Read Data From Google Sheet

```
!pip install --upgrade gspread google-auth
```

```
Requirement already satisfied: gspread in /usr/local/lib/python3.10/dist-packages (6.1.2)
Requirement already satisfied: google-auth in /usr/local/lib/python3.10/dist-packages (2.33.0)
Requirement already satisfied: google-auth-oauthlib>=0.4.1 in /usr/local/lib/python3.10/dist-packages (from gspread) (1.2.1)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from google-auth) (5.4.0)
Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from google-auth) (0.4.0)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.10/dist-packages (from google-auth) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from google-auth-oauthlib>=0.4.1->g
Requirement already satisfied: pyasn1<0.7.0,>=0.4.6 in /usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1->google-auth
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.10/dist-packages (from requests-oauthlib>=0.7.0->google-auth-o
Requirement already satisfied: requests>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from requests-oauthlib>=0.7.0->google-auth-o
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests>=2.0.0->requests-oaut
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests>=2.0.0->requests-oauthlib>=0.7.0-
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests>=2.0.0->requests-oauthlib>=
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests>=2.0.0->requests-oauthlib>=
```

```
from google.colab import auth
auth.authenticate_user()

import gspread
from google.auth import default
creds, _ = default()

gc = gspread.authorize(creds)


# Open a sheet from a spreadsheet by name
spreadsheet = gc.open('DPAM Population-weighted coverage of health services')

# If you have the URL, you can do it this way:
# spreadsheet = gc.open_by_url('Your_Spreadsheet_URL')
```

Data preparation and Cleaning

on-track and off-track countries dataset

```
# Get a worksheet by name
worksheet = spreadsheet.worksheet('On & off-track countries')

# Get all values from the worksheet
rows = worksheet.get_all_values()




#Convert data to pandas DataFrame (if needed)
import pandas as pd
on_off_track_df = pd.DataFrame.from_records(rows[1:],columns=rows[0])  # Skip header row


# Checking for any missing values and the data types in the dataframe
on_off_track_df.info()

# Summary statistics to understand numerical columns, although most data seems categorical
on_off_track_df.describe(include='all')
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 3 columns):
 #   Column        Non-Null Count  Dtype 
---  ------        --------------  ----- 
 0   ISO3Code      200 non-null    object
 1   OfficialName  200 non-null    object
 2   Status.U5MR   200 non-null    object
dtypes: object(3)
memory usage: 4.8+ KB
```

	ISO3Code	OfficialName	Status.U5MR
count	200	200	200
unique	200	200	3
top	AFG	Afghanistan	Achieved
freq	1	1	134

```
# Step 1: Check for duplicates
duplicates = on_off_track_df.duplicated().sum()

# Step 2: Checking the unique values in the "Status.U5MR" column to ensure consistency
unique_status_values = on_off_track_df['Status.U5MR'].unique()

# Step 3: Renaming columns for clarity
on_off_track_df_cleaned = on_off_track_df.rename(columns={
    'ISO3Code': 'Country Code',
    'OfficialName': 'Country Name',
    'Status.U5MR': 'U5MR Status'
})

# Displaying the results
duplicates, unique_status_values, on_off_track_df_cleaned.head()
```

```
(0,
 array(['Acceleration Needed', 'Achieved', 'On Track'], dtype=object),
   Country Code Country Name          U5MR Status
 0          AFG  Afghanistan  Acceleration Needed
 1          AGO       Angola  Acceleration Needed
 2          AIA     Anguilla             Achieved
 3          ALB      Albania             Achieved
 4          AND      Andorra             Achieved)
```

```
# Updating the values in the 'U5MR Status' column
on_off_track_df_cleaned['U5MR Status'] = on_off_track_df_cleaned['U5MR Status'].replace({
    'Achieved': 'On-Track',
    'On Track': 'On-Track',
    'Acceleration Needed': 'Off-Track'
})

# Displaying the first few rows to confirm the changes
on_off_track_df_cleaned.head()
```

	Country Code	Country Name	U5MR Status
0	AFG	Afghanistan	Off-Track
1	AGO	Angola	Off-Track
2	AIA	Anguilla	On-Track
3	ALB	Albania	On-Track
4	AND	Andorra	On-Track

Extract on-track and off-track cleaned data countries dataset to new Google sheet

```
# Add a new sheet with a name and specify rows and columns
worksheet_title = 'on_off_track_df_cleaned'

ws = spreadsheet.worksheet(worksheet_title)
```

```
# Use the gspread_dataframe to set the DataFrame to the sheet
from gspread_dataframe import set_with_dataframe
# Set the DataFrame to the worksheet
set_with_dataframe(ws, on_off_track_df_cleaned)
```

ANC4 & SAB Data

```
# Get a worksheet by name
ANC4_SAB_worksheet = spreadsheet.worksheet('ANC4 & SAB Data')

# Get all values from the worksheet
ANC4_SAB_rows = ANC4_SAB_worksheet.get_all_values()


# Checking the general information and structure of the ANC4 & SAB Data sheet
anc4_sab_df = pd.DataFrame.from_records(ANC4_SAB_rows[1:],columns=ANC4_SAB_rows[0])  # Skip header row
anc4_sab_df.info()

# Summary statistics for numerical columns
anc4_sab_df.describe(include='all')
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 291 entries, 0 to 290
Data columns (total 8 columns):
 #   Column           Non-Null Count  Dtype 
---  ------           --------------  ----- 
 0   Geographic area  291 non-null    object
 1   Indicator        291 non-null    object
 2   Sex              291 non-null    object
 3   2022             291 non-null    object
 4   2021             291 non-null    object
 5   2020             291 non-null    object
 6   2019             291 non-null    object
 7   2018             291 non-null    object
dtypes: object(8)
memory usage: 18.3+ KB
```

	Geographic area	Indicator	Sex	2022	2021	2020	2019	2018
count	291	291	291	291	291	291	291	291
unique	181	2	1	62	34	54	71	84
top	Latin America and the Caribbean	Skilled birth attendant - percentage of delive...	Female	-	-	-	-	-
freq	7	159	291	210	251	213	175	159

```
# Converting the column names to strings
anc4_sab_df.columns = anc4_sab_df.columns.astype(str)


year_columns = ['2022', '2021', '2020', '2019', '2018']
anc4_sab_df[year_columns] = anc4_sab_df[year_columns].apply(pd.to_numeric, errors='coerce')

# Step 3: Drop the "Sex" column as it is redundant
anc4_sab_df_cleaned = anc4_sab_df.drop(columns=['Sex'])

# Displaying the cleaned data to verify
anc4_sab_df_cleaned.head()
```

	Geographic area	Indicator	2022	2021	2020	2019	2018
0	Afghanistan	Antenatal care 4+ visits - percentage of women...	NaN	NaN	27.6	NaN	20.9
1	Afghanistan	Skilled birth attendant - percentage of delive...	NaN	NaN	61.8	NaN	58.8
2	Africa	Antenatal care 4+ visits - percentage of women...	56.8	NaN	NaN	NaN	NaN
3	Africa	Skilled birth attendant - percentage of delive...	71.0	NaN	NaN	NaN	NaN
4	Albania	Antenatal care 4+ visits - percentage of women...	NaN	NaN	NaN	NaN	77.8

```
# Creating a new column 'Most Recent Coverage Estimate' which takes the most recent non-null value from 2018 to 2022
anc4_sab_df_cleaned['Most Recent Coverage Estimate'] = anc4_sab_df_cleaned[year_columns].bfill(axis=1).iloc[:, 0]

# Displaying the updated dataframe
anc4_sab_df_cleaned.head()
```

	Geographic area	Indicator	2022	2021	2020	2019	2018	Most Recent Coverage Estimate
0	Afghanistan	Antenatal care 4+ visits - percentage of women...	NaN	NaN	27.6	NaN	20.9	27.6
1	Afghanistan	Skilled birth attendant - percentage of delive...	NaN	NaN	61.8	NaN	58.8	61.8
2	Africa	Antenatal care 4+ visits - percentage of women...	56.8	NaN	NaN	NaN	NaN	56.8
3	Africa	Skilled birth attendant - percentage of delive...	71.0	NaN	NaN	NaN	NaN	71.0
4	Albania	Antenatal care 4+ visits - percentage of women...	NaN	NaN	NaN	NaN	77.8	77.8

```
# Dropping the year columns as requested
anc4_sab_df_cleaned = anc4_sab_df_cleaned.drop(columns=year_columns)

# Displaying the cleaned dataframe with the year columns removed
anc4_sab_df_cleaned.head()
```

	Geographic area	Indicator	Most Recent Coverage Estimate
0	Afghanistan	Antenatal care 4+ visits - percentage of women...	27.6
1	Afghanistan	Skilled birth attendant - percentage of delive...	61.8
2	Africa	Antenatal care 4+ visits - percentage of women...	56.8
3	Africa	Skilled birth attendant - percentage of delive...	71.0
4	Albania	Antenatal care 4+ visits - percentage of women...	77.8

```
# Replacing the values in the 'Indicator' column as requested
anc4_sab_df_cleaned['Indicator'] = anc4_sab_df_cleaned['Indicator'].replace({
    'Antenatal care 4+ visits - percentage of women (aged 15-49 years) attended at least four times during pregnancy by any provider': 'ANC4',
    'Skilled birth attendant - percentage of deliveries attended by skilled health personnel': 'SAB'
})

# Displaying the updated dataframe to confirm changes
anc4_sab_df_cleaned.head()
```

	Geographic area	Indicator	Most Recent Coverage Estimate
0	Afghanistan	ANC4	27.6
1	Afghanistan	SAB	61.8
2	Africa	ANC4	56.8
3	Africa	SAB	71.0
4	Albania	ANC4	77.8

```
# Creating a pivot table with 'Geographic area' as the index, 'Indicator' as columns, and summing 'Most Recent Coverage Estimate'
anc4_sab_pivot = anc4_sab_df_cleaned.pivot_table(
    index='Geographic area',
    columns='Indicator',
    values='Most Recent Coverage Estimate',
    aggfunc='sum'
).reset_index()

# Displaying the resulting pivot table
anc4_sab_pivot.head()
```

Indicator	Geographic area	ANC4	SAB
0	Afghanistan	27.6	61.8
1	Africa	56.8	71.0
2	Albania	77.8	99.8
3	Algeria	69.8	98.8
4	Americas	94.0	96.8

```
# Renaming the 'Geographic area' column to 'Country Name'
anc4_sab_pivot.rename(columns={'Geographic area': 'Country Name'}, inplace=True)

# Displaying the updated pivot table
anc4_sab_pivot.head()
```

Indicator	Country Name	ANC4	SAB
0	Afghanistan	27.6	61.8
1	Africa	56.8	71.0
2	Albania	77.8	99.8
3	Algeria	69.8	98.8
4	Americas	94.0	96.8

Extract ANC4 & SAB cleaned dataset to new Google sheet

```
# Add a new sheet with a name and specify rows and columns
worksheet_title = 'anc4_sab_df_cleaned'

ws = spreadsheet.worksheet(worksheet_title)


# Use the gspread_dataframe to set the DataFrame to the sheet
from gspread_dataframe import set_with_dataframe
# Set the DataFrame to the worksheet
set_with_dataframe(ws, anc4_sab_pivot)
```

Population data

```
# Get a worksheet by name
population_worksheet = spreadsheet.worksheet('Population data')

# Get all values from the worksheet
population_rows = population_worksheet.get_all_values()

# Checking the general information and structure of the ANC4 & SAB Data sheet
population_df = pd.DataFrame.from_records(population_rows[1:],columns=population_rows[0])  # Skip header row
population_df.info()

# Filtering the Projections Population  data where Year = 2022 and Type = 'Country/Area'
population_df_filtered = population_df[
    (population_df['Year'] == '2022') &
    (population_df['Type'] == 'Country/Area')
]

# Selecting the relevant columns as per the user's request
selected_columns = [
    'Index',
    'Variant',
    'Region, subregion, country or area *',
    'Notes',
    'Location code',
    'ISO3 Alpha-code',
    'ISO2 Alpha-code',
    'SDMX code**',
    'Type',
    'Parent code',
    'Year',
    'Total Population, as of 1 January (thousands)',
    'Total Population, as of 1 July (thousands)',
    'Male Population, as of 1 July (thousands)',
    'Female Population, as of 1 July (thousands)',
    'Births (thousands)',
    'Births by women aged 15 to 19 (thousands)',
    'Crude Birth Rate (births per 1,000 population)',
    'Total Fertility Rate (live births per woman)',
    'Net Reproduction Rate (surviving daughters per woman)',
    'Mean Age Childbearing (years)',
    'Sex Ratio at Birth (males per 100 female births)',
    'Live Births Surviving to Age 1 (thousands)',
    'Under-Five Deaths, under age 5 (thousands)',
    'Under-Five Mortality (deaths under age 5 per 1,000 live births)'
]

# Selecting only these columns and dropping others
population_df_selected = population_df_filtered[selected_columns]



# Renaming the columns
population_df_selected.rename(columns={
    'Region, subregion, country or area *': 'Country Name',
    'ISO3 Alpha-code': 'Country Code'
}, inplace=True)

# Displaying the first few rows to confirm the changes
population_df_selected.head()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 237 entries, 0 to 236
Data columns (total 25 columns):
 #   Column                                                    Non-Null Count  Dtype
---  ------                                                    --------------  -----
 0   Index                                                     237 non-null    object
 1   Variant                                                   237 non-null    object
 2   Region, subregion, country or area *                      237 non-null    object
 3   Notes                                                     237 non-null    object
 4   Location code                                             237 non-null    object
 5   ISO3 Alpha-code                                           237 non-null    object
 6   ISO2 Alpha-code                                           237 non-null    object
 7   SDMX code**                                               237 non-null    object
 8   Type                                                      237 non-null    object
 9   Parent code                                               237 non-null    object
 10  Year                                                      237 non-null    object
 11  Total Population, as of 1 January (thousands)             237 non-null    object
 12  Total Population, as of 1 July (thousands)                237 non-null    object
 13  Male Population, as of 1 July (thousands)                 237 non-null    object
 14  Female Population, as of 1 July (thousands)               237 non-null    object
 15  Births (thousands)                                        237 non-null    object
 16  Births by women aged 15 to 19 (thousands)                 237 non-null    object
 17  Crude Birth Rate (births per 1,000 population)            237 non-null    object
 18  Total Fertility Rate (live births per woman)              237 non-null    object
 19  Net Reproduction Rate (surviving daughters per woman)     237 non-null    object
 20  Mean Age Childbearing (years)                             237 non-null    object
 21  Sex Ratio at Birth (males per 100 female births)          237 non-null    object
 22  Live Births Surviving to Age 1 (thousands)                237 non-null    object
 23  Under-Five Deaths, under age 5 (thousands)                237 non-null    object
 24  Under-Five Mortality (deaths under age 5 per 1,000 live births)  237 non-null    object
dtypes: object(25)
memory usage: 46.4+ KB
```

	Index	Variant	Country Name	Notes	Location code	Country Code	ISO2 Alpha-code	SDMX code**	Type	Parent code	...	Births (thousands)	Births by women aged 15 to 19 (thousands)	Crude Birth Rate (births per 1,000 population)	Fe
0	1901	Medium	Burundi		108	BDI	BI	108	Country/Area	910	...	440.0	37.0	34.1	
1	1980	Medium	Comoros		174	COM	KM	174	Country/Area	910	...	24.0	2.0	28.9	
2	2059	Medium	Djibouti		262	DJI	DJ	262	Country/Area	910	...	25.0	1.0	21.9	
3	2138	Medium	Eritrea		232	ERI	ER	232	Country/Area	910	...	105.0	14.0	28.4	
4	2217	Medium	Ethiopia		231	ETH	ET	231	Country/Area	910	...	3 928	450.0	31.8	

5 rows × 25 columns

```
# Merging all three datasets on 'Country Name'
merged_df = pd.merge(on_off_track_df_cleaned,anc4_sab_pivot, on='Country Name', how='left')
merged_df = pd.merge(merged_df, population_df_selected, on='Country Name', how='left')

# Displaying the first few rows of the merged dataset
merged_df.head()
```

	Country Code_x	Country Name	U5MR Status	ANC4	SAB	Index	Variant	Notes	Location code	Country Code_y	...	Births (thousands)	Births by women aged 15 to 19 (thousands)	Crude Birth Rate (births per 1,000 population)	Tot Fertili Ra (li birt p woma
0	AFG	Afghanistan	Off-Track	27.6	61.8	8142	Medium		4	AFG	...	1 447	187.0	35.1	
1	AGO	Angola	Off-Track	NaN	NaN	3560	Medium		24	AGO	...	1 360	254.0	38.2	
2	AIA	Anguilla	On-Track	NaN	100.0	15805	Medium	19	660	AIA	...	0	0	9.4	
3	ALB	Albania	On-Track	77.8	99.8	13514	Medium		8	ALB	...	29.0	1.0	10.1	
4	AND	Andorra	On-Track	NaN	NaN	13593	Medium		20	AND	...	1.0	0	7.2	

5 rows × 29 columns

Extract Whole Clean and prepare data to Google Sheet

```
# Add a new sheet with a name and specify rows and columns
worksheet_title = 'Merged_Cleaned_Data'

ws = spreadsheet.worksheet(worksheet_title)
# Use the gspread_dataframe to set the DataFrame to the sheet
from gspread_dataframe import set_with_dataframe
# Set the DataFrame to the worksheet
set_with_dataframe(ws, merged_df)
```

Calculate weighted averages for on-track and off-track countries

Filter the data where ANC4 or SAB have a value (not NaN) for countries with a coverage estimate between 2018 to 2022

```
df = merged_df
# Filter the data where ANC4 or SAB have a value (not NaN)  for countries with a coverage estimate between 2018 to 2022.
filtered_df = df[(df['ANC4'].notna()) | (df['SAB'].notna())]
```

Identify the Variables:

- $x\ i$: This will be the ANC4 and SAB coverage for each country.
- $w\ i$: This will be the number of projected Births (thousands)*1000 (which we can approximate using the births data available).

Apply the Formula:

- Calculate the numerator: $\sum i = 1\ n\ x\ i\ w\ i$ ∑ i=1 nx iw i, which is the sum of the product of coverage and births across all countries in each category (on-track and off-track).
- Calculate the denominator:$\sum i = 1\ n\ w\ i$ ∑ i=1 nw i, which is the total number of projected births for all countries in each category.
- Divide the numerator by the denominator to get the weighted coverage.

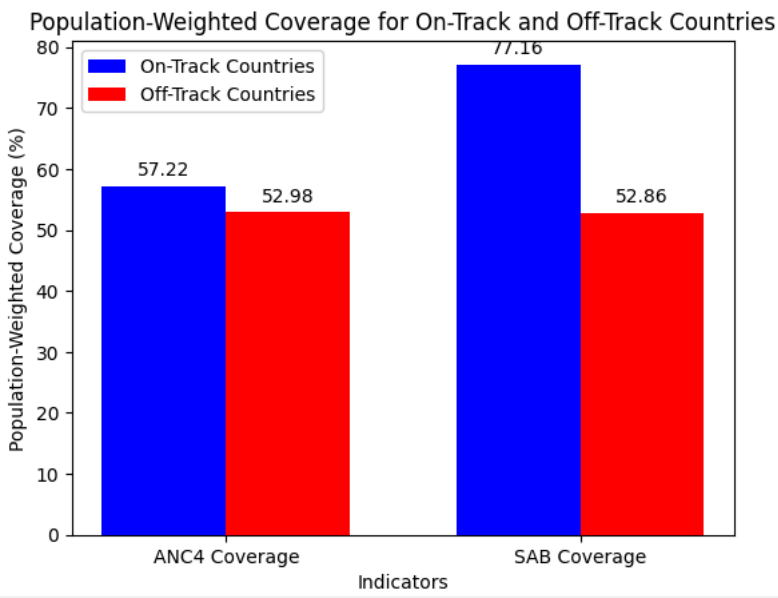
```
import pandas as pd
import matplotlib.pyplot as plt
df = filtered_df


# Filtering the data for On-Track and Off-Track countries
on_track_df = df[df['U5MR Status'] == 'On-Track'].copy()
off_track_df = df[df['U5MR Status'] == 'Off-Track'].copy()

# Cleaning birth data by removing commas and spaces, and converting to float
on_track_df.loc[:, 'Births (thousands)'] = on_track_df['Births (thousands)'].str.replace(',', '').str.replace(' ', '').astype(float)
off_track_df.loc[:, 'Births (thousands)'] = off_track_df['Births (thousands)'].str.replace(',', '').str.replace(' ', '').astype(float)

# Adjusting the birth numbers by multiplying by 1000
on_track_df.loc[:, 'Births (thousands)'] = on_track_df['Births (thousands)'] * 1000
off_track_df.loc[:, 'Births (thousands)'] = off_track_df['Births (thousands)'] * 1000



# Calculating the numerator for on-track and off-track countries
numerator_anc4_on_track = (on_track_df['ANC4'] * on_track_df['Births (thousands)']).sum()
numerator_sab_on_track = (on_track_df['SAB'] * on_track_df['Births (thousands)']).sum()

numerator_anc4_off_track = (off_track_df['ANC4'] * off_track_df['Births (thousands)']).sum()
numerator_sab_off_track = (off_track_df['SAB'] * off_track_df['Births (thousands)']).sum()

# Calculating the denominator (total births) for on-track and off-track countries
denominator_on_track = on_track_df['Births (thousands)'].sum()
denominator_off_track = off_track_df['Births (thousands)'].sum()

# Calculating the weighted coverage for ANC4 and SAB
weighted_coverage_anc4_on_track = numerator_anc4_on_track / denominator_on_track
weighted_coverage_sab_on_track = numerator_sab_on_track / denominator_on_track

weighted_coverage_anc4_off_track = numerator_anc4_off_track / denominator_off_track
weighted_coverage_sab_off_track = numerator_sab_off_track / denominator_off_track


(weighted_coverage_anc4_on_track, weighted_coverage_sab_on_track, weighted_coverage_anc4_off_track, weighted_coverage_sab_off_track)
```

```
(57.224890978166066, 77.15541561340488, 52.97644857743828, 52.859515111258716)
```

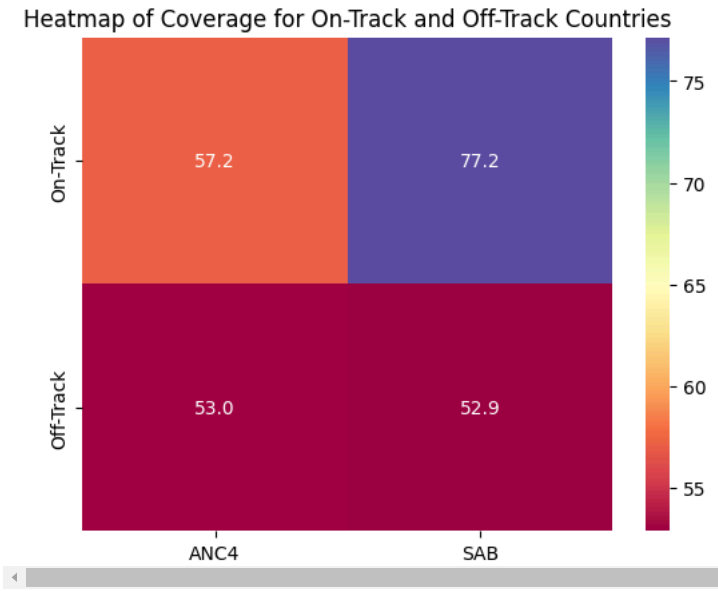
Visualization

Create a visualization of your choice comparing population-weighted coverage estimates for on-track and off-track countries for each indicator, with a short paragraph on interpretation and caveats.

```
# Data to plot
categories = ['ANC4 Coverage', 'SAB Coverage']
on_track_values = [weighted_coverage_anc4_on_track, weighted_coverage_sab_on_track]
off_track_values = [weighted_coverage_anc4_off_track, weighted_coverage_sab_off_track]

# Create a bar chart
fig, ax = plt.subplots()
bar_width = 0.35
index = range(len(categories))

bar1 = ax.bar(index, on_track_values, bar_width, label='On-Track Countries', color='blue')
bar2 = ax.bar([i + bar_width for i in index], off_track_values, bar_width, label='Off-Track Countries', color='red')

# Adding labels and title
ax.set_xlabel('Indicators')
ax.set_ylabel('Population-Weighted Coverage (%)')
ax.set_title('Population-Weighted Coverage for On-Track and Off-Track Countries')
ax.set_xticks([i + bar_width/2 for i in index])
ax.set_xticklabels(categories)
ax.legend()

# Adding data labels on top of bars
for bar in bar1:
    yval = bar.get_height()
    ax.text(bar.get_x() + bar.get_width()/2, yval + 1, round(yval, 2), ha='center', va='bottom', fontsize=10)

for bar in bar2:
    yval = bar.get_height()
    ax.text(bar.get_x() + bar.get_width()/2, yval + 1, round(yval, 2), ha='center', va='bottom', fontsize=10)

# Display the plot
plt.show()
```




```
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np

# Create synthetic data for demonstration, replace with actual data if available
heatmap_data = np.array([[weighted_coverage_anc4_on_track, weighted_coverage_sab_on_track],
                         [weighted_coverage_anc4_off_track, weighted_coverage_sab_off_track]])

# Create a heatmap
fig, ax = plt.subplots()
sns.heatmap(heatmap_data, annot=True, fmt=".1f", cmap='Spectral', xticklabels=['ANC4', 'SAB'], yticklabels=['On-Track', 'Off-Track'])

# Adding title
ax.set_title('Heatmap of Coverage for On-Track and Off-Track Countries')

# Display the plot
plt.show()
```




```
# Calculating the weighted coverage for ANC4 and SAB per country
df=filtered_df
# Cleaning birth data by removing commas and spaces, and converting to float for the entire dataset
df['Births (thousands)'] = df['Births (thousands)'].astype(str).str.replace(',', '').str.replace(' ', '').astype(float)

# Adjusting the birth numbers by multiplying by 1000
df['Births (thousands)'] = df['Births (thousands)'] * 1000

# Calculating the weighted coverage for ANC4 and SAB per country
df['Weighted ANC4'] = df['ANC4'] * df['Births (thousands)'] / df['Births (thousands)'].sum()
df['Weighted SAB'] = df['SAB'] * df['Births (thousands)'] / df['Births (thousands)'].sum()

# Selecting relevant columns for display
weighted_coverage_df = df[['Country Name', 'Weighted ANC4', 'Weighted SAB']]

weighted_coverage_df.head()
```

	Country Name	Weighted ANC4	Weighted SAB
0	Afghanistan	0.354016	0.792687
2	Anguilla	NaN	0.000000
3	Albania	0.020000	0.025655
5	United Arab Emirates	NaN	0.081779
6	Argentina	0.503237	0.549998

```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt

# Load the provided Excel file

df

# Load a world map with simplified geometry to avoid complex issues
world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))

# Merge the world map with the provided data on country codes (ISO Alpha-3 code)
merged_df = world.merge(df, left_on='iso_a3', right_on='Country Code_y', how='left')

# Plotting the map
fig, ax = plt.subplots(1, 1, figsize=(15, 10))
merged_df.boundary.plot(ax=ax, linewidth=1)
merged_df.plot(column='Weighted ANC4', ax=ax, legend=True, cmap='Blues',
               legend_kwds={'label': "Weighted ANC4 (%)", 'orientation': "horizontal"})

# Annotate each country with its Weighted ANC4 value
for idx, row in merged_df.iterrows():
    if not pd.isna(row['Weighted ANC4']):
        plt.text(x=row['geometry'].centroid.x,
                 y=row['geometry'].centroid.y,
                 s=f'{row["Weighted ANC4"]:.2f}',
                 fontsize=8,
                 ha='center',
                 color='black')


ax.set_title('Weighted ANC4 Rate by Country', fontsize=15)
ax.set_axis_off()

plt.show()
```

```
import pandas as pd
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# Plotting the map
fig, ax = plt.subplots(1, 1, figsize=(15, 10))
merged_df.boundary.plot(ax=ax, linewidth=1)
merged_df.plot(column='Weighted SAB', ax=ax, legend=True, cmap='Blues',
               legend_kwds={'label': "Weighted SAB (%)", 'orientation': "horizontal"})

# Annotate each country with its Weighted ANC4 value
for idx, row in merged_df.iterrows():
    if not pd.isna(row['Weighted SAB']):
        plt.text(x=row['geometry'].centroid.x,
                 y=row['geometry'].centroid.y,
                 s=f'{row["Weighted SAB"]:.2f}',
                 fontsize=8,
                 ha='center',
                 color='black')


ax.set_title('Weighted SAB Rate by Country', fontsize=15)
ax.set_axis_off()

plt.show()
```

```
<ipython-input-121-ef85904ceff1>:10: FutureWarning: The geopandas.dataset module is deprecated and will be removed in GeoPandas 1.0. Yo
  world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
```