Avg_MMR
400
300
200
100
3.6
3.8
4.0
4.2
4.4
4.6
Log GDP per Capita

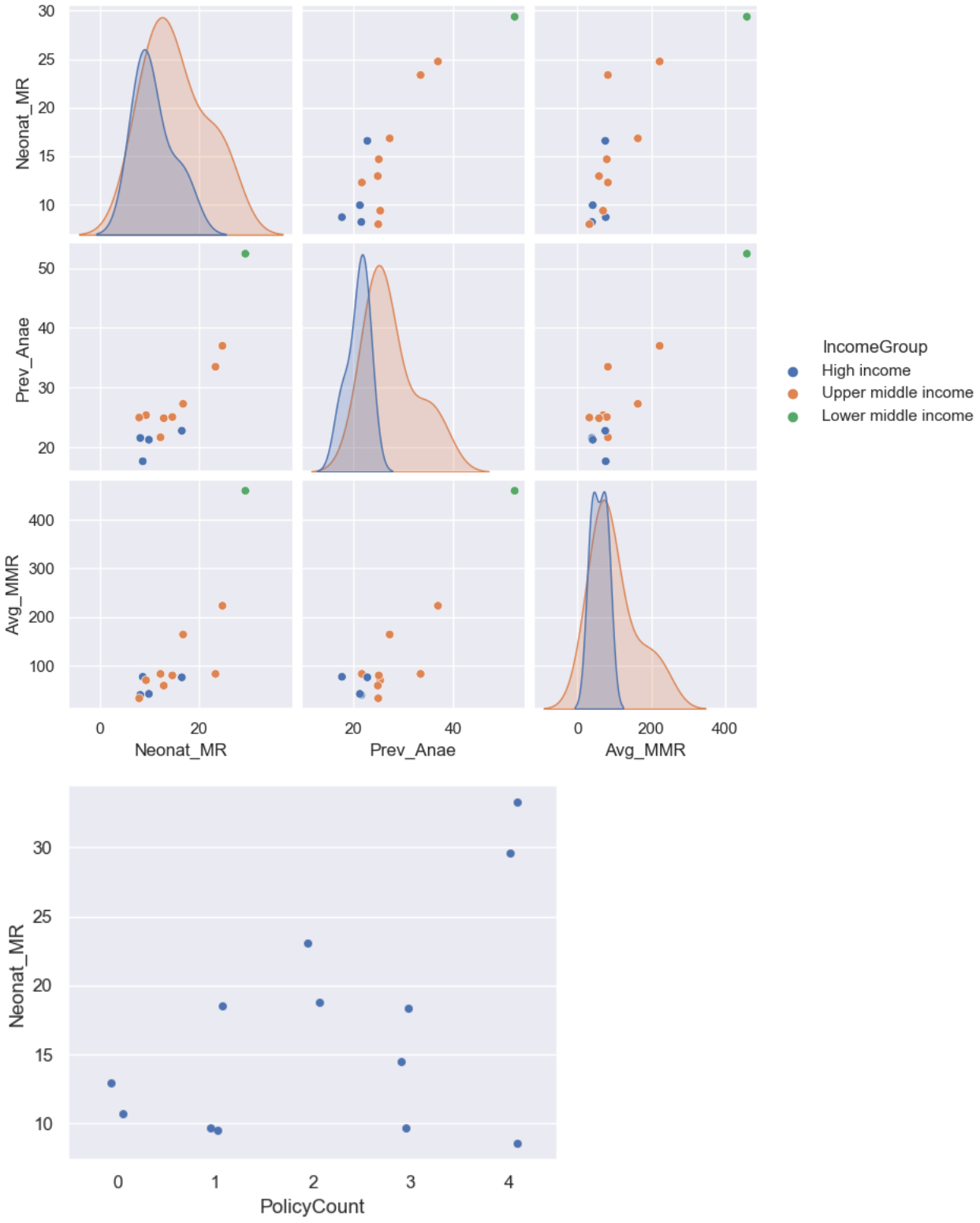

Neonat_MR
30
25
20
15
10
3.6
3.8
4.0
4.2
4.4
4.6
Log GDP per Capita


Neonat_MR
30
20
10
0
1
2
3
4
PolicyCount


Prev_Anae
50
25
0
1
2
3
4
PolicyCount

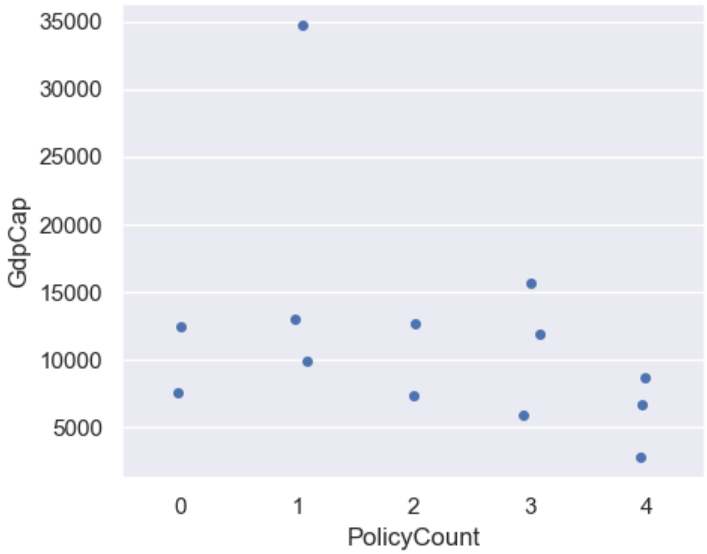

Avg_MMR
400
200
0
1
2
3
4
PolicyCount


Neonat_MR
Prev_Anae
Avg_MMR
PolicyCount
0
1
2
3
4
30
25
20
15
10
50
40
30
20
400
300
200
100
0
25
50
0
50
−500
0
500
1000
Neonat_MR
Prev_Anae
Avg_MMR


Neonat_MR
Prev_Anae
Avg_MMR
IncomeGroup
High income
Upper middle income
Lower middle income
Neonat_MR
Prev_Anae
Avg_MMR

Neonat_MR
PolicyCount

None

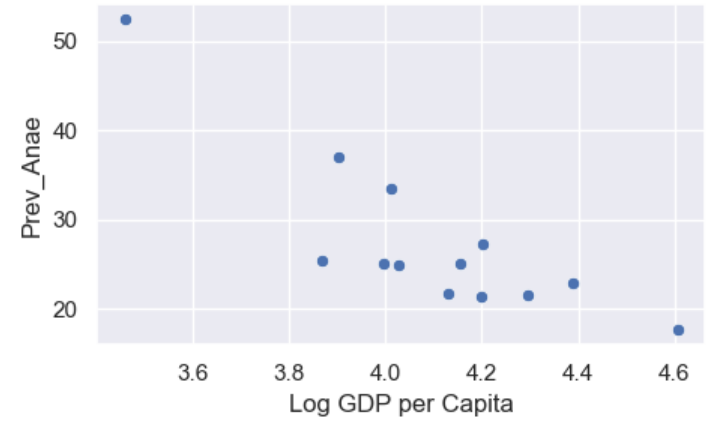


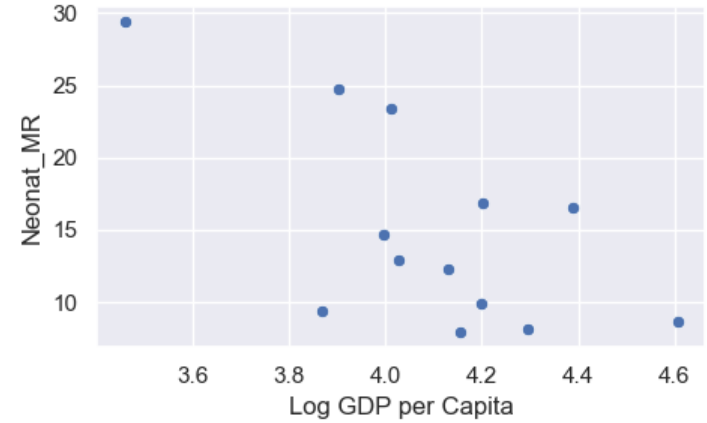
None

These plots are to examine the link between healthcare policy and neonatal death rates, as well as the connection between GDP and Policy aimed at care. It seems having more than one policy does not significantly alter neonatal health outcomes. Policies although present might not have been allocated a significant budget in 1995

Maternal Indicators-2005

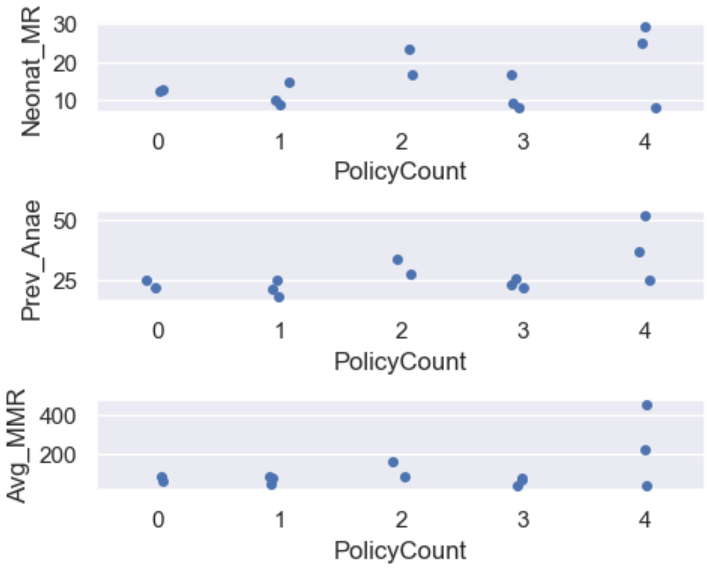
In [10]:
```
#Investigating influence of economy (GDP/capita) on 3 MCH indicators
from mch_policy import gdp_subplots,extract_6_cols,plot_pairplot,Mch_05ind
gdp_subplots(mch_05, ['Prev_Anae', 'Avg_MMR', 'Neonat_MR'])
```



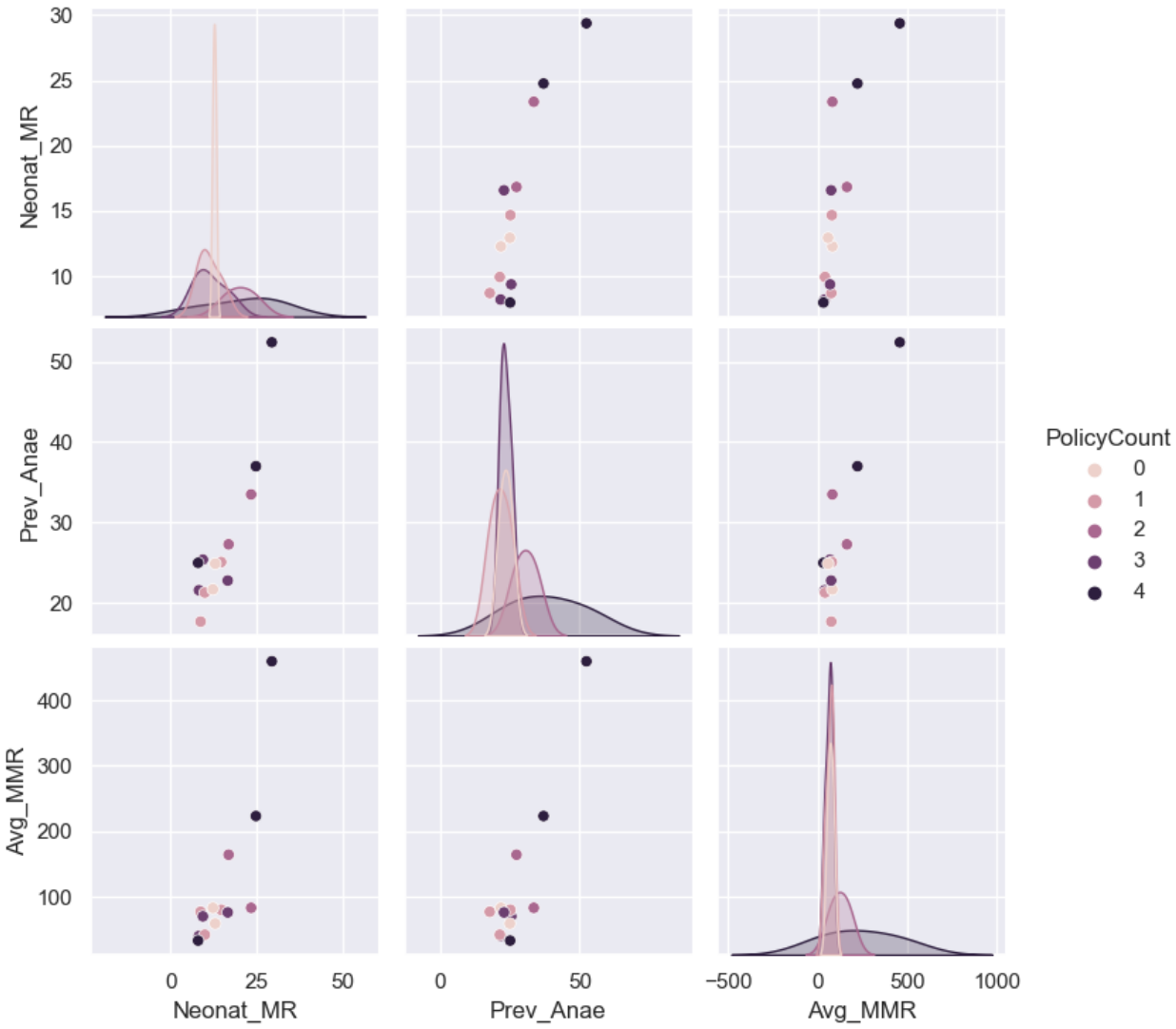


The above subplots try to find 2005 correlation between Maternal and Neonatal mortality, as well as the Prevalance of Anaemia in pregnant women (%) and GDP per capita. Compared to the 2005 visualization that does not use a log scale, the negative regression is more clear indicating that a a higher GDP per capita might be associated with better maternal and childcare healthoutcomes.

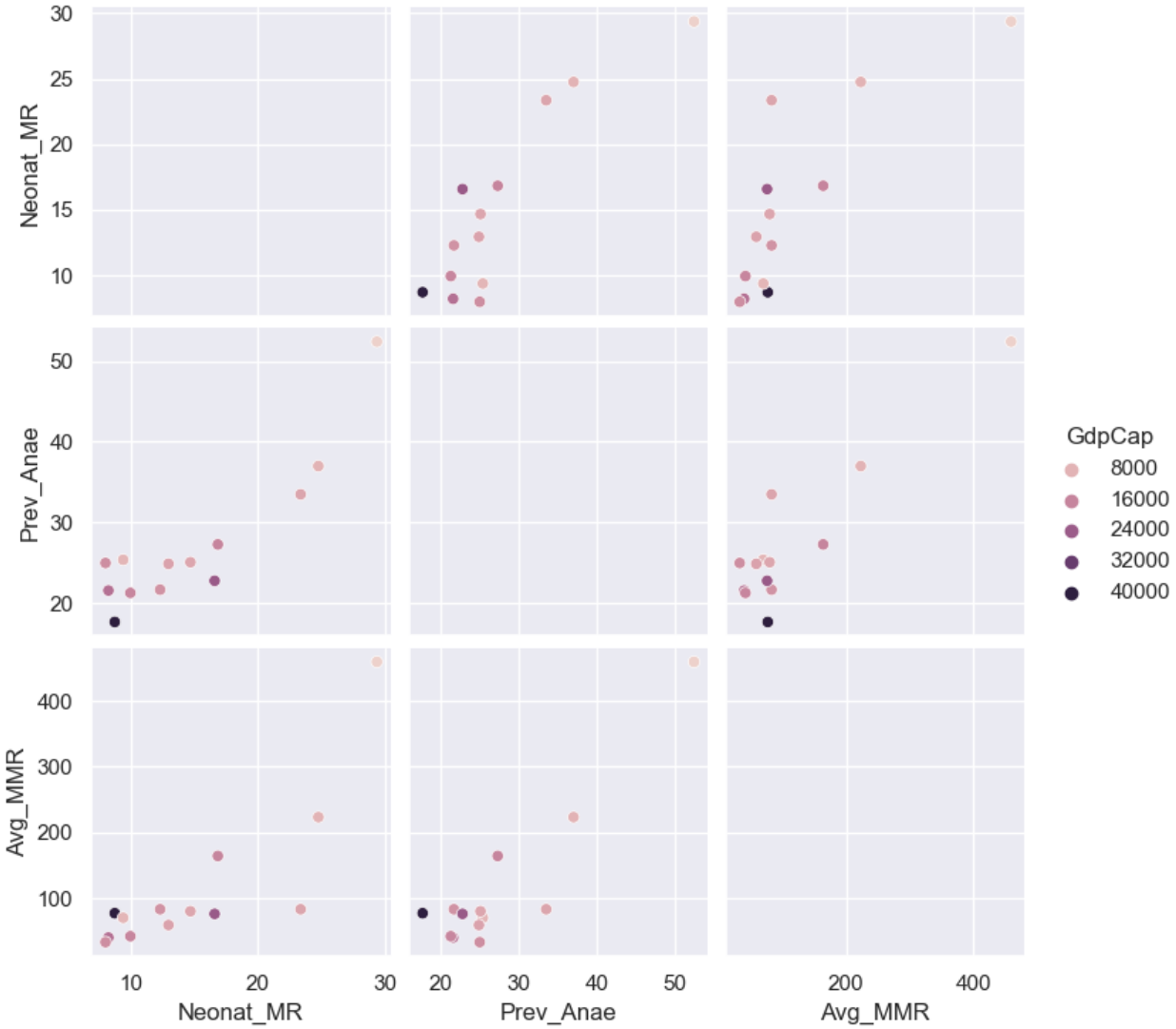
In [11]:
```
#Influnce of Policy on MCH indicators
plot_strip_subplots(Mch_05ind,["Neonat_MR",'Prev_Anae', 'Avg_MMR'])

#The plots below again show no clear influence of the amount of healthcare policies on health outcome
```



In [12]:
```
#Creating function to analyse various variables in a pairplot
plot_pairplot(mch_05, ["Neonat_MR",'Prev_Anae', 'Avg_MMR'], hue='PolicyCount')
# The plots below relate healthcare indicators with one another and track policy count associations
```



In [13]:
```
plot_pairplot(mch_05, ["Neonat_MR",'Prev_Anae', 'Avg_MMR'], hue='GdpCap')
# The plots below relate healthcare indicators with one another and track Gdp/capita associations
```



From the above plots it seems that GdpCap compared to the number of Maternal and Childcare policies a country had more significant relationship in health indicator outcomes. Also maternal indicators of morbidity and mortality (Anaemia prevalence and Maternal mortality rate) also have a significant correlation to neonatal mortality i.e. the early life of the child is impacted by the health of the mother.

Maternal Indicators-2015

All the plots done for 2005 were completed for 2015. See Mch_policy jupyter notebook for code in Github repository.

Analyses: Assessing and Comparing Changes in Maternal Indicators between the decades

Pandas analyses on descriptive statistics were carried out on the datasets for 1995, 2005 and 2015 and most can be found in the code in the Github repository in the Drangle Jupyter notebook. Once we have completed our statistics and machine learning module I will try to incorperate more in this section.

For eg. below is a summary stat table for the 2015 data

In [14]:
```
from Drangle import indi_15
summary15=indi_15.describe()
summary15
```

Out[14]:

	Year	FemPop	GdpCap	Wrep_age15_49	Prev_Anae	Avg_MMR	Neonat_MR
count	13.0	1.300000e+01	13.000000	13.000000	13.000000	13.000000	13.000000
mean	2015.0	1.082402e+06	15851.423846	570.184231	24.361538	109.000000	13.281262
std	0.0	1.883032e+06	8738.850481	995.839321	8.789154	121.031676	6.613892
min	2015.0	4.711300e+04	3102.340000	26.132000	16.000000	25.000000	4.249840
25%	2015.0	8.823900e+04	11261.780000	50.925000	19.200000	43.000000	10.065210
50%	2015.0	2.038580e+05	15142.060000	103.962000	21.600000	74.000000	11.018600
75%	2015.0	7.405810e+05	18594.540000	355.087000	23.900000	115.000000	12.681690
max	2015.0	5.317598e+06	36023.590000	2828.054000	49.300000	488.000000	27.069100

Conclusions

A finding from the data suggests that Country Income and GDP per capita correlates with maternal and child health outcomes. Another finiding is that the total numbers of policies does not have any significant relationship with health outcomes. I had expected that number of policies might be associated with the overall strength of the healthcare system but this does not seem to be the case, as the countries with two or more policies seemed to have poorer health outcomes compared to those with 0 or none. Moreover the number of policies showed little connection to country wealth as well.

When comparing across the years 1995, 2005 and 2015 it was seen that there was an increase in the average GDP per capita across these years and corresponding decreases in maternal and neonatal mortality as well as anaemia prevalence in pregnant women. These differences have standard deviations of between 0.6 to 0.8. However these trends are only seen when comparing between years and are less clear within years. This is possible due to the small data set of less than 20 countries and as the region is mostly homogenous is cultural, social and demographic makeup the data points more or less overlap making it harder to notice profound differences.

It is worth exploring this data amongst the wider Latin America and Caribbean region, and with more indicators detailing maternal and child health outcomes. Mortality as a proxy for health is poor, and it would be more insightful to see what mother and child are dying from.. If these diseases are mostly treatable and preventable it might give further insight into the connection between healthcare access, poverty and subsequent health outcomes. Secondaly instead of focusing on the number of healthcare policies present the data could instead be health expenditure for maternal and child health services. This will see if policies present are actually being implemented and having an impact on the people they are supposed to help.

Reflection

I had a hard time making my data set work for me, and I wish I had the opportunity to get data on government expenditure that is more accessible. I think this would have helped me refine and have a more nuanced analysis for my research question. However the hardest part of the project was manipulating the data and deciding what visualization would serve the analysis best. It took a lot cleaning the data, ensuring no spaces in between words and ensuring the correct dtypes.

I had a fun time playing around with the modules and creating functions to use in my project file. I got a lot of practice using functions to manipulate dataframes and to create subplots that I would be using multiple times. It was also fun getting geometry data online and using to to create a map of the Caribbean and plotting a chloropleth map from it.

But overall I enjoyed working on this project and learning about visualations like pairplot, and I feel like I learned a lot. I hope I am able to use the Hypothesis testing that we learned from class to add more depth to my analysis and incorperate new visualizations that go into these potential varibale relationships that I might have overlooked.

I spent a total of twenty hours on this draft, most time was spent finding and cleaning data as well as coming up with a research idea.

Appendix (optional)

You can find my modules under their corresponding juptyer notebooks in my Github repository Link:
https://github.com/ininzliz/Mch_Indicators-Carib/tree/main/finalproject

In [ ]: