1. Requirement and Specification

A Health Care insurance company is facing challenges in enhancing its revenue and understanding the customers. To address these challenges, the company aims to leverage the Big Data Ecosystem to analyze competitors' company data received from various sources, such as web scraping and third-party sources. This analysis will help track customer behavior and conditions, enabling the company to customize offers and calculate royalties for customers who have previously purchased policies, thereby enhancing revenue.

Project Goals

The primary goal of this project is to create data pipelines for the Health Care insurance company. These pipelines will enable the company to:

- Analyze customer behaviors.
- Send customized offers to customers.
- Calculate and distribute royalties to past customers.
- Develop appropriate business strategies to enhance revenue.

MoreDetails:
https://github.com/eshrestha21/Health-Care-insurance-Company-Analysis/blob/main/Requirements%20Specifications%20Document.pdf

2. Solution Design

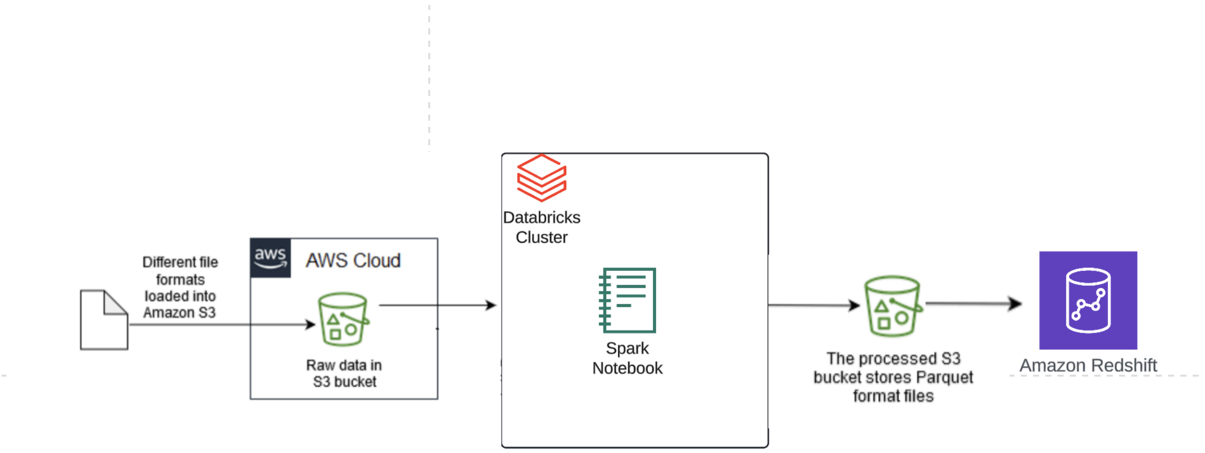
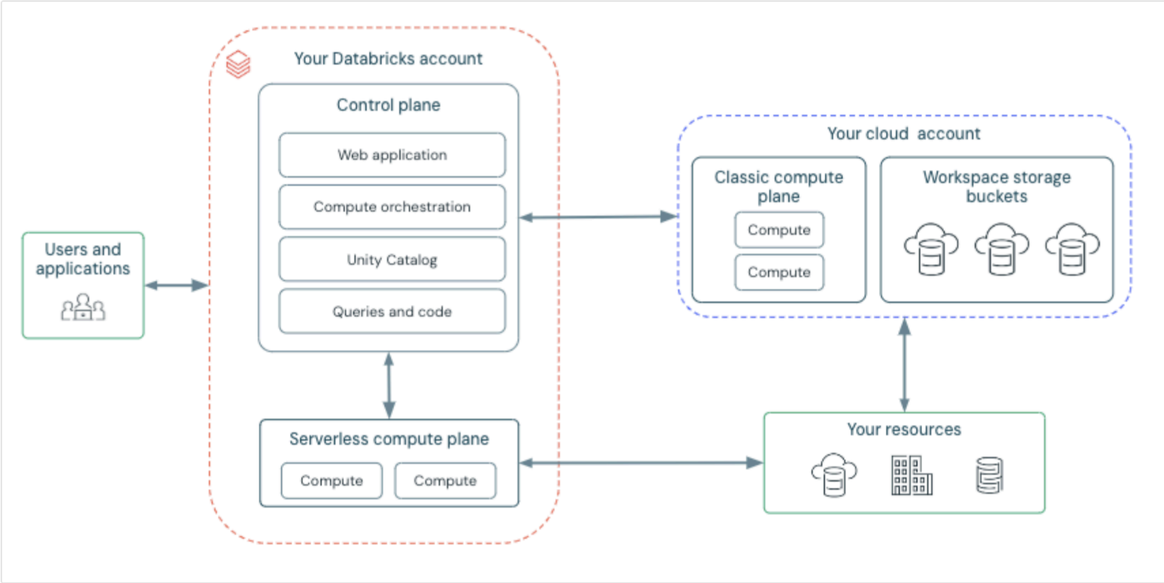


Figure: Architecture Diagram to create data pipelines for the Health Care insurance company

The following diagram describes the overall Databricks architecture.



Details:

https://github.com/eshrestha21/Health-Care-insurance-Company-Analysis/blob/main/Solution%20Design%20Document.pdf

3. Environment

- **AWS S3:** Data storage for raw and processed data
- **AWS Redshift**: Data warehousing for analysis and reporting
- **Databricks**: Data processing and analysis platform
- **PySpark**: Distributed data processing framework
- **GitHub**: Version control and code repository
- **Jira**: Project management and tracking
- **AWS EMR Studio**: For deployment (optional)

4. Requirements

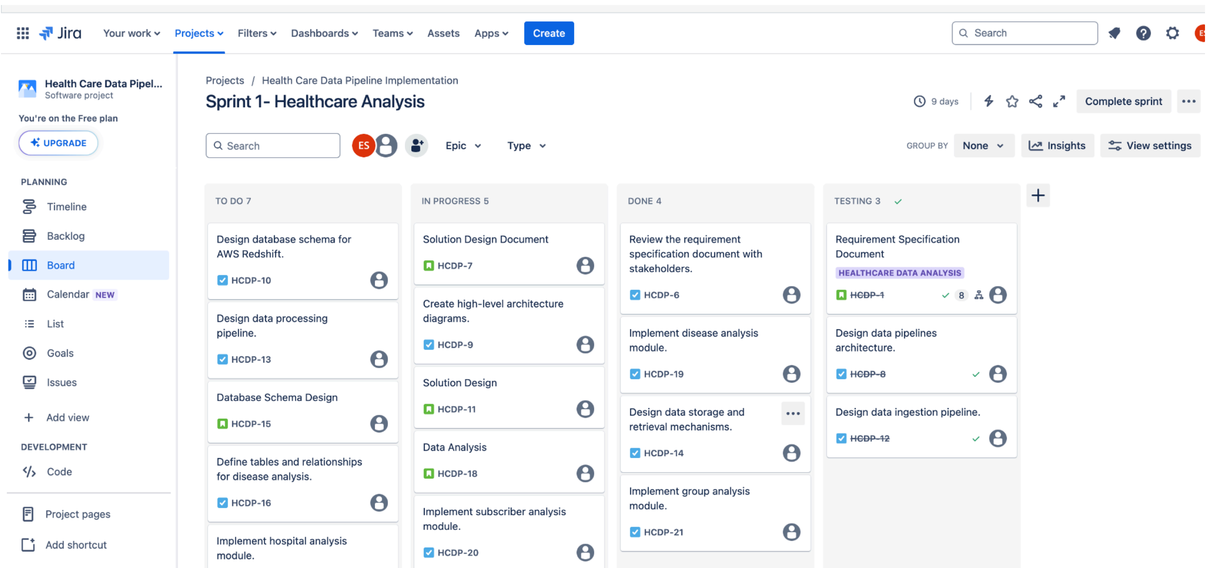
- **Disease Analysis**: Identify the disease with the maximum number of claims.
- **Subscriber Analysis**: Find subscribers under the age of 30 who subscribe to any subgroup.
- **Group Analysis**: Determine which group has the maximum number of subgroups.
- **Hospital Analysis:** Identify the hospital that serves the most number of patients.
- **Subgroup Analysis:** Find out which subgroup is subscribed to the most.
- **Claims Rejection Analysis:** Calculate the total number of claims that were rejected.
- **Claims Origin Analysis:** Determine the city from which most claims are coming.
- **Policy Type Analysis:** Identify whether subscribers mostly subscribe to government or private policies.

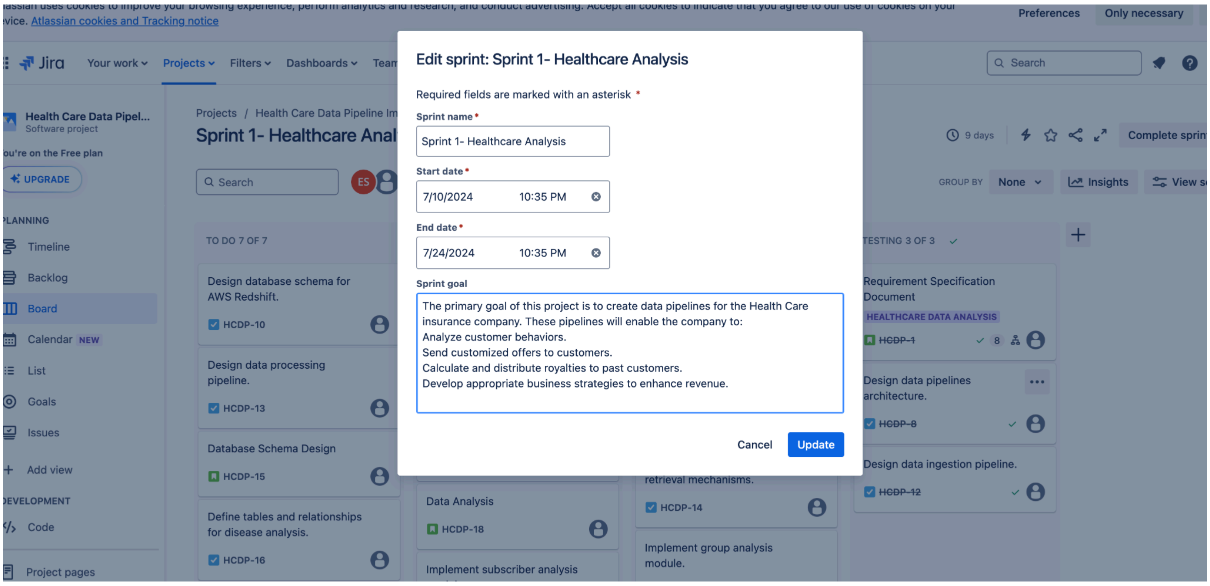
- **Premium Analysis:** Calculate the average monthly premium paid by subscribers to the insurance company.
- **Profitability Analysis:** Find out which group is most profitable.
- **Pediatric Cancer Patients:** List all patients below age 18 who are admitted for cancer.
- **High-Value Cashless Insurance Patients:** List patients who have cashless insurance and total charges greater than or equal to Rs. 50,000.
- **Female Knee Surgery Patients:** List female patients over the age of 40 that have undergone knee surgery in the past year.

5. Project Management - JIRA

This entire project can be managed using Jira(project tracking tool), breaking it down into 2 week sprints. The first week focuses on documentation and solution design, while the second week is dedicated to implementation and testing. Each use case and test scenario is tracked as a Jira user story or task, allowing us to monitor progress and manage resources effectively.

I have created a scrum project in JIRA - Healthcare Analysis with a 2 week sprint. Created a major Epic as - Healthcare Data Analysis. Then user stories and tasks are added under each epic such as Requirement, Design Document, Data Cleaning, Analysis and so on. Jira's board view to track progress





6. Github

Throughout this process, I have maintained comprehensive documentation, including our requirement specifications, solution design documents, and database schema designs. All our PySpark code for data cleansing and result generation is version-controlled and stored in a GitHub repository. This ensures transparency, reproducibility, and ease of collaboration for our team.

https://github.com/eshrestha21/Health-Care-insurance-Company-Analysis

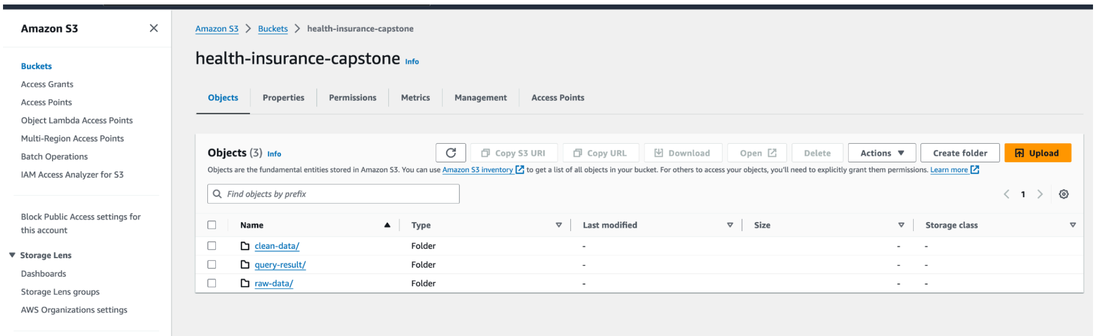
https://databricks-prod-cloudfront.cloud.databricks.com/public/4027ec902e239c93eaaa8714f173bcfc/1166544219295246/2435706089467460/8156463845699645/latest.html

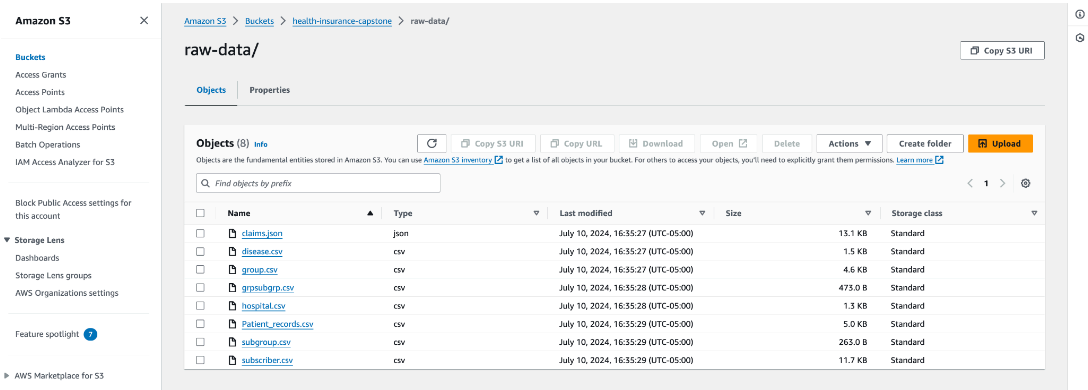
7. Dataset Creation

Here, the data resides in AWS S3. I am leveraging the power of Databricks to ingest this data efficiently. Using PySpark, I have established a secure connection to our S3 bucket and read the various datasets - patients, subscribers, claims, and group_subgroup - into Databricks DataFrames. This step sets the foundation for our entire data pipeline.

Environment: Databricks, PySpark, AWS S3

Data stored in AWS S3





Accessing the AWS Bucket

02:21 PM (<1s) 3

```
#Import libraries
from pyspark.sql import SparkSession, Row
from pyspark.sql.functions import col, count, avg, when, year,datediff, current_date, avg, sum, count
from pyspark.sql.types import IntegerType

# Initialize Spark session
spark = SparkSession.builder \
    .appName("Health Insurance Analysis") \
    .getOrCreate()
```

02:21 PM (<1s) 4

```
# Accessing the AWS Bucket
access_key = 'XXXXXXXXXXx'
secret_key = 'XXXXXX+xIP9o/I'
sc._jsc.hadoopConfiguration().set("fs.s3a.access.key", access_key)
sc._jsc.hadoopConfiguration().set("fs.s3a.secret.key", secret_key)

# If you are using Auto Loader file notification mode to load files, provide the AWS Region ID.
aws_region = "us-east-2"
sc._jsc.hadoopConfiguration().set("fs.s3a.endpoint", "s3." + aws_region + ".amazonaws.com")
```

#ExtractLoad Data in Databricks from AWS S3

06:42 PM (10s) 6 Python

```python
# Load the data from AWS S3
claims_df = spark.read.json("s3a://health-insurance-capstone/raw-data/claims.json")
disease_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/disease.csv", header=True, inferSchema=True)
group_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/group.csv", header=True, inferSchema=True)
grpsubgrp_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/grpsubgrp.csv", header=True, inferSchema=True)
hospital_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/hospital.csv", header=True, inferSchema=True)
subgroup_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/subgroup.csv", header=True, inferSchema=True)
subscriber_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/subscriber.csv", header=True, inferSchema=True)
patient_records_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/Patient_records.csv", header=True, inferSchema=True)
```

(15) Spark Jobs

```
claims_df: pyspark.sql.dataframe.DataFrame = [Claim_Or_Rejected: string, SUB_ID: string ... 6 more fields]
disease_df: pyspark.sql.dataframe.DataFrame = [SubGrpID: string, Disease_ID: integer ... 1 more field]
group_df: pyspark.sql.dataframe.DataFrame = [Country: string, premium_written: integer ... 6 more fields]
grpsubgrp_df: pyspark.sql.dataframe.DataFrame = [SubGrp_ID: string, Grp_Id: string]
hospital_df: pyspark.sql.dataframe.DataFrame = [Hospital_id: string, Hospital_name: string ... 3 more fields]
subgroup_df: pyspark.sql.dataframe.DataFrame = [SubGrp_id: string, SubGrp_Name: string ... 1 more field]
subscriber_df: pyspark.sql.dataframe.DataFrame = [sub _id: string, first_name: string ... 12 more fields]
patient_records_df: pyspark.sql.dataframe.DataFrame = [Patient_id: integer, Patient_name: string ... 6 more fields]
```

06:42 PM (10s) 6 Python

```python
# EXTRACT DATA FROM AWS S3
# Reading the data from AWS S3
claims_df = spark.read.json("s3a://health-insurance-capstone/raw-data/claims.json")
disease_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/disease.csv", header=True, inferSchema=True)
group_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/group.csv", header=True, inferSchema=True)
grpsubgrp_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/grpsubgrp.csv", header=True, inferSchema=True)
hospital_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/hospital.csv", header=True, inferSchema=True)
subgroup_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/subgroup.csv", header=True, inferSchema=True)
subscriber_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/subscriber.csv", header=True, inferSchema=True)
patient_records_df = spark.read.csv("s3a://health-insurance-capstone/raw-data/Patient_records.csv", header=True, inferSchema=True)
```

(15) Spark Jobs

```
claims_df: pyspark.sql.dataframe.DataFrame
    Claim_Or_Rejected: string
    SUB_ID: string
    claim_amount: string
    claim_date: string
    claim_id: long
    claim_type: string
    disease_name: string
    patient_id: long
disease_df: pyspark.sql.dataframe.DataFrame
    SubGrpID: string
    Disease_ID: integer
    Disease_name: string
group_df: pyspark.sql.dataframe.DataFrame
    Country: string
    premium_written: integer
    zipcode: integer
    Grp_Id: string
    Grp_Name: string
    Grp_Type: string
    city: string
```

Just now (1s) 8 Python

```python
# Print schema and display data for each DataFrame
print("Schema of claims_df:")
claims_df.printSchema()
claims_df.show()
```

(1) Spark Jobs

```
Schema of claims_df:
root
 |-- Claim_Or_Rejected: string (nullable = true)
 |-- SUB_ID: string (nullable = true)
 |-- claim_amount: string (nullable = true)
 |-- claim_date: string (nullable = true)
 |-- claim_id: long (nullable = true)
 |-- claim_type: string (nullable = true)
 |-- disease_name: string (nullable = true)
 |-- patient_id: long (nullable = true)

+-----------------+----------+------------+----------+--------+---------------+---------------+----------+
|Claim_Or_Rejected|    SUB_ID|claim_amount|claim_date|claim_id|     claim_type|   disease_name|patient_id|
+-----------------+----------+------------+----------+--------+---------------+---------------+----------+
|                N| SUBID1000|       79874|1949-03-14|       0| claims of value|   Galactosemia|    187158|
|              NaN|SUBID10001|      151142|1970-03-16|       1|claims of policy| Bladder cancer|    112766|
|              NaN|SUBID10002|       59924|2008-02-03|       2| claims of value|  Kidney cancer|    199252|
|              NaN|SUBID10003|      143120|1995-02-08|       3|  claims of fact|        Suicide|    133424|
|                Y|SUBID10004|      168634|1967-05-23|       4| claims of value|   Food allergy|    172579|
|              NaN|SUBID10005|       64840|1991-10-04|       5|claims of policy|       Whiplash|    171320|
|                N| SUBID1006|       26800|1991-03-26|       6|  claims of fact|      Sunbathing|    107794|
```

Just now (<1s) 8 Python

```python
# Print schema and display data for each DataFrame
print("Schema of disease_df:")
disease_df.printSchema()
disease_df.show()
```

(1) Spark Jobs

```
Schema of disease_df:
root
 |-- SubGrpID: string (nullable = true)
 |--  Disease_ID: integer (nullable = true)
 |-- Disease_name: string (nullable = true)

+--------+-----------+-------------------+
|SubGrpID| Disease_ID|       Disease_name|
+--------+-----------+-------------------+
|    S101|     110001|           Beriberi|
|    S101|     110002|             Scurvy|
|    S101|     110003|             Goitre|
|    S101|     110004|       Osteoporosis|
|    S101|     110005|            Rickets|
|    S101|     110006|            Anaemia|
|    S102|     110007|          Fractures|
|    S102|     110008|       Heart Attack|
|    S102|     110009|              Burns|
|    S102|     110010|            Choking|
|    S102|     110011|             Stroke|
```

Just now (<1s) 8

```python
# Print schema and display data for each DataFrame
print("Schema of group_df:")
group_df.printSchema()
group_df.show()
```

(1) Spark Jobs

```
Schema of group_df:
root
 |-- Country: string (nullable = true)
 |-- premium_written: integer (nullable = true)
 |-- zipcode: integer (nullable = true)
 |-- Grp_Id: string (nullable = true)
 |-- Grp_Name: string (nullable = true)
 |-- Grp_Type: string (nullable = true)
 |-- city: string (nullable = true)
 |-- year: integer (nullable = true)

+-------+---------------+-------+------+--------------------+--------+---------+----+
|Country|premium_written|zipcode|Grp_Id|            Grp_Name|Grp_Type|     city|year|
+-------+---------------+-------+------+--------------------+--------+---------+----+
|  India|          72000| 482018|GRP101|Life Insurance Co...|   Govt.|   Mumbai|1956|
|  India|          45000| 482049|GRP102|HDFC Standard Lif...| Private|   Mumbai|2000|
|  India|          64000| 482030|GRP103|Max Life Insuranc...| Private|    Delhi|2000|
|  India|          59000| 482028|GRP104|ICICI Prudential ...| Private|   Mumbai|2000|
|  India|          37000| 482014|GRP105|Kotak Mahindra Li...| Private|   Mumbai|2001|
|  India|          89000| 482011|GRP106|Aditya Birla Sun ...| Private|   Mumbai|2000|
|  India|          70000| 482006|GRP107|TATA AIG Life Ins...| Private|   Mumbai|2001|
```

Just now (<1s)

```
print("Schema of hospital_df:")
hospital_df.printSchema()
hospital_df.show()
```

(1) Spark Jobs

```
Schema of hospital_df:
root
 |-- Hospital_id: string (nullable = true)
 |-- Hospital_name: string (nullable = true)
 |-- city: string (nullable = true)
 |-- state: string (nullable = true)
 |-- country: string (nullable = true)

+-----------+--------------------+----------+-----------+-------+
|Hospital_id|       Hospital_name|      city|      state|country|
+-----------+--------------------+----------+-----------+-------+
|      H1000|All India Institu...| New Delhi|        NaN|  India|
|      H1001|Medanta The Medicity|   Gurgaon|    Haryana|  India|
|      H1002|The Christian Med...|   Vellore| Tamil Nadu|  India|
|      H1003|PGIMER - Postgrad...|Chandigarh|    Haryana|  India|
|      H1004|Apollo Hospital -...|   Chennai| Tamil Nadu|  India|
|      H1005|P. D. Hinduja Nat...|    Mumbai|Maharashtra|  India|
|      H1006|Breach Candy Hosp...|    Mumbai|Maharashtra|  India|
|      H1007|Fortis Flt. Lt. R...| New Delhi|        NaN|  India|
|      H1008|King Edward Memor...|    Mumbai|Maharashtra|  India|
|      H1009|Indraprastha Apol...|     Delhi|        NaN|  India|
```

Just now (<1s)

```
print("Schema of subgroup_df:")
subgroup_df.printSchema()
subgroup_df.show()
```

(1) Spark Jobs

```
Schema of subgroup_df:
root
 |-- SubGrp_id: string (nullable = true)
 |-- SubGrp_Name: string (nullable = true)
 |-- Monthly_Premium: integer (nullable = true)

+---------+-------------------+---------------+
|SubGrp_id|        SubGrp_Name|Monthly_Premium|
+---------+-------------------+---------------+
|     S101|Deficiency Diseases|           3000|
|     S102|           Accident|           1000|
|     S103|         Physiology|           2000|
|     S104|            Therapy|           1500|
|     S105|          Allergies|           2300|
|     S106|      Self inflicted|          1200|
|     S107|             Cancer|           3200|
|     S108| Infectious disease|           1500|
|     S109|         Hereditary|           2000|
|     S110|              Viral|           1000|
+---------+-------------------+---------------+
```

```python
print("Schema of subscriber_df:")
subscriber_df.printSchema()
subscriber_df.show()
```

(1) Spark Jobs

```
 |-- Birth_date: date (nullable = true)
 |-- Gender: string (nullable = true)
 |-- Phone: string (nullable = true)
 |-- Country: string (nullable = true)
 |-- City: string (nullable = true)
 |-- Zip Code: integer (nullable = true)
 |-- Subgrp_id: string (nullable = true)
 |-- Elig_ind: string (nullable = true)
 |-- eff_date: date (nullable = true)
 |-- term_date: date (nullable = true)

+----------+----------+-----------+----------------+----------+------+--------------+-------+--------------------+--------+---------+--------+---
-------+----------+
|   sub _id|first_name|  last_name|          Street|Birth_date|Gender|         Phone|Country|                City|Zip Code|Subgrp_id|Elig_ind|  e
ff_date| term_date|
+----------+----------+-----------+----------------+----------+------+--------------+-------+--------------------+--------+---------+--------+---
-------+----------+
|SUBID10000|    Harbir|Vishwakarma|      Baria Marg|1924-06-30|Female|+91 0112009318|  India|            Rourkela|  767058|     S107|       Y|194
4-06-30|1954-01-14|
|SUBID10001|  Brahmdev|     Sonkar|       Lala Marg|1948-12-20|Female|+91 1727749552|  India|         Tiruvottiyur|   34639|     S105|       Y|196
8-12-20|1970-05-16|
```

```python
print("Schema of patient_records_df:")
patient_records_df.printSchema()
patient_records_df.show()
```

(1) Spark Jobs

```
Schema of patient_records_df:
root
 |-- Patient_id: integer (nullable = true)
 |-- Patient_name: string (nullable = true)
 |-- patient_gender: string (nullable = true)
 |-- patient_birth_date: date (nullable = true)
 |-- patient_phone: string (nullable = true)
 |-- disease_name: string (nullable = true)
 |-- city: string (nullable = true)
 |-- hospital_id: string (nullable = true)

+----------+------------+--------------+------------------+--------------+---------------+--------------------+-----------+
|Patient_id|Patient_name|patient_gender|patient_birth_date| patient_phone|   disease_name|                city|hospital_id|
+----------+------------+--------------+------------------+--------------+---------------+--------------------+-----------+
|    187158|      Harbir|        Female|        1924-06-30|+91 0112009318|   Galactosemia|            Rourkela|      H1001|
|    112766|    Brahmdev|        Female|        1948-12-20|+91 1727749552| Bladder cancer|        Tiruvottiyur|      H1016|
|    199252|     Ujjawal|          Male|        1980-04-16|+91 8547451606|  Kidney cancer|            Berhampur|      H1009|
|    133424|     Ballari|        Female|        1969-09-25|+91 0106026841|        Suicide|        Bihar Sharif|      H1017|
|    172579|     Devnath|        Female|        1946-05-01|+91 1868774631|   Food allergy|          Bidhannagar|      H1019|
|    171320|       Atasi|          Male|        1967-10-02|+91 9747336855|       Whiplash|            Amravati|      H1013|
|    107794|      Manish|          Male|        1967-06-06|+91 4354294043|      Sunbathing|              Panvel|      H1004|
```

8. Data Cleaning

Data cleaning is the process of fixing or removing incorrect, corrupted, incorrectly formatted, duplicate, or incomplete data within a dataset. When combining multiple data sources, there are many opportunities for data to be duplicated or mislabeled. If data is incorrect, outcomes and algorithms are unreliable, even though they may look correct. There is no one absolute way to prescribe the exact steps in the data cleaning process because the processes will vary from dataset to dataset.

- Cleaning Activity
    - First check if there are null values in dataset
    - Count the total Null values for each column
    - And then replace the null values for specific columns by NA
    - Check the If three are duplicates records
    - If there are duplicates then drop duplicates

10

```python
# TRANSFORM DATA

# Function to clean a DataFrame
def clean_data(df, df_name):
    # 1. Replace empty strings with None (null)
    df = df.replace('', None)

    # 2. Check for null values and count them for each column
    null_counts = df.select([count(when(col(c).isNull(), c)).alias(c) for c in df.columns])
    null_counts.show()

    # 3. Replace remaining null values with 'NA' for specific columns (customize as needed)
    columns_to_replace = df.columns
    df = df.fillna("NA", subset=columns_to_replace)

    # 4. Check for duplicates and drop duplicates
    initial_count = df.count()
    df = df.dropDuplicates()
    final_count = df.count()

    print(f"Number of duplicates dropped in {df_name}: {initial_count - final_count}")

return df
```

07:01 PM (14s) 12

```python
# Clean each DataFrame using user defined function clean_data()
claims_df_cleaned = clean_data(claims_df, "claims_df")
disease_df_cleaned = clean_data(disease_df, "disease_df")
group_df_cleaned = clean_data(group_df, "group_df")
grpsubgrp_df_cleaned = clean_data(grpsubgrp_df, "grpsubgrp_df")
hospital_df_cleaned = clean_data(hospital_df, "hospital_df")
subgroup_df_cleaned = clean_data(subgroup_df, "subgroup_df")
subscriber_df_cleaned = clean_data(subscriber_df, "subscriber_df")
patient_records_df_cleaned = clean_data(patient_records_df, "patient_records_df")
```

(56) Spark Jobs

- claims_df_cleaned: pyspark.sql.dataframe.DataFrame = [Claim_Or_Rejected: string, SUB_ID: string ... 6 more fields]
- disease_df_cleaned: pyspark.sql.dataframe.DataFrame = [SubGrpID: string, Disease_ID: integer ... 1 more field]
- group_df_cleaned: pyspark.sql.dataframe.DataFrame = [Country: string, premium_written: integer ... 6 more fields]
- grpsubgrp_df_cleaned: pyspark.sql.dataframe.DataFrame = [SubGrp_ID: string, Grp_Id: string]
- hospital_df_cleaned: pyspark.sql.dataframe.DataFrame = [Hospital_id: string, Hospital_name: string ... 3 more fields]
- subgroup_df_cleaned: pyspark.sql.dataframe.DataFrame = [SubGrp_id: string, SubGrp_Name: string ... 1 more field]
- subscriber_df_cleaned: pyspark.sql.dataframe.DataFrame = [sub _id: string, first_name: string ... 12 more fields]
- patient_records_df_cleaned: pyspark.sql.dataframe.DataFrame = [Patient_id: integer, Patient_name: string ... 6 more fields]

```
+-----------------+------+------------+----------+--------+----------+------------+----------+
|Claim_Or_Rejected|SUB_ID|claim_amount|claim_date|claim_id|claim_type|disease_name|patient_id|
+-----------------+------+------------+----------+--------+----------+------------+----------+
|                0|     0|           0|         0|       0|         0|           0|         0|
+-----------------+------+------------+----------+--------+----------+------------+----------+

Number of duplicates dropped in claims_df: 0
+--------+-----------+------------+
|SubGrpID| Disease_ID|Disease_name|
+--------+-----------+------------+
|       0|          0|           0|
+--------+-----------+------------+
```

```
Number of duplicates dropped in disease_df: 0
+-------+---------------+-------+------+--------+--------+----+----+
|Country|premium_written|zipcode|Grp_Id|Grp_Name|Grp_Type|city|year|
+-------+---------------+-------+------+--------+--------+----+----+
|      0|              0|      0|     0|       0|       0|   0|   0|
+-------+---------------+-------+------+--------+--------+----+----+

Number of duplicates dropped in group_df: 0
+---------+------+
|SubGrp_ID|Grp_Id|
+---------+------+
|        0|     0|
+---------+------+

Number of duplicates dropped in grpsubgrp_df: 0
+-----------+-------------+----+-----+-------+
|Hospital_id|Hospital_name|city|state|country|
+-----------+-------------+----+-----+-------+
|          0|            0|   0|    0|      0|
+-----------+-------------+----+-----+-------+
```

```
▸ subgroup_df_cleaned: pyspark.sql.dataframe.DataFrame = [SubGrp_id: string, SubGrp_Name: string ... 1 more field]
▸ subscriber_df_cleaned: pyspark.sql.dataframe.DataFrame = [sub _id: string, first_name: string ... 12 more fields]
▸ patient_records_df_cleaned: pyspark.sql.dataframe.DataFrame = [Patient_id: integer, Patient_name: string ... 6 more fields]
+---------+-----------+---------------+
|SubGrp_id|SubGrp_Name|Monthly_Premium|
+---------+-----------+---------------+
|        0|          0|              0|
+---------+-----------+---------------+

Number of duplicates dropped in subgroup_df: 0
+-------+----------+---------+------+----------+------+-----+-------+----+--------+---------+--------+--------+---------+
|sub _id|first_name|last_name|Street|Birth_date|Gender|Phone|Country|City|Zip Code|Subgrp_id|Elig_ind|eff_date|term_date|
+-------+----------+---------+------+----------+------+-----+-------+----+--------+---------+--------+--------+---------+
|      0|        27|        0|     0|         0|     0|    3|      0|   0|       0|        2|       4|       0|        0|
+-------+----------+---------+------+----------+------+-----+-------+----+--------+---------+--------+--------+---------+

Number of duplicates dropped in subscriber_df: 0
+----------+------------+--------------+------------------+-------------+------------+----+-----------+
|Patient_id|Patient_name|patient_gender|patient_birth_date|patient_phone|disease_name|city|hospital_id|
+----------+------------+--------------+------------------+-------------+------------+----+-----------+
|         0|          17|             0|                 0|            2|           0|   0|          0|
+----------+------------+--------------+------------------+-------------+------------+----+-----------+

Number of duplicates dropped in patient_records_df: 0
```

Table: Patient

Before Cleaning

```
02:37 PM (1s)                                    14

patient_records_df.show()

▸ (1) Spark Jobs

|    187158|      Harbir|        Female|        1924-06-30|+91 0112009318|    Galactosemia|            Rourkela|      H1001|
|    112766|    Brahmdev|        Female|        1948-12-20|+91 1727749552|  Bladder cancer|         Tiruvottiyur|      H1016|
|    199252|     Ujjawal|          Male|        1980-04-16|+91 8547451606|   Kidney cancer|           Berhampur|      H1009|
|    133424|     Ballari|        Female|        1969-09-25|+91 0106026841|         Suicide|         Bihar Sharif|      H1017|
|    172579|     Devnath|        Female|        1946-05-01|+91 1868774631|    Food allergy|          Bidhannagar|      H1019|
|    171320|       Atasi|          Male|        1967-10-02|+91 9747336855|        Whiplash|            Amravati|      H1013|
|    107794|      Manish|          Male|        1967-06-06|+91 4354294043|      Sunbathing|              Panvel|      H1004|
|    130339|       Aakar|        Female|        1925-03-05|+91 2777633911|Drug consumption|         Bihar Sharif|      H1000|
|    110377|     Gurudas|          Male|        1945-05-06|+91 1232859381|          Dengue|           Kamarhati|      H1001|
|    149367|        null|          Male|        1925-06-12|+91 1780763280|    Head banging|           Bangalore|      H1013|
|    156168|        null|          Male|        1976-02-03|+91 5586075345| Fanconi anaemia|              Rajkot|      H1004|
|    114241|        null|        Female|        1955-01-22|+91 4146391938|   Breast cancer|           Ghaziabad|      H1015|
|    146382|   Dharmadaas|          Male|        1964-04-29|+91 6345482027|         Anthrax|Bhalswa Jahangir Pur|      H1019|
|    132748|     Brahmvir|          Male|        1991-11-11|+91 7316972612| Cystic fibrosis|              Ambala|      H1018|
|    167340|        null|        Female|        1981-01-25|+91 2960004518|    Galactosemia|Surendranagar Dud...|      H1003|
|    135184|      Bhagvan|        Female|        1966-07-24|+91 0297693485|          Dengue|           Bhimavaram|      H1018|
|    179662|    Amritkala|        Female|        1933-11-20|+91 0537157280|        Smallpox|              Meerut|      H1018|
|    184479|      Bandhu|          Male|        1996-10-15|+91 0695289163|  Pollen allergy|            Chinsurah|      H1010|
|    156988|   Bhagavaana|        Female|        1935-09-16|+91 6071745855|   Breast cancer|         Shahjahanpur|      H1012|
|    132870|        null|        Female|        1924-11-09|+91 8906694405|        Glaucoma|             Jabalpur|      H1017|
+----------+------------+--------------+------------------+--------------+----------------+--------------------+-----------+
```

After Cleaning

02:37 PM (1s) 15

```
patient_records_df_cleaned.show()
```

(2) Spark Jobs

```
|    132748|    Brahmvir|          Male|         1991-11-11|+91 7316972612| Cystic fibrosis|               Ambala|     H1018|
|    172579|     Devnath|        Female|         1946-05-01|+91 1868774631|    Food allergy|          Bidhannagar|     H1019|
|    146382|  Dharmadaas|          Male|         1964-04-29|+91 6345482027|         Anthrax|Bhalswa Jahangir Pur|     H1019|
|    114241|          NA|        Female|         1955-01-22|+91 4146391938|   Breast cancer|            Ghaziabad|     H1015|
|    148137|       Umang|        Female|         1963-07-14|+91 9485838770|     Pet allergy|             Haridwar|     H1002|
|    171320|       Atasi|          Male|         1967-10-02|+91 9747336855|        Whiplash|             Amravati|     H1013|
|    187158|      Harbir|        Female|         1924-06-30|+91 0112009318|   Galactosemia|             Rourkela|     H1001|
|    199252|     Ujjawal|          Male|         1980-04-16|+91 8547451606|   Kidney cancer|            Berhampur|     H1009|
|    149367|          NA|          Male|         1925-06-12|+91 1780763280|    Head banging|            Bangalore|     H1013|
|    133424|     Ballari|        Female|         1969-09-25|+91 0106026841|         Suicide|         Bihar Sharif|     H1017|
|    130339|       Aakar|        Female|         1925-03-05|+91 2777633911|Drug consumption|         Bihar Sharif|     H1000|
|    156988|  Bhagavaana|        Female|         1935-09-16|+91 6071745855|   Breast cancer|         Shahjahanpur|     H1012|
|    112766|    Brahmdev|        Female|         1948-12-20|+91 1727749552|  Bladder cancer|         Tiruvottiyur|     H1016|
|    107794|      Manish|          Male|         1967-06-06|+91 4354294043|      Sunbathing|               Panvel|     H1004|
|    110377|     Gurudas|          Male|         1945-05-06|+91 1232859381|          Dengue|            Kamarhati|     H1001|
|    132870|          NA|        Female|         1924-11-09|+91 8906694405|        Glaucoma|             Jabalpur|     H1017|
|    179662|   Amritkala|        Female|         1933-11-20|+91 0537157280|        Smallpox|               Meerut|     H1018|
|    184479|      Bandhu|          Male|         1996-10-15|+91 0695289163|  Pollen allergy|            Chinsurah|     H1010|
+----------+------------+--------------+-------------------+--------------+----------------+---------------------+----------+
only showing top 20 rows
```

Table: Subscriber

Before Cleaning

02:24 PM (1s) 12 Python

```
subscriber_df.show()
```

(1) Spark Jobs

```
9-09-25|1995-06-05|
|SUBID10004|   Devnath|  Srivastav|       Magar Zila|1946-05-01|Female|+91 1868774631|  India|         Bidhannagar|  531742|     S110|        N|196
6-05-01|1970-12-09|
|SUBID10005|     Atasi|       Seth|     Khatri Nagar|1967-10-02|  Male|+91 9747336855|  India|            Amravati|  229062|     S104|        Y|198
7-10-02|1995-02-13|
| SUBID1006|    Manish|     Maurya|Swaminathan Chowk|1967-06-06|  Male|+91 4354294043|  India|              Panvel|  438733|     S109|     null|198
7-06-06|1995-03-21|
|SUBID10007|     Aakar|      Yadav|            Swamy|1925-03-05|Female|+91 2777633911|  India|        Bihar Sharif|  535907|     S104|        N|194
5-03-05|1946-11-07|
|SUBID10008|   Gurudas|      Gupta|      Sarin Nagar|1945-05-06|  Male|+91 1232859381|  India|           Kamarhati|  933226|     S103|        Y|196
5-05-06|1970-09-16|
|SUBID10009|      null|      Gupta|    Thakur Circle|1925-06-12|  Male|+91 1780763280|  India|           Bangalore|  957469|     S105|        Y|194
5-06-12|1953-08-30|
| SUBID1010|      null|     Divedi|          Dhillon|1976-02-03|  Male|+91 5586075345|  India|              Rajkot|  911319|     S102|        Y|199
6-02-03|2002-01-27|
|SUBID10011|      null|Vishwakarma|      Rajagopalan|1955-01-22|Female|+91 4146391938|  India|           Ghaziabad|  337042|     S106|        N|197
5-01-22|1978-11-02|
|SUBID10012|Dharmadaas|     Tiwari|             Rama|1964-04-29|  Male|+91 6345482027|  India|Bhalswa Jahangir Pur|  430793|     S103|        N|198
4-04-29|1988-02-07|
|SUBID10013|  Brahmvir|        Rai|        Shah Path|1991-11-11|  Male|+91 7316972612|  India|              Ambala|  249898|     S106|        N|201
1-11-11|2020-05-23|
```

After Cleaning

4 minutes ago (1s) 13 Python

```
subscriber_df_cleaned.show();
```

(2) Spark Jobs

```
+----------+----------+-----------+-----------------+----------+------+--------------+-------+--------------------+--------+---------+---------+---
-------+----------+
|SUBID10013|  Brahmvir|        Rai|        Shah Path|1991-11-11|  Male|+91 7316972612|  India|              Ambala|  249898|     S106|        N|201
1-11-11|2020-05-23|
|SUBID10012|Dharmadaas|     Tiwari|             Rama|1964-04-29|  Male|+91 6345482027|  India|Bhalswa Jahangir Pur|  430793|     S103|        N|198
4-04-29|1988-02-07|
|SUBID10011|        NA|Vishwakarma|      Rajagopalan|1955-01-22|Female|+91 4146391938|  India|           Ghaziabad|  337042|     S106|        N|197
5-01-22|1978-11-02|
|SUBID10018|Bhagavaana|      Kumar|    Kulkarni Zila|1935-09-16|Female|+91 6071745855|  India|        Shahjahanpur|  597276|     S101|        N|195
5-09-16|1958-05-31|
|SUBID10002|   Ujjawal|       Devi|      Mammen Zila|1980-04-16|  Male|+91 8547451606|  India|           Berhampur|  914455|     S106|        N|200
0-04-16|2008-05-04|
|SUBID10009|        NA|      Gupta|    Thakur Circle|1925-06-12|  Male|+91 1780763280|  India|           Bangalore|  957469|     S105|        Y|194
5-06-12|1953-08-30|
| SUBID1020|     Umang|  Srivastav|      Balay Chowk|1963-07-14|Female|+91 9485838770|  India|            Haridwar|  181692|     S109|        Y|198
3-07-14|1986-01-15|
| SUBID1010|        NA|     Divedi|          Dhillon|1976-02-03|  Male|+91 5586075345|  India|              Rajkot|  911319|     S102|        Y|199
6-02-03|2002-01-27|
|SUBID10000|    Harbir|Vishwakarma|       Baria Marg|1924-06-30|Female|+91 0112009318|  India|            Rourkela|  767058|     S107|        Y|194
4-06-30|1954-01-14|
|SUBID10014|        NA|  Srivastav|     Chandra Path|1981-01-25|Female|+91 2960004518|  India|Surendranagar Dud...|  111966|     S102|        N|200
```

9. Writing the cleaned data to AWS S3.

After cleaning and analysis, we now have high-quality, processed/cleaned data which is exported back to our AWS S3 bucket, creating a new 'cleaned-data' folder. This helps to ensure that we maintain a clear separation between raw and processed data, and provides a clean dataset for future use or additional analytics.

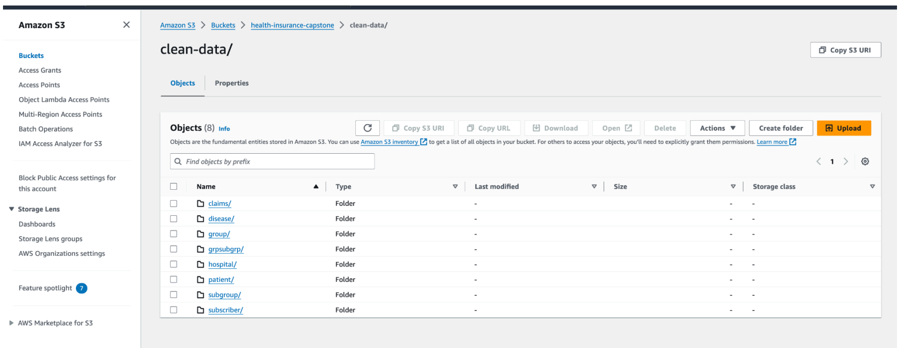
Environment: Databricks, PySpark, AWS S3

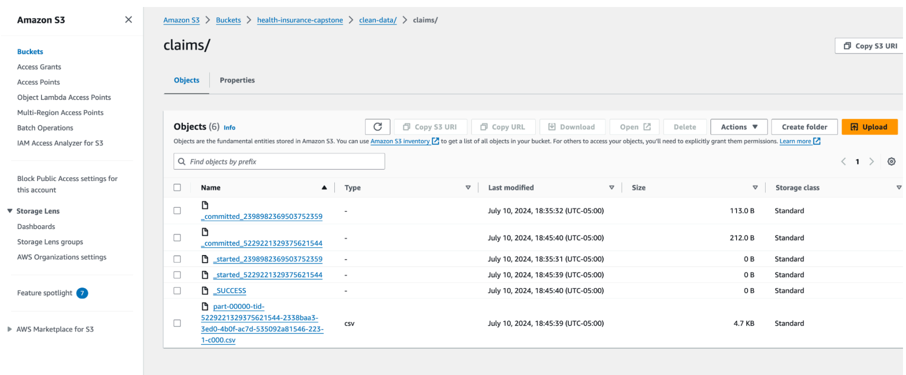
```
# WRITING DATA
```

1 minute ago (27s)   14   Python

```python
# # Writing the cleaned data to AWS S3
claims_df_cleaned.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/clean-data/claims")
disease_df_cleaned.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/clean-data/disease")
group_df_cleaned.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/clean-data/group")
grpsubgrp_df_cleaned.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/clean-data/grpsubgrp")
hospital_df_cleaned.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/clean-data/hospital")
subgroup_df_cleaned.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/clean-data/subgroup")
subscriber_df_cleaned.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/clean-data/subscriber")
patient_records_df_cleaned.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/clean-data/patient")
```

```
▾ (14) Spark Jobs
  ▸ Job 259 View (Stages: 1/1)
  ▸ Job 260 View (Stages: 1/1)
  ▸ Job 261 View (Stages: 1/1, 1 skipped)
  ▸ Job 262 View (Stages: 1/1)
  ▸ Job 263 View (Stages: 1/1, 1 skipped)
  ▸ Job 264 View (Stages: 1/1)
  ▸ Job 265 View (Stages: 1/1, 1 skipped)
  ▸ Job 266 View (Stages: 1/1)
  ▸ Job 267 View (Stages: 1/1, 1 skipped)
  ▸ Job 268 View (Stages: 1/1)
  ▸ Job 269 View (Stages: 1/1, 1 skipped)
  ▸ Job 270 View (Stages: 1/1)
  ▸ Job 271 View (Stages: 1/1, 1 skipped)
  ▸ Job 272 View (Stages: 1/1)
```

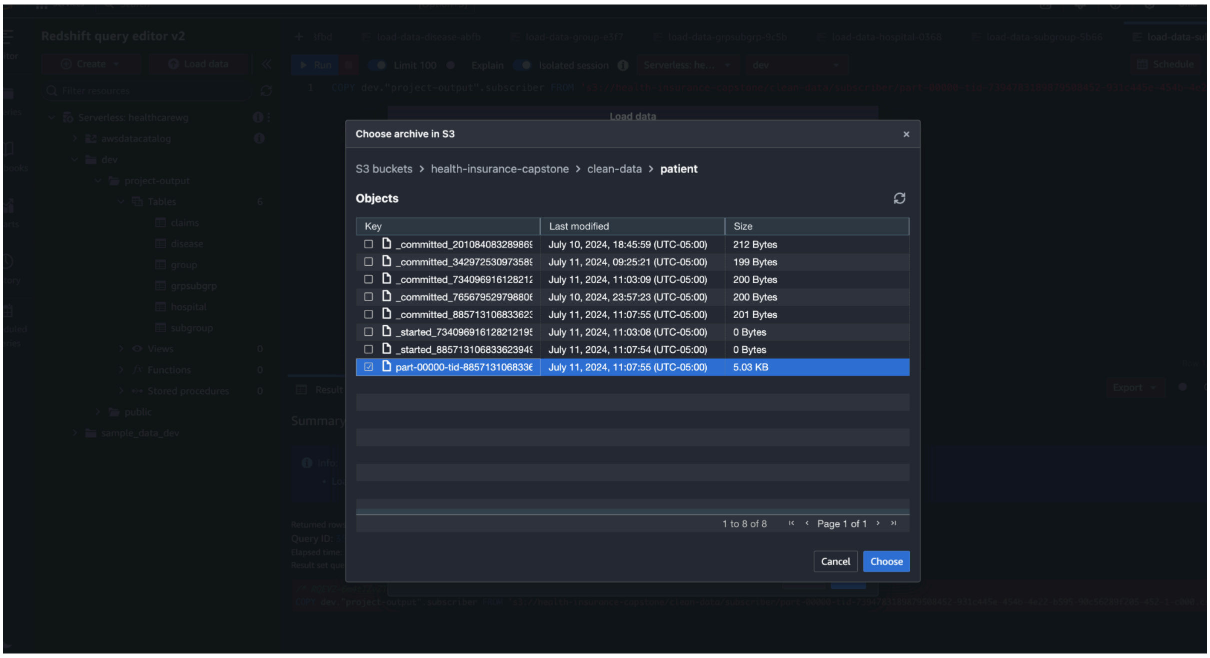


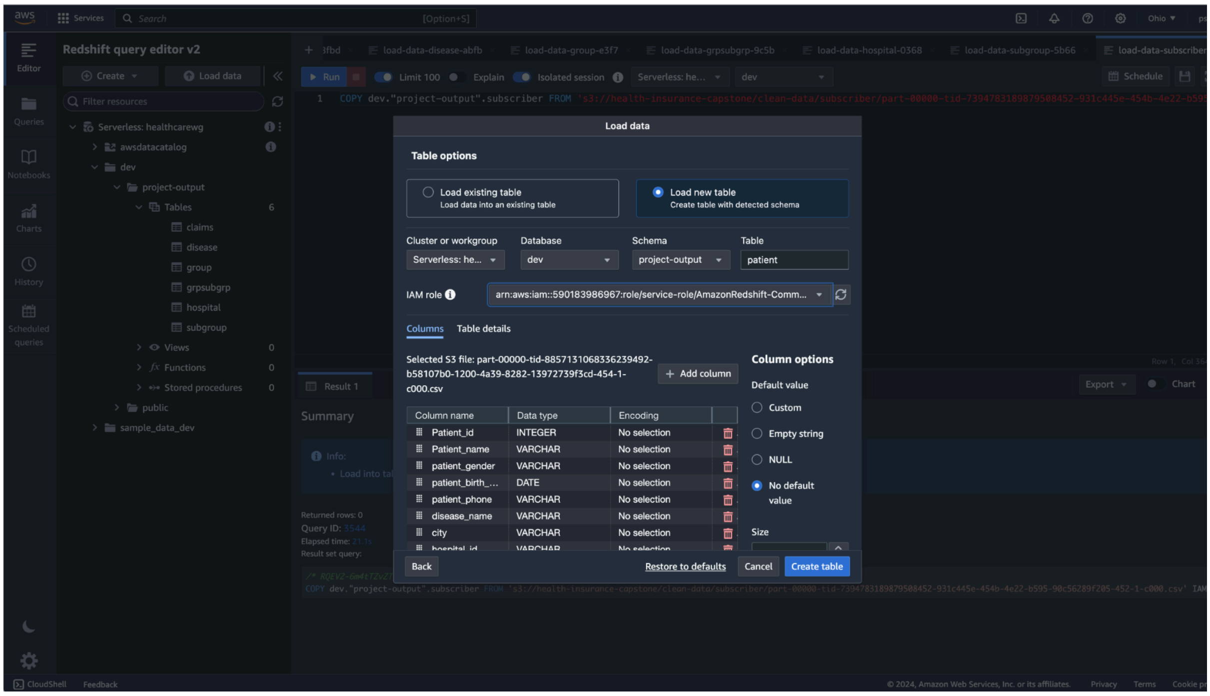


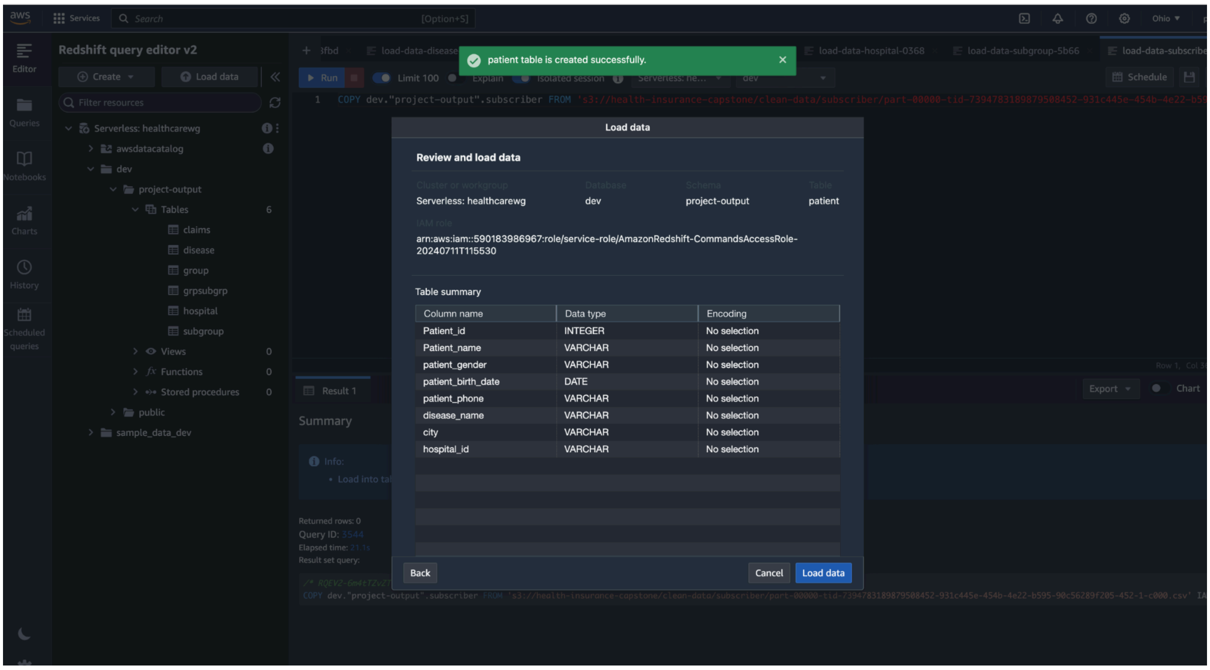
10. Upload cleaned data corresponding to each data set into a redshift table.

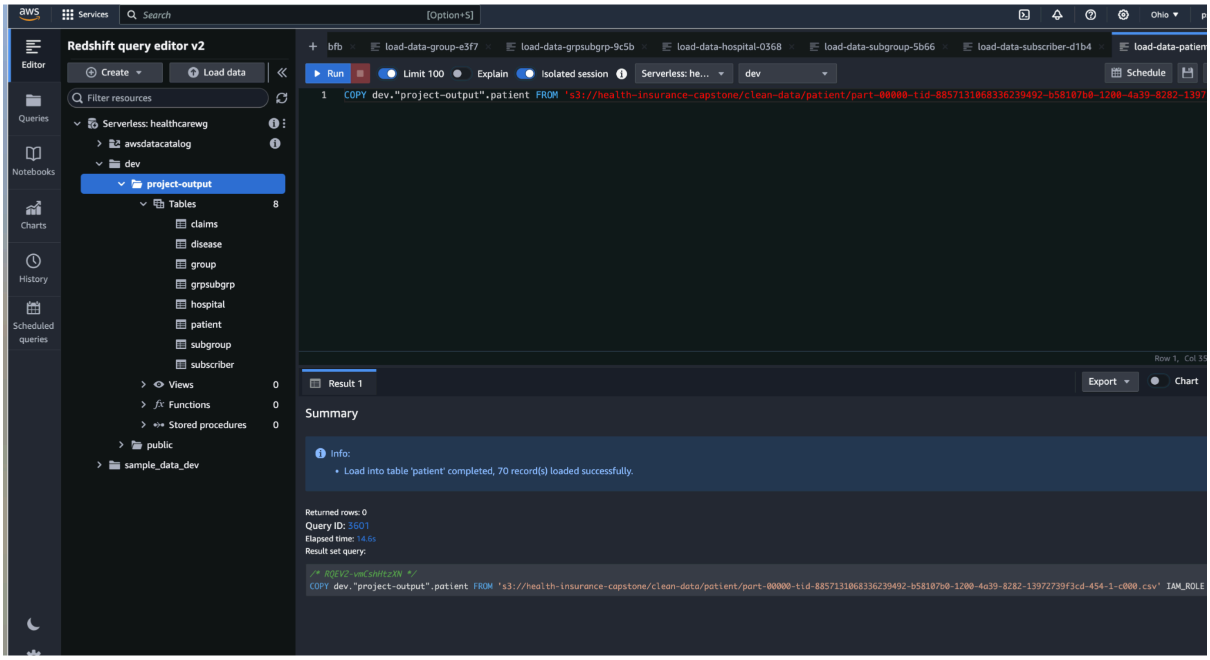
For efficient querying and long-term storage, the cleaned data is loaded to S3 to AWS Redshift. Each dataset is loaded into its corresponding table in the Redshift cluster. Similarly, each use case output is stored in a separate Redshift table within a schema named `Project-Output`."

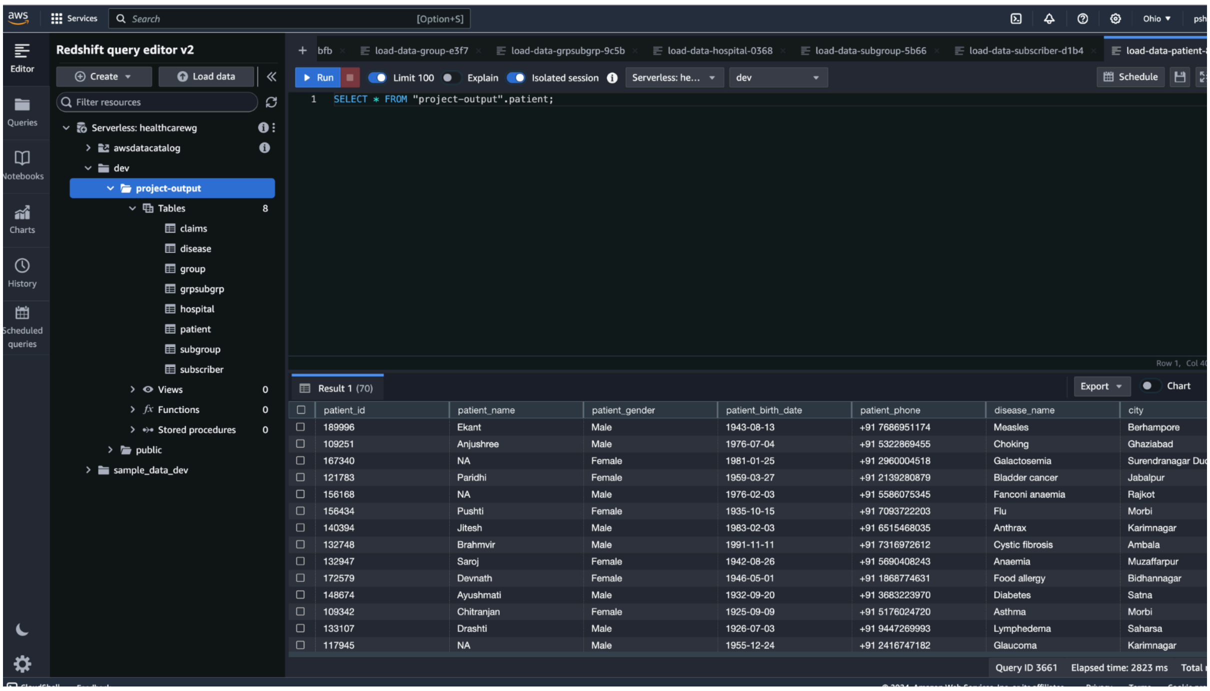
Environment: AWS Redshift, AWS S3






Redshift query editor v2
patient table is created successfully.
Load data
Review and load data
Serverless: healthcarewg
dev
project-output
patient
arn:aws:iam::590183986967:role/service-role/AmazonRedshift-CommandsAccessRole-20240711T115530
Table summary
Column name
Data type
Encoding
Patient_id
INTEGER
No selection
Patient_name
VARCHAR
No selection
patient_gender
VARCHAR
No selection
patient_birth_date
DATE
No selection
patient_phone
VARCHAR
No selection
disease_name
VARCHAR
No selection
city
VARCHAR
No selection
hospital_id
VARCHAR
No selection
Back
Cancel
Load data


Redshift query editor v2
Create
Load data
Filter resources
Serverless: healthcarewg
awsdatacatalog
dev
project-output
Tables
8
claims
disease
group
grpsubgrp
hospital
patient
subgroup
subscriber
Views
Functions
Stored procedures
public
sample_data_dev
Run
Limit 100
Explain
Isolated session
Serverless: he...
dev
Schedule
COPY dev."project-output".patient FROM 's3://health-insurance-capstone/clean-data/patient/part-00000-tid-8857131068336239492-b58107b0-1200-4a39-8282-1397
Result 1
Export
Chart
Summary
Info:
Load into table 'patient' completed, 70 record(s) loaded successfully.
Returned rows: 0
Query ID: 3601
Elapsed time: 14.6s
Result set query:
/* RQEV2-vmCshHtzXN */
COPY dev."project-output".patient FROM 's3://health-insurance-capstone/clean-data/patient/part-00000-tid-8857131068336239492-b58107b0-1200-4a39-8282-13972739f3cd-454-1-c000.csv' IAM_ROLE



11. Use Cases

- **Disease Analysis**: Identify the disease with the maximum number of claims.

Here, insurance claims are grouped by disease name, count the occurrences, and identify the disease with the maximum claims. The resulting DataFrame is displayed and then saved as a permanent table in Databricks, allowing for persistent storage and future analysis.

```python
# 1. Disease with maximum number of claim

from pyspark.sql.functions import col

# Group by disease_name and count the occurrences, then get the one with the maximum count
max_claims_disease_df = claims_df_cleaned.groupBy("disease_name") \
    .count() \
    .orderBy(col("count").desc()) \
    .limit(1)

# Display the result
max_claims_disease_df.show()

# Saving as a permanent table
permanent_table_name = "max_claims_disease"
max_claims_disease_df.write.mode("overwrite").saveAsTable(permanent_table_name)

# Saving data to AWS S3
max_claims_disease_df.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/max_claims_disease")
```

```
(15) Spark Jobs
max_claims_disease_df:  pyspark.sql.dataframe.DataFrame = [disease_name: string, count: long]
+------------+-----+
|disease_name|count|
+------------+-----+
| Pet allergy|    3|
+------------+-----+
```

- **Subscriber Analysis**: Find subscribers under the age of 30 who subscribe to any subgroup.

This query joins subscriber and subgroup data, filters out subscribers under 30 years old, and selects all relevant subscriber columns

```python
# 2. Subscribers under age 30 subscribing to any subgroup
from pyspark.sql.functions import datediff, current_date

subscribers_under_30_df = subscriber_df.join(subgroup_df, subscriber_df["Subgrp_id"] == subgroup_df["SubGrp_id"]) \
    .filter(datediff(current_date(), col("Birth_date")) / 365 < 30) \
    .select(subscriber_df["*"])

subscribers_under_30_df.show()

#Saving as a permanent table
permanent_table_name = "subscribers_under_30_df"
subscribers_under_30_df.write.format("csv").mode("overwrite").saveAsTable(permanent_table_name)
# Saving data to AWS S3
subscribers_under_30_df.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/
subscribers_under_30")
```

```
▸ (4) Spark Jobs
▸ subscribers_under_30_df: pyspark.sql.dataframe.DataFrame = [sub _id: string, first_name: string ... 12 more fields]
+----------+-----------+---------+-----------------+----------+------+--------------+-------+-----------+--------+---------+--------+----------+--
--------+
|   sub _id|  first_name|last_name|           Street|Birth_date|Gender|         Phone|Country|       City|Zip Code|Subgrp_id|Elig_ind|  eff_date| t
erm_date|
+----------+-----------+---------+-----------------+----------+------+--------------+-------+-----------+--------+---------+--------+----------+--
--------+
|SUBID10017|     Bandhu|     Seth|        Varughese|1996-10-15|  Male|+91 0695289163|  India|  Chinsurah|  136713|     S108|       N|2016-10-15|20
18-06-08|
|SUBID10083|  Bhilangana|   Pandit|Ramachandran Path|1995-01-04|Female|+91 6653069630|  India|   Fatehpur|  359466|     S109|       Y|2015-01-04|20
17-10-05|
|SUBID10093|Chandavarman|    Singh|    Sarkar Circle|1997-05-10|Others|+91 6559031791|  India|Navi Mumbai|   83240|     S110|       N|2017-05-10|20
22-08-27|
+----------+-----------+---------+-----------------+----------+------+--------------+-------+-----------+--------+---------+--------+----------+--
--------+
```

- **Group Analysis**: Determine which group has the maximum number of subgroups.

This query groups data by Grp_Id and counts the subgroups for each group. It then identifies the group with the most subgroups, displays the result, and saves this information as a permanent table in Databricks, ensuring the data is persistently stored for future analysis

```python
# 3. Group with maximum subgroup
# Group by Grp_Id and count the subgroups, then get the one with the maximum count
max_subgroup_group_df = grpsubgrp_df.groupBy("Grp_Id") \
    .count() \
    .orderBy(col("count").desc()) \
    .limit(1)

# Display the result
max_subgroup_group_df.show()

# Saving as a permanent table
permanent_table_name = "max_subgroup_group"
max_subgroup_group_df.write.mode("overwrite").saveAsTable(permanent_table_name)
# Saving data to AWS S3
max_subgroup_group_df.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/max_subgroup_group")
```

```
(13) Spark Jobs
▸ max_subgroup_group_df: pyspark.sql.dataframe.DataFrame = [Grp_Id: string, count: long]
------+-----+
Grp_Id|count|
------+-----+
GRP104|    2|
------+-----+
```

- **Hospital Analysis:** Identify the hospital that serves the most number of patients.

This DataFrame groups the data by hospital_id, counts the number of patients, and selects the hospital with the highest patient count.

```
from pyspark.sql.functions import col

# Group by hospital_id and count the patients, then get the hospital with the maximum count
most_patients_hospital_df = patient_records_df.groupBy("hospital_id") \
    .count() \
    .orderBy(col("count").desc()) \
    .limit(1)

# Display the result
most_patients_hospital_df.show()

# Saving as a permanent table
permanent_table_name = "most_patients_hospital"
most_patients_hospital_df.write.mode("overwrite").saveAsTable(permanent_table_name)
# Saving data to AWS S3
most_patients_hospital_df.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/
most_patients_hospital")
```

```
(13) Spark Jobs
most_patients_hospital_df:  pyspark.sql.dataframe.DataFrame = [hospital_id: string, count: long]
+-----------+-----+
|hospital_id|count|
+-----------+-----+
|      H1017|    9|
+-----------+-----+
```

- **Subgroup Analysis:** Find out which subgroup is subscribed to the most.

```
# 5. Subgroup subscribed most number of times
from pyspark.sql.functions import col

# Group by Subgrp_id and count the occurrences, then get the one with the maximum count
most_subscribed_subgroup_df = subscriber_df.groupBy("Subgrp_id") \
    .count() \
    .orderBy(col("count").desc()) \
    .limit(1)

# Display the result
most_subscribed_subgroup_df.show()

# Saving as a permanent table
permanent_table_name = "most_subscribed_subgroup"
most_subscribed_subgroup_df.write.mode("overwrite").saveAsTable(permanent_table_name)

# Saving data to AWS S3
most_subscribed_subgroup_df.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/
most_subscribed_subgroup")
```

```
(13) Spark Jobs
most_subscribed_subgroup_df:  pyspark.sql.dataframe.DataFrame = [Subgrp_id: string, count: long]
+---------+-----+
|Subgrp_id|count|
+---------+-----+
|     S104|   13|
+---------+-----+
```

This DataFrame groups the data by Subgrp_id, counts the subscriptions, and selects the subgroup with the highest subscription count.

- **Claims Rejection Analysis:** Calculate the total number of claims that were rejected.

The script filters claims_df for rejected claims and counts them. To save this count as a permanent table, it converts the count into a DataFrame and saves it under total_rejected_claims.

```
# 6. Total number of claims which were rejected
from pyspark.sql import Row

total_rejected_claims = claims_df.filter(col("Claim_Or_Rejected") == "Rejected") \
    .count()
#print("Total number of rejected claims:", total_rejected_claims)
# Convert the count to a DataFrame
total_rejected_claims_df = spark.createDataFrame([Row(total_rejected_claims=total_rejected_claims)])

# Display the result
total_rejected_claims_df.show()

# Saving as a permanent table
permanent_table_name = "total_rejected_claims"
total_rejected_claims_df.write.mode("overwrite").saveAsTable(permanent_table_name)

# Saving data to AWS S3
total_rejected_claims_df.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/
total_rejected_claims")
```

```
(15) Spark Jobs
total_rejected_claims_df:  pyspark.sql.dataframe.DataFrame = [total_rejected_claims: long]
+---------------------+
|total_rejected_claims|
+---------------------+
|                    0|
+---------------------+
```

- **Claims Origin Analysis:** Determine the city from which most claims are coming.

  This script joins claims_df with subscriber_df based on SUB_ID and sub _id to include city information. Then it Groups by city, counts claims, orders by count in descending order, and retrieves the city with the most claims.

```
# 7. Join claims_df with subscriber_df to get city information for claims
from pyspark.sql.functions import count, avg, year, current_date, desc
claims_with_city_df = claims_df.join(subscriber_df, claims_df.SUB_ID == subscriber_df["sub _id"], "left")

# City with most claims
city_most_claims = claims_with_city_df.groupBy("City").count().orderBy(desc("count")).first()
print(f"City with most claims: {city_most_claims['City']}")

# Convert to DataFrame
city_most_claims_df = spark.createDataFrame([city_most_claims])

# Display the result
city_most_claims_df.show()

#Saving as a permanent table
permanent_table_name = "city_most_claims"
city_most_claims_df.write.format("csv").mode("overwrite").saveAsTable(permanent_table_name)

# Saving data to AWS S3
city_most_claims_df.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/city_most_claims")
```

(7) Spark Jobs

claims_with_city_df: pyspark.sql.dataframe.DataFrame = [Claim_Or_Rejected: string, SUB_ID: string ... 20 more fields]
city_most_claims_df: pyspark.sql.dataframe.DataFrame = [City: string, count: long]

```
City with most claims: Mysore
+------+-----+
|  City|count|
+------+-----+
|Mysore|    2|
+------+-----+
```

- **Policy Type Analysis:** Identify whether subscribers mostly subscribe to government or private policies.

  This script Groups subscriber_df by Elig_ind (government or private policy indicator) and counts the number of subscriptions for each and displays the table of government and private policy subscriptions sorted by count.

```
# 8. Government or private policy subscriptions
policy_type_subscription = subscriber_df.groupBy("Elig_ind").count().orderBy(desc("count"))
policy_type_subscription.show()

#Saving as a permanent table
permanent_table_name = "policy_type_subscription"
policy_type_subscription.write.format("csv").mode("overwrite").saveAsTable(permanent_table_name)

# Saving data to AWS S3
policy_type_subscription.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/
policy_type_subscription")
```

(6) Spark Jobs

policy_type_subscription: pyspark.sql.dataframe.DataFrame = [Elig_ind: string, count: long]

```
+--------+-----+
|Elig_ind|count|
+--------+-----+
|       N|   50|
|       Y|   46|
|    null|    4|
+--------+-----+
```

- **Premium Analysis:** Calculate the average monthly premium paid by subscribers to the insurance company.

  This script uses subgroup_df to calculate the average monthly premium paid by subscribers using avg("Monthly_Premium")

```
# 9. Average monthly premium paid by subscribers
avg_monthly_premium = subgroup_df.select(avg("Monthly_Premium")).first()
print(f"Average monthly premium paid by subscribers: {avg_monthly_premium['avg(Monthly_Premium)']}")

# Convert to DataFrame
avg_monthly_premium_df = spark.createDataFrame([avg_monthly_premium])

# Display the result
avg_monthly_premium_df.show()

#Saving as a permanent table
permanent_table_name = "avg_monthly_premium"
avg_monthly_premium_df.write.format("csv").mode("overwrite").saveAsTable(permanent_table_name)

# Saving data to AWS S3
avg_monthly_premium_df.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/
avg_monthly_premium")
```

▸ (6) Spark Jobs

▸ avg_monthly_premium_df: pyspark.sql.dataframe.DataFrame = [avg(Monthly_Premium): double]

```
Average monthly premium paid by subscribers: 1870.0
+--------------------+
|avg(Monthly_Premium)|
+--------------------+
|              1870.0|
+--------------------+
```

- **Profitability Analysis:** Find out which group is most profitable.

  This script calculates the total premium written for each group in group_df, identifies the group with the highest total premium, and prints its Grp_Id. It uses aggregation functions like sum() and orderBy() to determine and display the most profitable group based on premium contributions.

```
# 10. Most profitable group

most_profitable_group = group_df.groupBy("Grp_Id") \
    .agg(sum("premium_written").alias("total_premium")) \
    .orderBy(col("total_premium").desc()) \
    .first()

print("Most profitable group:", most_profitable_group["Grp_Id"])

# Convert to DataFrame
most_profitable_group_df = spark.createDataFrame([most_profitable_group])

# Display the result
most_profitable_group_df.show()

#Saving as a permanent table
permanent_table_name = "most_profitable_group"
most_profitable_group_df.write.format("csv").mode("overwrite").saveAsTable(permanent_table_name)

# Saving data to AWS S3
most_profitable_group_df.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/
most_profitable_group")
```

▸ (6) Spark Jobs

▸ most_profitable_group_df: pyspark.sql.dataframe.DataFrame = [Grp_Id: string, total_premium: long]

```
Most profitable group: GRP131
+------+-------------+
|Grp_Id|total_premium|
+------+-------------+
|GRP131|        99000|
+------+-------------+
```

- **Pediatric Cancer Patients:** List all patients below age 18 who are admitted for cancer.

This script uses filter() on patient_records_df to select records where disease_name contains "cancer" and the patient's age is below 18 and it shows patients below 18 admitted for cancer.

```
# 11. Patients below age of 18 admitted for cancer
from pyspark.sql.functions import sum as spark_sum

# Filter patients below 18 with cancer
patients_below_18_cancer = patient_records_df.filter(
    (col("disease_name").contains("cancer")) &
    (datediff(current_date(), col("patient_birth_date")) / 365 < 18)
)

# Display the result
patients_below_18_cancer.show()

#Saving as a permanent table
permanent_table_name = "patients_below_18_cancer"
patients_below_18_cancer.write.format("csv").mode("overwrite").saveAsTable(permanent_table_name)

# Saving data to AWS S3
patients_below_18_cancer.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/
patients_below_18_cancer")
```

```
(2) Spark Jobs
patients_below_18_cancer:  pyspark.sql.dataframe.DataFrame = [Patient_id: integer, Patient_name: string ... 6 more fields]

+----------+------------+--------------+------------------+-------------+------------+----+-----------+
|Patient_id|Patient_name|patient_gender|patient_birth_date|patient_phone|disease_name|city|hospital_id|
+----------+------------+--------------+------------------+-------------+------------+----+-----------+
+----------+------------+--------------+------------------+-------------+------------+----+-----------+
```

- **High-Value Cashless Insurance Patients:** List patients who have cashless insurance and total charges greater than or equal to Rs. 50,000.

  This script Performs a join between patient_records_df_cleaned and claims_df_cleaned based on Patient_id then filters the joined DataFrame to include only records where claim_type is "claims of value" and claim_amount is 50,000 or more. Finally, selects the necessary columns from both DataFrames (patient_records_df_cleaned and claims_df_cleaned) to include in the patients_cashless DataFrame.

```
#12 List patients who have cashless insurance and have total charges greater than or equal for Rs. 50,000.
# Joining patients and claims DataFrames
joined_df = patient_records_df_cleaned.join(claims_df_cleaned, patient_records_df_cleaned["Patient_id"] == claims_df_cleaned["patient_id"])
# Applying filters
filtered_df = joined_df.filter(
    (claims_df_cleaned["claim_type"] == "claims of value") &
    (claims_df_cleaned["claim_amount"].cast("int") >= 50000)
)
# Selecting required columns
patients_cashless = filtered_df.select(
    patient_records_df_cleaned["Patient_id"],
    patient_records_df_cleaned["Patient_name"],
    patient_records_df_cleaned["hospital_id"],
    claims_df_cleaned["claim_amount"],
    claims_df_cleaned["claim_type"]
)
# Showing the result
patients_cashless.show()
# Saving as a permanent table
permanent_table_name = "patients_cashless"
patients_cashless.write.format("csv").mode("overwrite").saveAsTable(permanent_table_name)

# Saving data to AWS S3
patients_cashless.write.option("header", "true").mode("overwrite").csv("s3a://health-insurance-capstone/use-case-output/patients_cashless")
```

(8) Spark Jobs

joined_df: pyspark.sql.dataframe.DataFrame = [Patient_id: integer, Patient_name: string ... 14 more fields]

filtered_df: pyspark.sql.dataframe.DataFrame = [Patient_id: integer, Patient_name: string ... 14 more fields]

patients_cashless: pyspark.sql.dataframe.DataFrame = [Patient_id: integer, Patient_name: string ... 3 more fields]

```
+----------+------------+-----------+------------+---------------+
|Patient_id|Patient_name|hospital_id|claim_amount|     claim_type|
+----------+------------+-----------+------------+---------------+
|    189996|       Ekant|      H1003|      192381|claims of value|
|    109251|   Anjushree|      H1001|      116937|claims of value|
|    167340|          NA|      H1003|      118628|claims of value|
|    132947|       Saroj|      H1016|      186502|claims of value|
|    172579|     Devnath|      H1019|      168634|claims of value|
|    109342|  Chitranjan|      H1011|      125727|claims of value|
|    146382|  Dharmadaas|      H1019|       75983|claims of value|
```

- **Female Knee Surgery Patients:** List female patients over the age of 40 that have undergone knee surgery in the past year.

  The script filters female patients over 40 years old from cleaned patient records (patient_records_df_cleaned). It further refines this group to include only those who underwent knee surgery, displaying the results and saving them as a permanent CSV table named "knee_surgery_patients" in Spark.

Just now (2s)   30

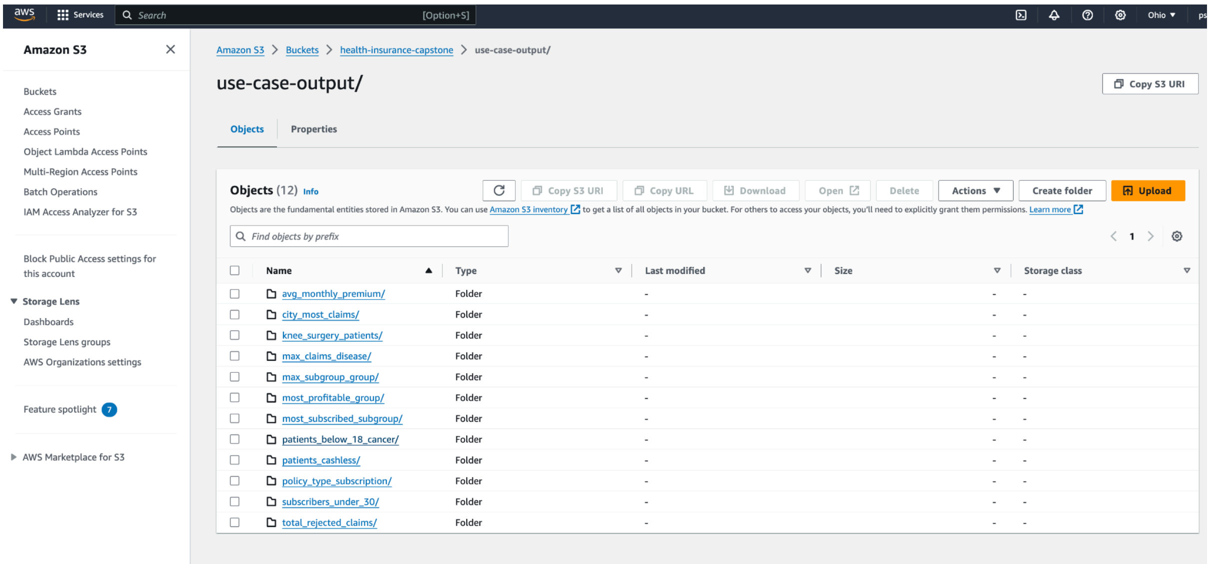
```python
# 13. Female patients over age 40 who underwent knee surgery in the past year
from pyspark.sql.functions import col, year, datediff, current_date

# Filter for female patients over the age of 40
female_patients_over_40 = patient_records_df.filter(
    (col("patient_gender") == "Female") &
    (datediff(current_date(), col("patient_birth_date")) / 365 > 40)
)
#female_patients_over_40.show()
# Filter for knee surgery in the past year
knee_surgery_patients = female_patients_over_40.filter(
    col("disease_name").contains("Knee Surgery"))

# Show the results
knee_surgery_patients.show()

# #Saving as a permanent table
permanent_table_name = "knee_surgery_patients"
knee_surgery_patients.write.format("csv").mode("overwrite").saveAsTable(permanent_table_name)
```

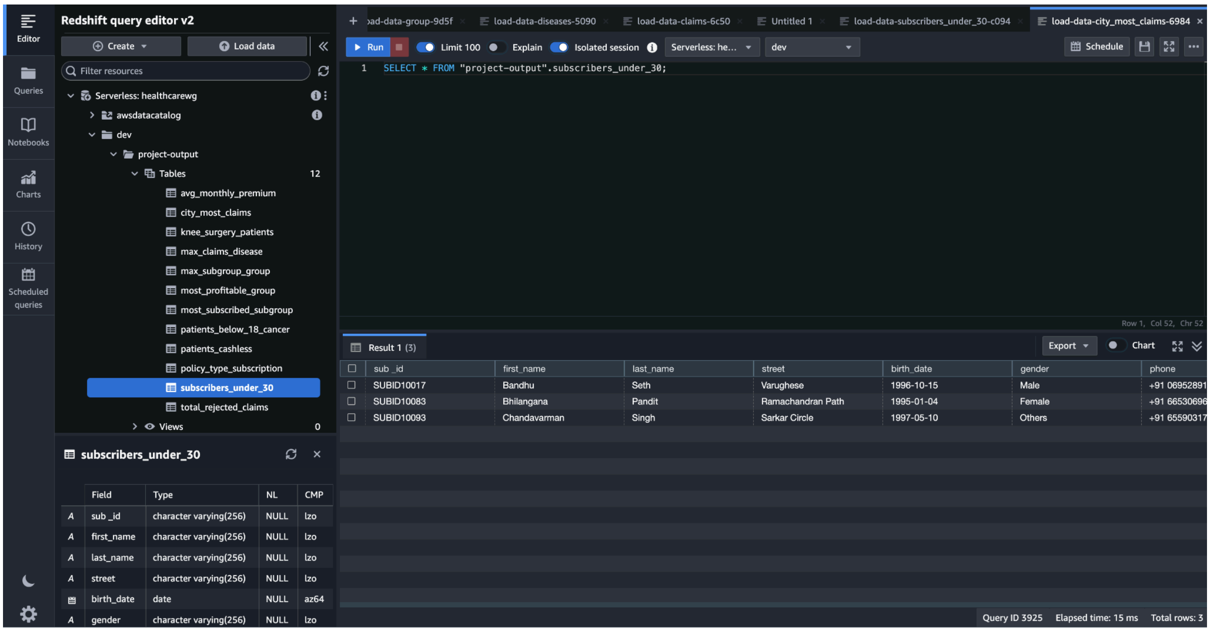
(2) Spark Jobs

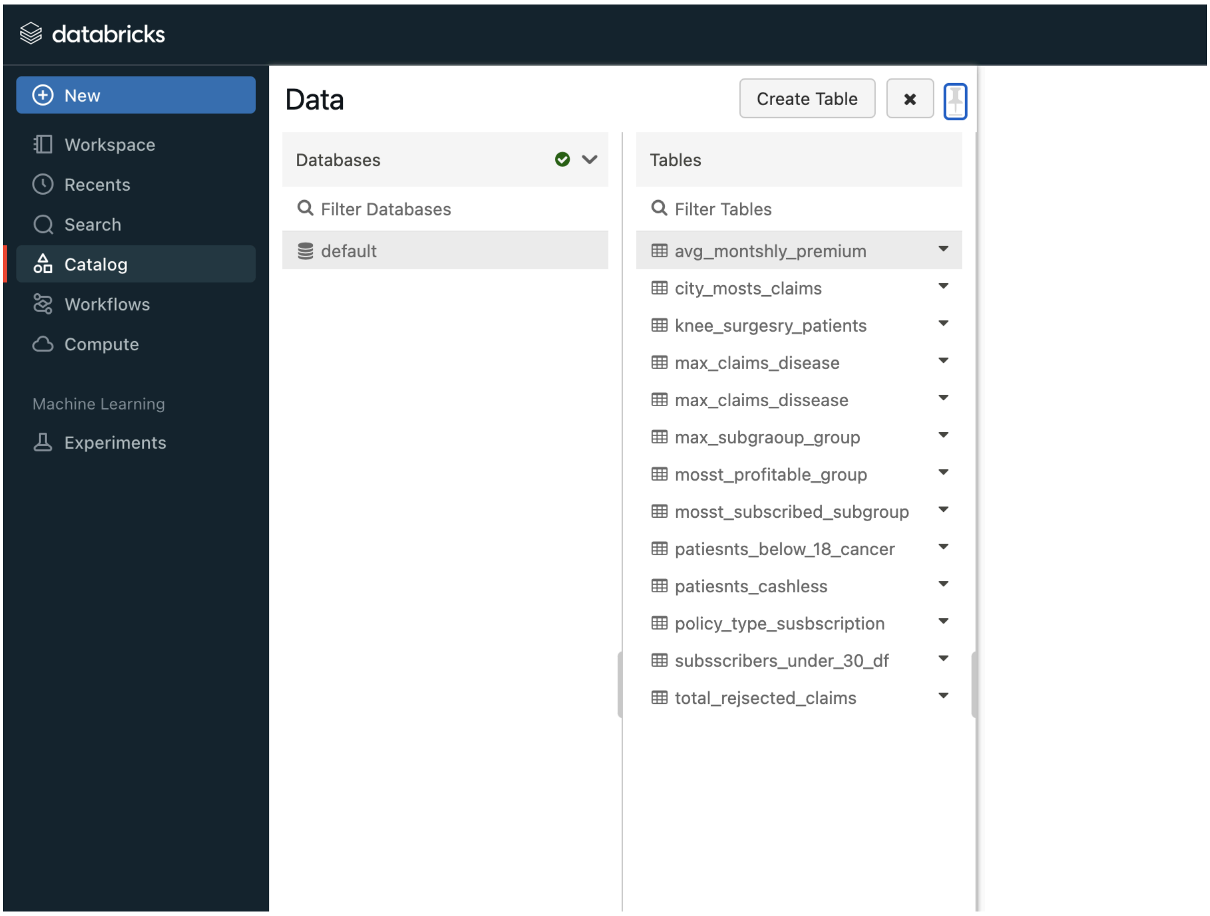
female_patients_over_40: pyspark.sql.dataframe.DataFrame = [Patient_id: integer, Patient_name: string ... 6 more fields]
knee_surgery_patients: pyspark.sql.dataframe.DataFrame = [Patient_id: integer, Patient_name: string ... 6 more fields]

```
+----------+------------+--------------+------------------+-------------+------------+----+-----------+
|Patient_id|Patient_name|patient_gender|patient_birth_date|patient_phone|disease_name|city|hospital_id|
+----------+------------+--------------+------------------+-------------+------------+----+-----------+
+----------+------------+--------------+------------------+-------------+------------+----+-----------+
```

12. Result Creation on Redshift




Redshift query editor v2
Editor
Queries
Notebooks
Charts
History
Scheduled queries
Create
Load data
Filter resources
Serverless: healthcarewg
awsdatacatalog
dev
project-output
Tables
12
avg_monthly_premium
city_most_claims
knee_surgery_patients
max_claims_disease
max_subgroup_group
most_profitable_group
most_subscribed_subgroup
patients_below_18_cancer
patients_cashless
policy_type_subscription
subscribers_under_30
total_rejected_claims
Views
0
subscribers_under_30
Field
Type
NL
CMP
sub_id
character varying(256)
NULL
lzo
first_name
last_name
street
birth_date
date
az64
gender
load-data-diseases-5090
load-data-claims-6c50
Untitled 1
load-data-subscribers_under_30-c094
load-data-city_most_claims-6984
Run
Limit 100
Explain
Isolated session
Serverless: he...
dev
Schedule
1 SELECT * FROM "project-output".subscribers_under_30;
Result 1 (3)
Export
Chart
sub_id
first_name
last_name
street
birth_date
gender
phone
SUBID10017
Bandhu
Seth
Varughese
1996-10-15
Male
SUBID10083
Bhilangana
Pandit
Ramachandran Path
1995-01-04
Female
SUBID10093
Chandavarman
Singh
Sarkar Circle
1997-05-10
Others
Query ID 3925
Elapsed time: 15 ms
Total rows: 3


databricks
New
Workspace
Recents
Search
Catalog
Workflows
Compute
Machine Learning
Experiments
Data
Create Table
Databases
Filter Databases
default
Tables
Filter Tables
avg_montshly_premium
city_mosts_claims
knee_surgesry_patients
max_claims_disease
max_claims_dissease
max_subgraoup_group
mosst_profitable_group
mosst_subscribed_subgroup
patiesnts_below_18_cancer
patiesnts_cashless
policy_type_susbscription
subsscribers_under_30_df
total_rejsected_claims