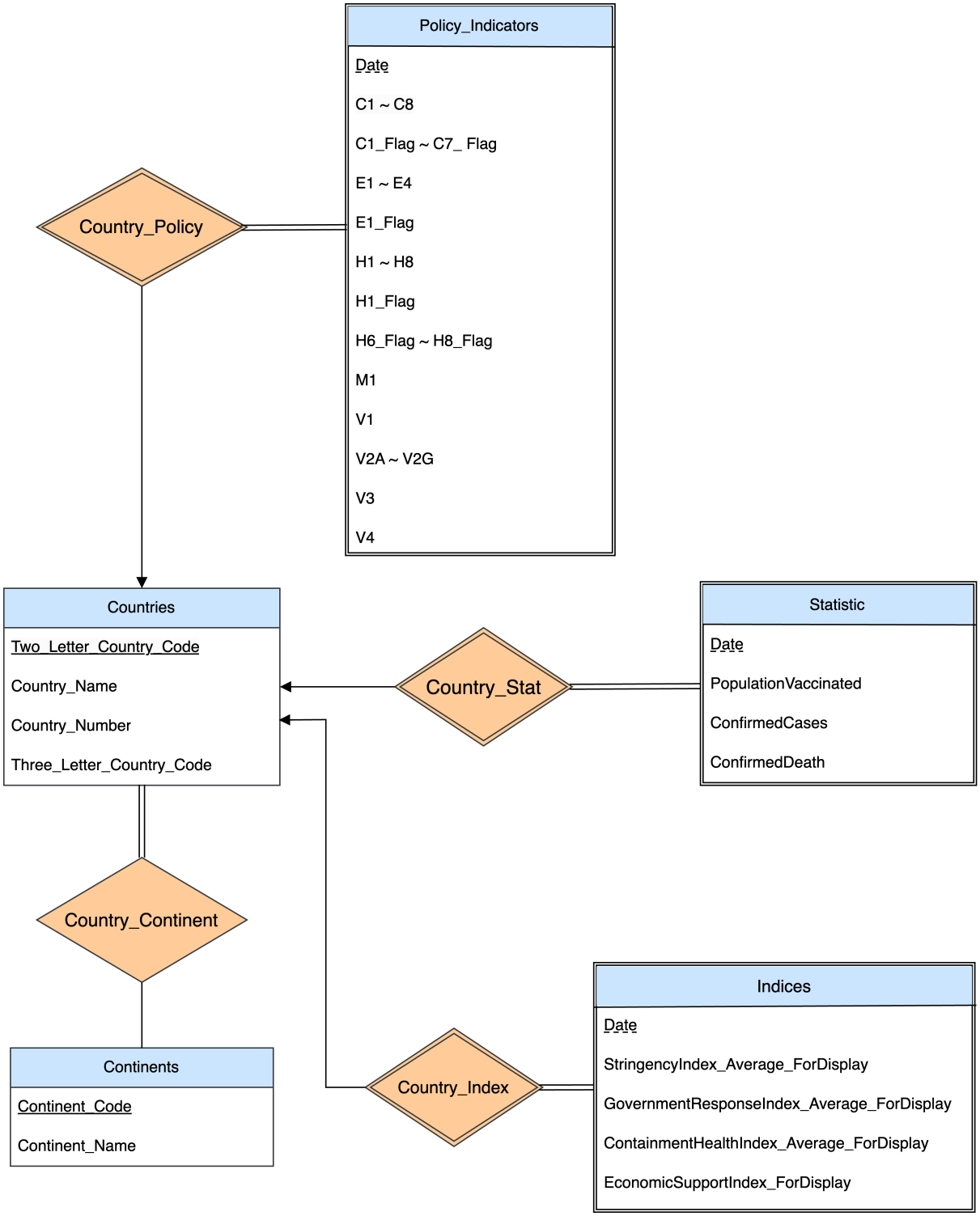
Database - HW2

Part 1

ER Diagram



Avoid Redundancy

- Keep every relation in BCNF to avoid redundancy. This will explain later.
- Remove columns *"RegionName"*, *"RegionCode"* and *"Jurisdiction"* . Because all datas from the columns of *"RegionName"* and *"RegionCode"* are all NULL data. And all datas from the column of *"Jurisdiction"* are all "NAT_TOTAL".

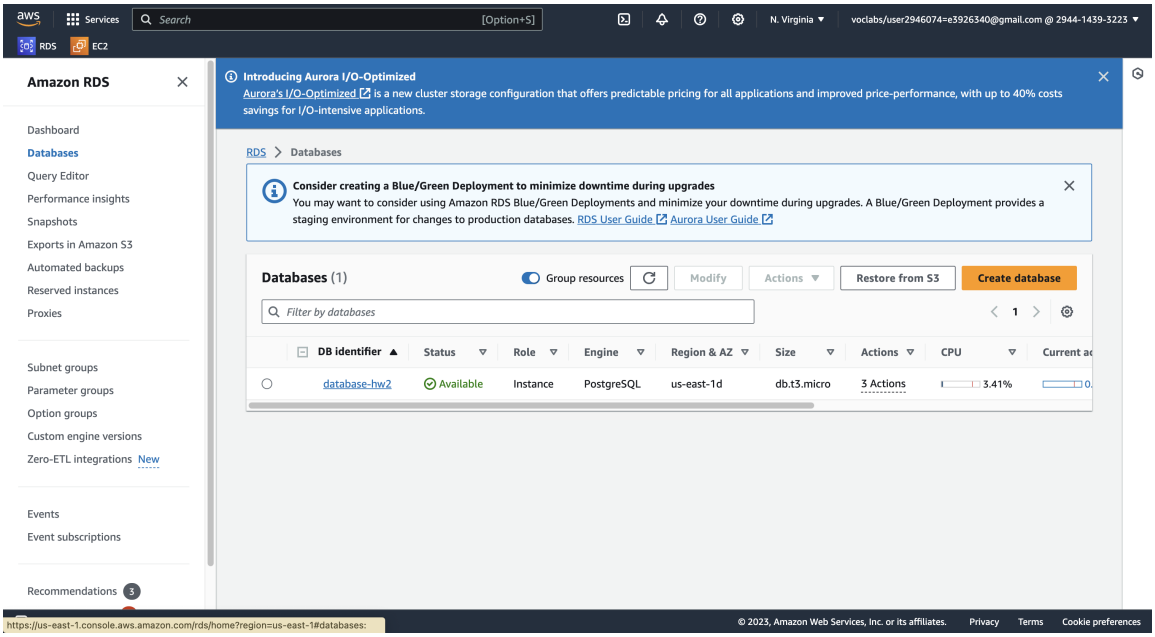
- Remove column *"MajorityVaccinated"* because it can be simply derived by *"PopulationVaccinated"*.
- Remove columns *"StringencyIndex_Average"*, *"GovernmentResponseIndex_Average"*, *"ContainmentHealthIndex_Average"*, *"EconomicSupportIndex"*. Because these datas are highly redundant with *"ForDisplay"* version. The only difference is that *"ForDisplay"* version have more datas than origin, so we can still have original version by deleting some rows if we want.

Add Constraints

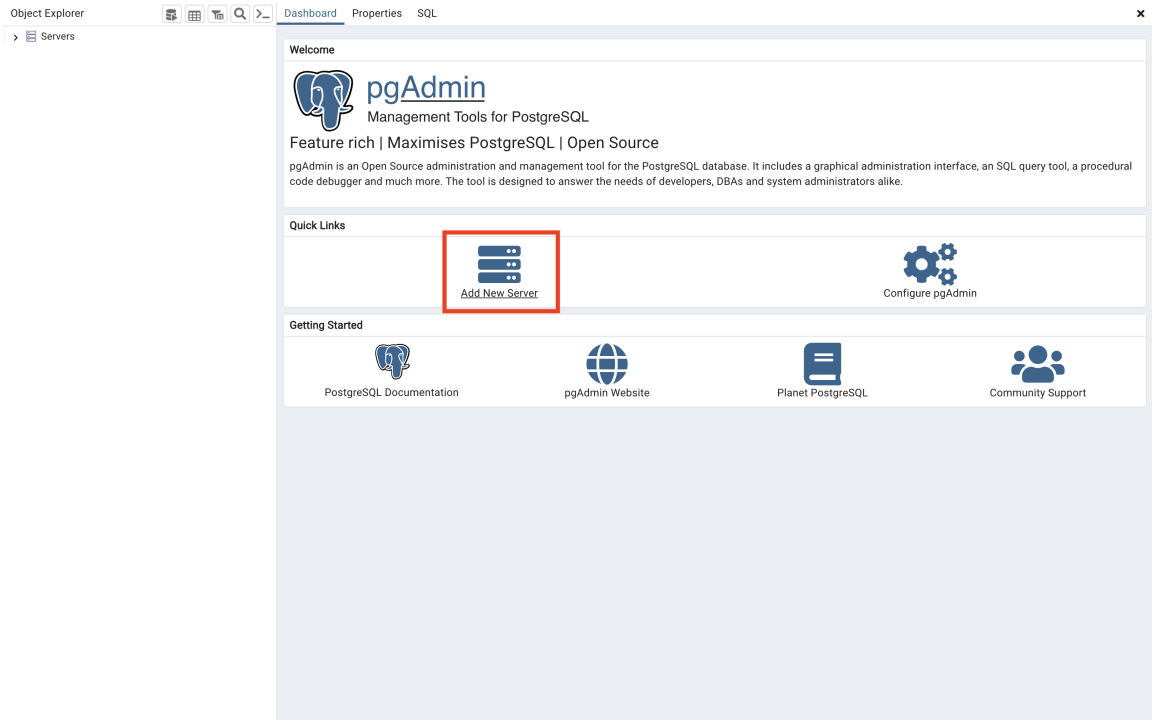
- Here we choose Many-to-Many cardinality constraint for *"Country_Continent"* relationship set. Because there are some countries that cross two continents, such as Turkey.
- *"Countries"* entity set has total participation in the relationship of *"Country_Continent"*. Because there exists a continent correspond to every country in "Countries" entity set. However, *"Continents"* entity set has partial participation. Because there doesn't exist a country in the *"Countries"* entity set that is in Antarctica.

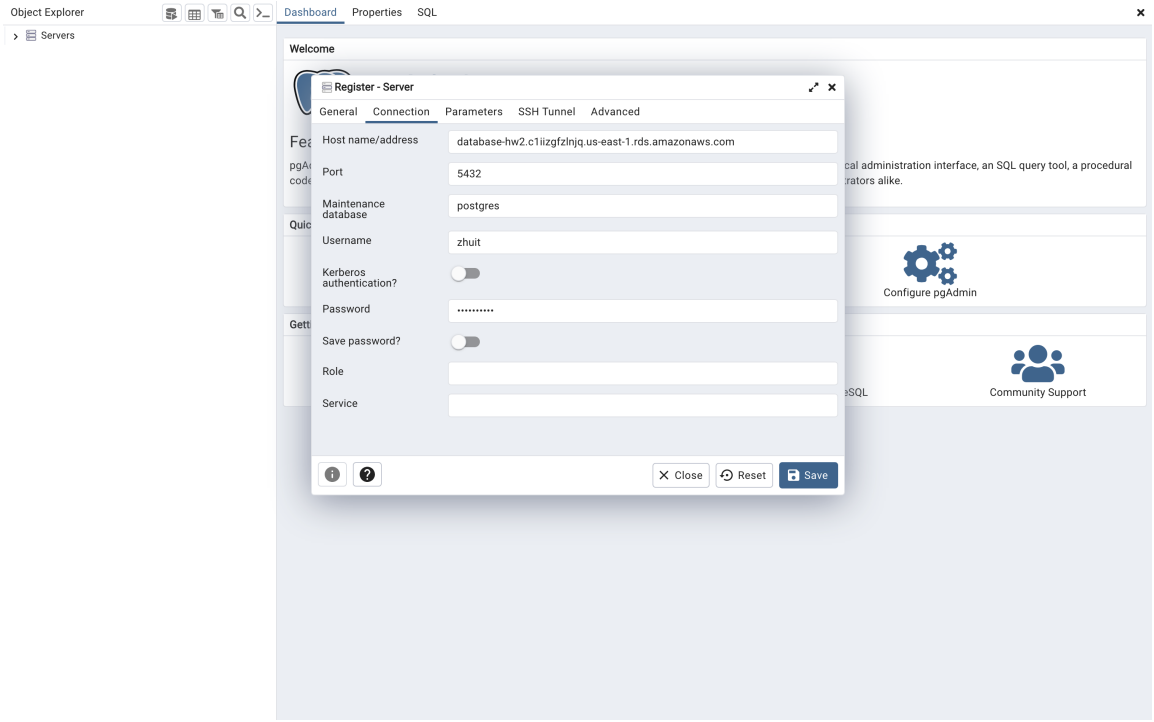
Part 2

- AWS RDS launch page



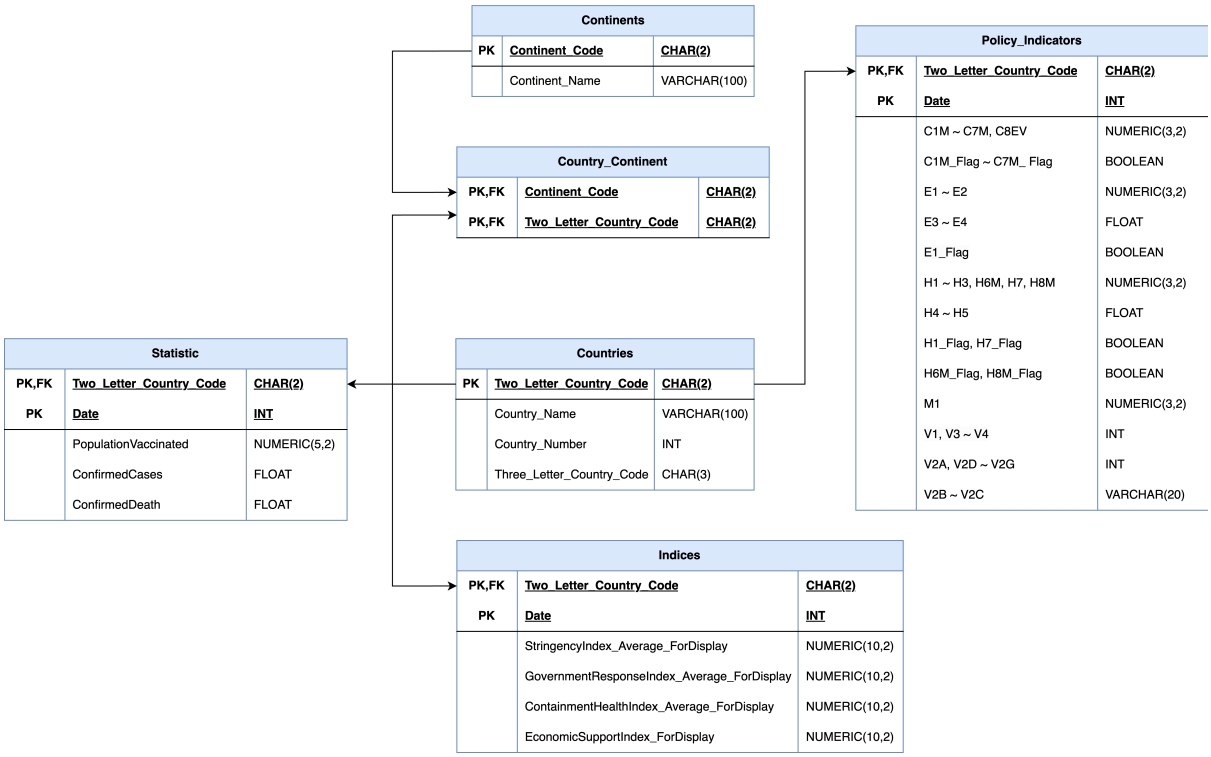
- Connect to the AWS RDS





Part 3

Schema Diagram



SQL queries to create table

▼ Create *"Countries"* Relation

```
CREATE TABLE public.Countries
(
    Two_Letter_Country_Code     CHAR(2),
    Three_Letter_Country_Code   CHAR(3),
    Country_Name                VARCHAR(100),
    Country_Number              INT,
    primary key (Two_Letter_Country_Code)
)
```

▼ Create *"Continents"* Relation

```
CREATE TABLE public.Continents
(
    Continent_Code              CHAR(2),
    Continent_Name              VARCHAR(100),
    primary key (Continent_Code)
)
```

▼ Create *"Country_Continent"* Relation

```
CREATE TABLE public.Country_Continent
(
    Two_Letter_Country_Code     CHAR(2),
    Continent_Code              CHAR(2),
    primary key (Two_Letter_Country_Code, Continent_Code),
    foreign key (Two_Letter_Country_Code) references Countries(Two_Letter_Country_Code),
    foreign key (Continent_Code) references Continents(Continent_Code)
)
```

▼ Create *"Policy_Indicators"* Relation

```
CREATE TABLE public.Policy_Indicators
(
    Two_Letter_Country_Code     CHAR(2),
    Date                        INT,
    C1M                 NUMERIC(3,2),
    C2M                 NUMERIC(3,2),
    C3M                 NUMERIC(3,2),
    C4M                 NUMERIC(3,2),
    C5M                 NUMERIC(3,2),
    C6M                 NUMERIC(3,2),
    C7M                 NUMERIC(3,2),
    C8EV                NUMERIC(3,2),
    C1M_Flag            BOOLEAN,
    C2M_Flag            BOOLEAN,
    C3M_Flag            BOOLEAN,
    C4M_Flag            BOOLEAN,
    C5M_Flag            BOOLEAN,
    C6M_Flag            BOOLEAN,
    C7M_Flag            BOOLEAN,
    E1                  NUMERIC(3,2),
    E2                  NUMERIC(3,2),
    E3                  FLOAT,
    E4                  FLOAT,
    E1_Flag             BOOLEAN,
    H1                  NUMERIC(3,2),
    H2                  NUMERIC(3,2),
    H3                  NUMERIC(3,2),
    H4                  FLOAT,
    H5                  FLOAT,
    H6M                 NUMERIC(3,2),
    H7                  NUMERIC(3,2),
    H8M                 NUMERIC(3,2),
    H1_Flag             BOOLEAN,
    H6M_Flag            BOOLEAN,
    H7_Flag             BOOLEAN,
    H8M_Flag            BOOLEAN,
    M1                  NUMERIC(3,2),
    V1                  INT,
    V2A                 V,
    V2B                 VARCHAR(20),
    V2C                 VARCHAR(20),
    V2D                 INT,
    V2E                 INT,
    V2F                 INT,
```

```
    V2G                 INT,
    V3                  INT,
    V4                  INT,
    primary key (Two_Letter_Country_Code, Date),
    foreign key (Two_Letter_Country_Code) references Countries(Two_Letter_Country_Code)
)
```

▼ Create *"Statistic"* Relation

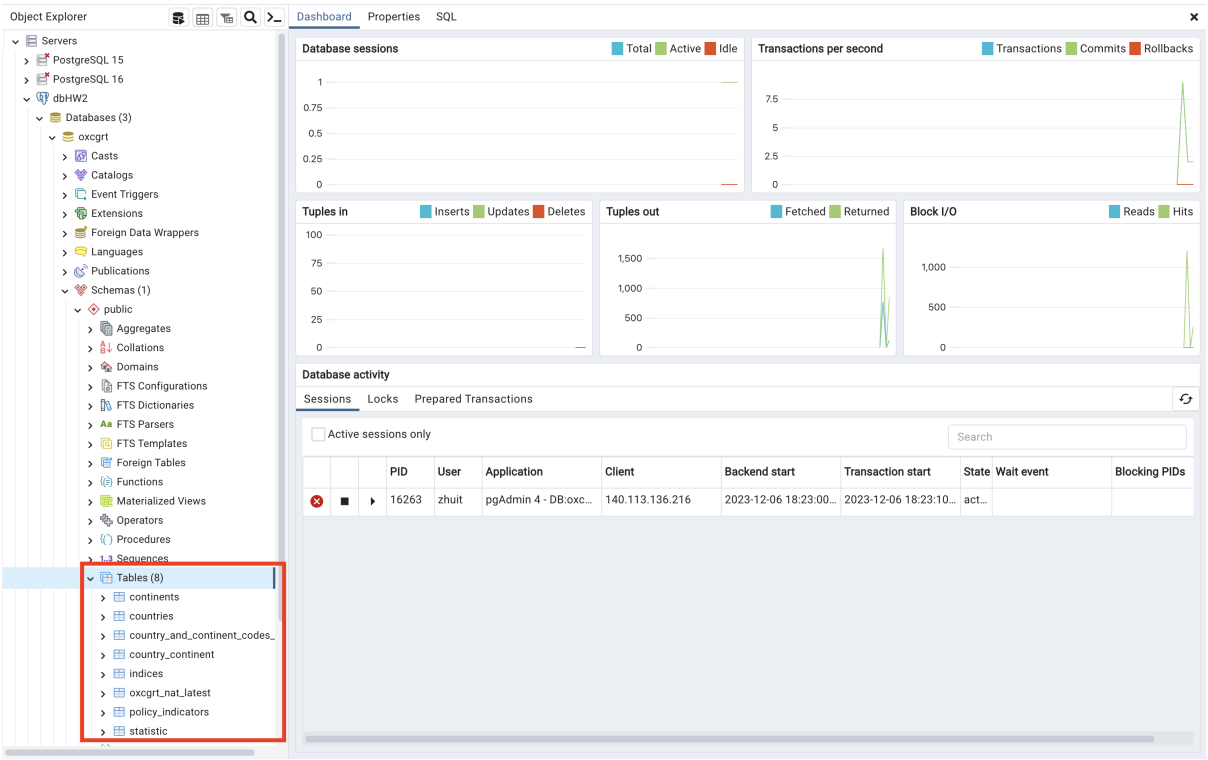
```
CREATE TABLE public.Statistic
(
    Two_Letter_Country_Code     CHAR(2),
    Date                        INT,
    PopulationVaccinated        NUMERIC(5,2),
    ConfirmedCases              FLOAT,
    ConfirmedDeath              FLOAT,
    primary key (Two_Letter_Country_Code, Date),
    foreign key (Two_Letter_Country_Code) references Countries(Two_Letter_Country_Code)
)
```

▼ Create *"Indices"* Relation

```
CREATE TABLE public.Indices
(
    Two_Letter_Country_Code                   CHAR(2),
    Date                                        INT,
    StringencyIndex_Average_ForDisplay          NUMERIC(10,2),
    GovernmentResponseIndex_Average_ForDisplay  NUMERIC(10,2),
    ContainmentHealthIndex_Average_ForDisplay   NUMERIC(10,2),
    EconomicSupportIndex_ForDisplay             NUMERIC(10,2),
    primary key (Two_Letter_Country_Code, Date),
    foreign key (Two_Letter_Country_Code) references Countries(Two_Letter_Country_Code)
)
```

ScreenShot

- "*oxcgrt_nat_latest"* and "*country_and_continent_codes_list"* are tables of original csv files.



Part 4

Test 1NF

- All datas from original csv file have no repeat group and all attributes are single value and atomic. So the original table are already 1NF.

In this part we need to test normal form of each tables, so we'll need to check functional dependency sets shown on the next part.

Countries

- Normal Form: **BCNF**
- Test Normal Form
  - Two_Letter_Country_Code is a candidate key for R.
  - Three_Letter_Country_Code is a candidate key for R.
  - Country_Name is a candidate key for R.
  - Country_Number is a candidate key for R.
  - So for all non-trivial functional dependencies $\alpha \rightarrow \beta$ in F^+, α are super key.
  - Thus it's BCNF.

Continent

- Normal Form: **BCNF**
- Test Normal Form
  - Continent_Code is a candidate key for R.
  - Continent_Name is a candidate key for R.
  - So for all non-trivial functional dependencies $\alpha \rightarrow \beta$ in F^+, α are super key.
  - Thus it's BCNF.

Country_Continent

- Normal Form: **BCNF**
- Test Normal Form
  - {Continent_Code, Two_Letter_Country_Code} is a candidate key for R.
  - So for all non-trivial functional dependencies $\alpha \rightarrow \beta$ in F^+, α are super key.
  - Thus it's BCNF.

Statistic

- Normal Form: **BCNF**
- Test Normal Form
  - {Continent_Code, Two_Letter_Country_Code} is a candidate key for R.
  - So for all non-trivial functional dependencies $\alpha \rightarrow \beta$ in F^+, α are super key.
  - Thus it's BCNF.

Indices

- Normal Form: **BCNF**
- Test Normal Form
  - {Continent_Code, Two_Letter_Country_Code} is a candidate key for R.
  - So for all non-trivial functional dependencies $\alpha \rightarrow \beta$ in F^+, α are super key.
  - Thus it's BCNF.

Policy_Indicators

- Normal Form: **BCNF**
- Test Normal Form

- {Continent_Code, Two_Letter_Country_Code} is a candidate key for R.
- So for all non-trivial functional dependencies $\alpha \rightarrow \beta$ in F^+, α are super key.
- Thus it's BCNF.

Part 5

Countries

```
Two_Letter_Country_Code -> R
Three_Letter_Country_Code -> R
Country_Name -> R
Country_Number -> R
```

Continent

```
Continent_Code -> Continent_Name
Continent_Name -> Continent_Code
```

Country_Continent

```
{Continent_Code, Two_Letter_Country_Code} -> R
```

Statistic

```
{Two_Letter_Country_Code, Date} -> R
```

Indices

```
{Two_Letter_Country_Code, Date} -> R
```

Policy_Indicators

```
{Two_Letter_Country_Code, Date} -> R
```

Part 6

▼ SQL Query

```
WITH StringencyIndex(Date, Continent_Code, Maximum, Minimum) AS(
  SELECT
    Date,
    Continent_Code,
    MAX(StringencyIndex_Average_ForDisplay),
    Min(StringencyIndex_Average_ForDisplay)
  FROM
    Indices NATURAL JOIN Country_Continent
  WHERE
    Date = 20200401 OR Date = 20210401 OR Date = 20220401
  GROUP BY
    Date, Continent_Code
  ),
  CountryCode_Index AS(
  SELECT
    S.Date,
    S.Continent_Code,
    S.Maximum,
    MaxCountry_Continent.Two_Letter_Country_Code AS Max_CountryCode,
    S.Minimum,
    MinCountry_Continent.Two_Letter_Country_Code AS Min_CountryCode
  FROM
    StringencyIndex AS S
    LEFT JOIN (Indices NATURAL JOIN Country_Continent) AS MaxCountry_Continent
      ON (S.Maximum = MaxCountry_Continent.StringencyIndex_Average_ForDisplay
        AND S.Date = MaxCountry_Continent.Date
          AND S.Continent_Code = MaxCountry_Continent.Continent_Code)
    LEFT JOIN (Indices NATURAL JOIN Country_Continent) AS MinCountry_Continent
      ON (S.Minimum = MinCountry_Continent.StringencyIndex_Average_ForDisplay
        AND S.Date = MinCountry_Continent.Date
          AND S.Continent_Code = MinCountry_Continent.Continent_Code)
  ORDER BY
    S.Date, S.Continent_Code
  ),
  Country_N_Continent AS(
  SELECT
    Countries.Two_Letter_Country_Code,
    Countries.Country_Name,
    Continents.Continent_Code,
    Continents.Continent_Name
  FROM
    Countries NATURAL JOIN Country_Continent NATURAL JOIN Continents
  )
SELECT
  S.Date,
  MaxCountryName.Continent_Name,
  S.Maximum AS Max_Stringency_Index,
  MaxCountryName.Country_Name AS Max_Country_Name,
  S.Minimum AS Min_Stringency_Index,
  MinCountryName.Country_Name AS Min_Country_Name
FROM
  CountryCode_Index AS S
  LEFT JOIN Country_N_Continent AS MaxCountryName
    ON (S.Max_CountryCode = MaxCountryName.Two_Letter_Country_Code
      AND S.Continent_Code = MaxCountryName.Continent_Code)
```

```
  LEFT JOIN Country_N_Continent AS MinCountryName
    ON (S.Min_CountryCode = MinCountryName.Two_Letter_Country_Code
      AND S.Continent_Code = MinCountryName.Continent_Code)
ORDER BY
  S.Date, MaxCountryName.Continent_Name
```

Output Results

▼ 2020/04/01

	date integer	continent_name character varying (100)	max_stringency_index numeric	max_country_name character varying (100)	min_stringency_index numeric	min_country_name character varying (100)
1	20200401	Africa	97.22	Congo	0.10	Comoros
2	20200401	Africa	97.22	Congo	0.10	Eritrea
3	20200401	Asia	100.00	Georgia	0.10	Turkmenistan
4	20200401	Asia	100.00	Philippines	0.10	Turkmenistan
5	20200401	Asia	100.00	Sri Lanka	0.10	Turkmenistan
6	20200401	Asia	100.00	Jordan	0.10	Turkmenistan
7	20200401	Asia	100.00	India	0.10	Turkmenistan
8	20200401	Europe	100.00	Serbia	12.04	Belarus
9	20200401	Europe	100.00	Georgia	12.04	Belarus
10	20200401	North America	100.00	Honduras	0.10	United States Virgin Islands
11	20200401	North America	100.00	Honduras	0.10	Grenada
12	20200401	North America	100.00	Honduras	0.10	Puerto Rico
13	20200401	Oceania	96.30	New Zealand	0.10	Guam
14	20200401	South America	100.00	Argentina	57.41	Guyana

▼ 2021/04/01

	date integer	continent_name character varying (100)	max_stringency_index numeric	max_country_name character varying (100)	min_stringency_index numeric	min_country_name character varying (100)
1	20210401	Africa	96.30	Mauritius	0.10	Comoros
2	20210401	Africa	96.30	Mauritius	0.10	Eritrea
3	20210401	Asia	85.19	Timor-Leste	0.10	Turkmenistan
4	20210401	Europe	87.96	Greece	36.57	Russia
5	20210401	North America	82.41	Honduras	0.10	United States Virgin Islands
6	20210401	North America	82.41	Honduras	0.10	Grenada
7	20210401	North America	82.41	Honduras	0.10	Puerto Rico
8	20210401	Oceania	62.04	Papua New Guinea	0.10	Guam
9	20210401	South America	87.96	Venezuela	25.00	Bolivia

▼ 2022/04/01

	date integer	continent_name character varying (100)	max_stringency_index numeric	max_country_name character varying (100)	min_stringency_index numeric	min_country_name character varying (100)
1	20220401	Africa	56.48	Seychelles	0.10	Eritrea
2	20220401	Africa	56.48	Seychelles	0.10	Comoros
3	20220401	Asia	78.70	Myanmar	0.00	Mongolia
4	20220401	Europe	60.16	Ukraine	8.33	Andorra
5	20220401	North America	59.41	Dominica	0.10	Puerto Rico
6	20220401	North America	59.41	Dominica	0.10	United States Virgin Islands
7	20220401	North America	59.41	Dominica	0.10	Grenada
8	20220401	Oceania	85.19	Vanuatu	0.10	Guam
9	20220401	South America	50.65	Suriname	14.82	Uruguay

▼ 2022/12/01

No data.

Part 7

▼ SQL Query

```
WITH Old_MovingAverage_Country AS(
    SELECT
      Date,
      Two_Letter_Country_Code,
      ConfirmedCases,
      (ConfirmedCases - LAG(ConfirmedCases, 7) OVER (
        PARTITION BY
                    Two_Letter_Country_Code
        ORDER BY
                    Date
      ) ) / 7 AS Moving_Average
    FROM
            Statistic
  ),
    MovingAverage_Country AS(
        SELECT
            Date,
      Two_Letter_Country_Code,
      COALESCE(NULLIF(Moving_Average, 0), 0.1) AS Moving_Average
        FROM
            Old_MovingAverage_Country
    ),
  OverStringencyIndices AS(
    SELECT
      I.Date,
      I.Two_Letter_Country_Code,
            C.Continent_Code,
      I.StringencyIndex_Average_ForDisplay / M.Moving_Average AS OverStringencyIndex
    FROM
      Indices AS I
      NATURAL JOIN MovingAverage_Country AS M
            NATURAL JOIN Country_Continent AS C
  ),
  MaxMin_OverStringencyIndices(Date, Continent_Code, Maximum, Minimum) AS(
  SELECT
    Date,
        Continent_Code,
    MAX(OverStringencyIndex),
    Min(OverStringencyIndex)
  FROM
    OverStringencyIndices
  WHERE
    Date = 20220401 OR Date = 20210401 OR Date = 20200401
  GROUP BY
    Date, Continent_Code
  ),
  CountryCode_Index AS(
  SELECT
```

```
    O.Date,
        O.Continent_Code,
    O.Maximum,
    O.Minimum,
    MaxCountryCode.Two_Letter_Country_Code AS Max_CountryCode,
    MinCountryCode.Two_Letter_Country_Code As Min_CountryCode
  FROM
    MaxMin_OverStringencyIndices AS O
    LEFT JOIN OverStringencyIndices AS MaxCountryCode
      ON (O.Maximum = MaxCountryCode.OverStringencyIndex
                AND O.Continent_Code = MaxCountryCode.Continent_Code
                AND O.Date = MaxCountryCode.Date)
    LEFT JOIN OverStringencyIndices AS MinCountryCode
      ON (O.Minimum = MinCountryCode.OverStringencyIndex
                AND O.Continent_Code = MinCountryCode.Continent_Code
                AND O.Date = MinCountryCode.Date)

  ),
  Country_N_Continent AS(
  SELECT
    Countries.Two_Letter_Country_Code,
    Countries.Country_Name,
    Continents.Continent_Name
  FROM
    Countries NATURAL JOIN Country_Continent NATURAL JOIN Continents
  )
SELECT
  S.Date,
  MaxCountryName.Continent_Name AS Continent,
  MaxCountryName.Country_Name AS Max_Country,
  S.Maximum AS Max_Over_Stringency_Index,
  MinCountryName.Country_Name AS Min_Country,
  S.Minimum AS Min_Over_Stringency_Index
FROM
  CountryCode_Index AS S
  LEFT JOIN Country_N_Continent AS MaxCountryName
    ON S.Max_CountryCode = MaxCountryName.Two_Letter_Country_Code
  LEFT JOIN Country_N_Continent AS MinCountryName
    ON S.Min_CountryCode = MinCountryName.Two_Letter_Country_Code
ORDER BY
  S.Continent_Code
```

Output Results

▼ 2020/04/01

	date integer	continent character varying (100)	max_country character varying (100)	max_over_stringency_index double precision	min_country character varying (100)	min_over_stringency_index double precision
1	20200401	Africa	Lesotho	907.3999999999999	South Africa	0.9176154992548434
2	20200401	Asia	Timor-Leste	750	Iran	0.01953100699844479
3	20200401	Europe	Monaco	25.655	Spain	0.010921194806146181
4	20200401	North America	Belize	525	United States	0.003199142418831577
5	20200401	Oceania	Tonga	935.1999999999999	Australia	0.19979983987189753
6	20200401	South America	Suriname	249.55	Brazil	0.12185427370387672

▼ 2021/04/01

	date integer	continent character varying (100)	max_country character varying (100)	max_over_stringency_index double precision	min_country character varying (100)	min_over_stringency_index double precision
1	20210401	Africa	Congo	472.2	Cameroon	0.014737062518695783
2	20210401	Asia	Tajikistan	287	India	0.0008874230797035569
3	20210401	Europe	Faeroe Islands	481.49999999999994	France	0.001785796728049861
4	20210401	North America	Greenland	370.4	United States	0.000849797703331448
5	20210401	Oceania	Fiji	490.7	Papua New Guinea	0.2168147778332501
6	20210401	South America	Suriname	13.313243243243244	Brazil	0.0009635592281575945

▼ 2022/04/01

	date integer	continent character varying (100)	max_country character varying (100)	max_over_stringency_index double precision	min_country character varying (100)	min_over_stringency_index double precision
1	20220401	Africa	Guinea	462.99999999999994	Botswana	0.002338608812776602
2	20220401	Asia	Macao	324.09999999999997	Mongolia	0
3	20220401	Europe	Faeroe Islands	111.1	France	0.00013628130182056675
4	20220401	North America	El Salvador	332.2	United States	0.0010650926731927328
5	20220401	Oceania	Kiribati	106.1375	Australia	0.000745880681107425
6	20220401	South America	Guyana	5.18	Brazil	0.0013755748352534015

▼ 2022/12/01

No data.