# FutureCart CRM Analytics Project Documentation

### 1. Business Objective

FutureCart Inc. aims to enhance customer satisfaction and loyalty through a robust CRM strategy. The company operates over 5000 retail stores and an e-commerce platform across India. A dedicated Customer Care team handles complaints and feedback, which are logged as cases and followed by customer surveys.

The goal is to:

- Improve after-sales service.
- Track and optimize customer support performance.
- Enable real-time and historical insights for leadership decision-making.

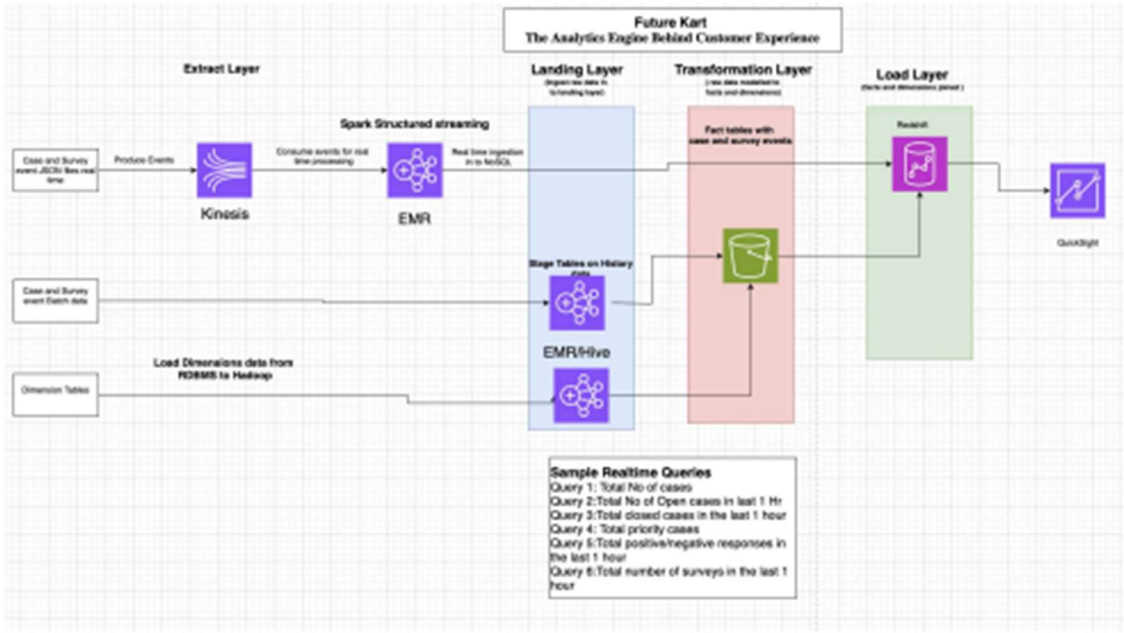
### 2. Business Process Overview

- Customers contact support via **calls, chat, or email**.
- A **Customer Care Representative (CCR)** logs each interaction as a **case**.
- Cases are categorized and prioritized based on business rules.
- After resolution, customers receive a **survey** to rate their experience.
- All data is collected and analyzed to monitor **KPIs** and improve service.

### 3. Key KPIs Tracked

| Type | KPI |
|---|---|
| Real-Time | Open/closed cases in last hour, priority cases, survey sentiment |
| Batch | Daily/weekly/monthly case volumes, survey counts, sentiment trends |

## 4. Technical Architecture: Data Flow Layers




| Layer | Purpose | Tools |
|---|---|---|
| **Extract** | Ingest raw data | Kinesis (real-time), S3 (batch), EC2 MySQL (dimension) |
| **Landing** | Store raw data | EMR + Hive |
| **Transformation** | Clean & model data | Hive/Spark |
| **Load** | Store for analytics | Redshift |
| **Visualization** | Business insights | Quick Sight |

## 5. Step-by-Step Execution Plan

### Step 1: Dimension Data Setup

- Create Base Dimension table and load 8 datasets.
- Create MySQL tables on EC2 using SQL scripts.
- Load .txt files into MySQL using LOAD DATA INFILE.

**Step 2: Batch Ingestion**

- Use Sqoop to import MySQL dimension tables into Hive.
- Use Spark to export Hive tables to S3.
- Load S3 data into Redshift.

**Step 3: Historical Data Setup**

- Use generate_historical_data.py to simulate 10 days of case and survey data in JSON format.
- Load JSON files into HDFS.
- Create Hive tables for historical case and survey data.

**Step 4: Real-Time Data Simulation**

- Use stream_to_kinesis.py to generate real-time case and survey events.
- Send JSON data to Kinesis streams:
    - futurecart_case_event
    - futurecart_survey_event

**Step 5: Real-Time Processing**

- Create a consumer application to read from Kinesis.
- Parse incoming JSON:
    - If it's a case → load into Redshift case table.
    - If it's a survey → load into Redshift survey table.

**Step 6: Data Export and Load**

- Export transformed Hive data to S3 using Spark DataFrames.
- Load S3 data into Redshift using COPY or Glue.

**Step 7: KPI Queries**

- Write SQL queries on Redshift to calculate KPIs:
    - Case volumes
    - SLA compliance
    - Survey sentiment.

# Dimension Data to S3

**Dimension Data Workflow EC2 → MariaDB → EMR/Hive → Spark.**

| Phase | Description |
|---|---|
| 1 | Setup EC2 and install MariaDB |
| 2 | Create database and tables |
| 3 | Upload .txt files from local to EC2 |
| 4 | Load data into MariaDB |
| 5 | Setup EMR and Hive |
| 6 | Transfer data from MariaDB to Hive using Sqoop |
| 7 | Export Hive tables to S3 using Spark |

**Phase 1: Setup EC2 and Install MariaDB**

- **Step 1.1: Launch EC2 Instance**
  - **AMI**: Amazon Linux 2
  - **Instance Type**: t2.medium or higher
  - **Storage**: 20 GB
  - **Security Group**:
    - Allow **SSH (port 22)** from your IP
    - Allow **MySQL (port 3306)** from EMR subnet or your IP
    - Allow http
    - Allow redshift
- **Step 1.2: Connect to EC2**

ssh -i your-key.pem ec2-user@<EC2-Public-IP>

- **Step 1.3 Install MariaDB 10.5 on Amazon Linux 2023**

1. **Update packages:** sudo dnf update -y
2. **Install MariaDB 10.5:** sudo dnf install mariadb105-server mariadb105 -y

3. **Start and enable MariaDB service:**

   sudo systemctl start mariadb

   sudo systemctl enable mariadb

4. **Secure MariaDB installation:**

   sudo mysql_secure_installation

   Follow the prompts to set root password and remove test users/databases.

5. **Verify MariaDB is running:**

   sudo systemctl status mariadb

---

**Phase 2: Create Database and Tables**

🔹 **Step 2.1: Login to MariaDB**

```
mysql -u root -p
```

🔹 **Step 2.2: Create Database**

```
CREATE DATABASE futurecart_crm;

USE futurecart_crm;
```

🔹 **Step 2.3: Create All 8 Tables**

```
-- SQL for futurecart_calendar_details

CREATE TABLE futurecart_calendar_details (
    calendar_date DATE,
    date_desc VARCHAR(50),
    week_day_nbr SMALLINT,
    week_number SMALLINT,
    week_name VARCHAR(50),
    year_week_number INT,
    month_number SMALLINT,
    month_name VARCHAR(50),
    quarter_number SMALLINT,
    quarter_name VARCHAR(50),
```

```
    half_year_number SMALLINT,
    half_year_name VARCHAR(50),
    geo_region_cd CHAR(2)
);
```

**-- SQL for futurecart_call_center_details**

```
CREATE TABLE futurecart_call_center_details (
    call_center_id VARCHAR(10),
    call_center_vendor VARCHAR(50),
    location VARCHAR(50),
    country VARCHAR(50)
);
```

**-- SQL for futurecart_case_category_details**

```
CREATE TABLE futurecart_case_category_details (
    category_key VARCHAR(10),
    sub_category_key VARCHAR(10),
    category_description VARCHAR(50),
    sub_category_description VARCHAR(50),
    priority VARCHAR(10),
);
```

**-- SQL for futurecart_case_country_details**

```
CREATE TABLE futurecart_case_country_details (
    id INT,
    name VARCHAR(75),
    alpha_2 VARCHAR(2),
    alpha_3 VARCHAR(3)
);
```

```
-- SQL for futurecart_case_priority_details
CREATE TABLE futurecart_case_priority_details (
    priority_key VARCHAR(5),
    priority VARCHAR(20),
    severity VARCHAR(100),
    sla VARCHAR(100)
);
-- SQL for futurecart_employee_details
CREATE TABLE futurecart_employee_details (
    emp_key INT,
    first_name VARCHAR(50),
    last_name VARCHAR(50),
    email VARCHAR(100),
    gender VARCHAR(10),
    ldap VARCHAR(50),
    hire_date DATE,
    manager VARCHAR(50)
);
-- SQL for futurecart_product_details
CREATE TABLE futurecart_product_details (
    product_id VARCHAR(20),
    department VARCHAR(50),
    brand VARCHAR(50),
    commodity_desc VARCHAR(100),
    sub_commodity_desc VARCHAR(100)
);
```

**-- SQL for futurecart_survey_question_details (// put range in ‘ ‘ as The problem here is that range is a reserved keyword)**

```
CREATE TABLE futurecart_survey_question_details (
  question_id VARCHAR(10),
  question_desc VARCHAR(255),
  response_type VARCHAR(50),
  `range` VARCHAR(20),
  negative_response_range VARCHAR(20),
  neutral_response_range VARCHAR(20),
  positive_response_range VARCHAR(20)
);
```

```
MariaDB [futurecart_crm]> show tables
    -> ;
+-----------------------------------+
| Tables_in_futurecart_crm          |
+-----------------------------------+
| futurecart_calendar_details       |
| futurecart_call_center_details    |
| futurecart_case_category_details  |
| futurecart_case_country_details   |
| futurecart_case_priority_details  |
| futurecart_employee_details       |
| futurecart_product_details        |
| futurecart_survey_question_details |
+-----------------------------------+
8 rows in set (0.001 sec)
```

---

## 📁 Phase 3: Upload 8 .txt Files to EC2

### 🔹 Step 3.1: From Local to EC2

scp -i your-key.pem futurecart_*.txt ec2-user@<EC2-Public-IP>:/home/ec2-user/

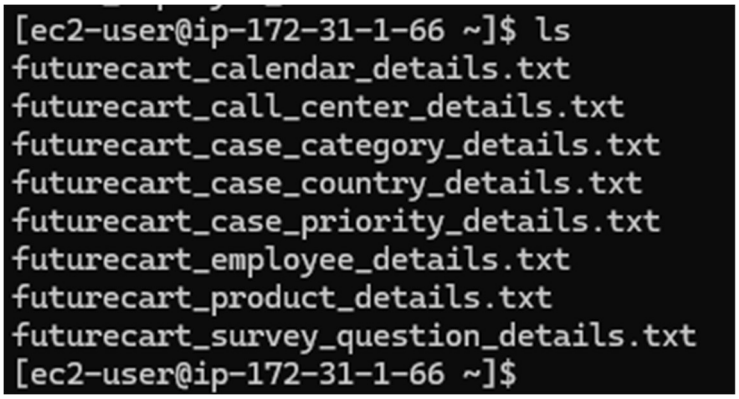
---

## 📜 Phase 4: Load Data into MariaDB

**4.1: Upload files to S3 then extract it from ec2**

aws s3 cp s3://tbsm-source/db/ ~/ --recursive

CHECK FOR THE FILES




# Restart MariaDB

sudo systemctl restart mariadb

**4.2: Login again and setup permission for loading for marida db**

sudo mysql -u root -p

**4.3. Allow MariaDB to load local files**

Check MariaDB config allows local file loading. In your MariaDB session:

- SHOW VARIABLES LIKE 'local_infile';

**4.4 If it's OFF, enable it:**

- SET GLOBAL local_infile = 1;

**Step 4.5:**

**Use database**
use futurecart_crm;

**4.6: Load One Table (Example: Calendar)**

-LOAD DATA LOCAL INFILE '/home/ec2-user/futurecart_calendar_details.txt'

INTO TABLE futurecart_calendar_details

FIELDS TERMINATED BY ' '

LINES TERMINATED BY '\n'

IGNORE 1 LINES;

LOAD DATA LOCAL INFILE '/home/ec2-user/futurecart_call_center_details.txt'

INTO TABLE futurecart_call_center_details

FIELDS TERMINATED BY ' '

```
LINES TERMINATED BY '\n'
IGNORE 1 LINES;

LOAD DATA LOCAL INFILE '/home/ec2-user/futurecart_case_category_details.txt'
INTO TABLE futurecart_case_category_details
FIELDS TERMINATED BY ' '
LINES TERMINATED BY '\n'
IGNORE 1 LINES;

LOAD DATA LOCAL INFILE '/home/ec2-user/futurecart_case_country_details.txt'
INTO TABLE futurecart_case_country_details
FIELDS TERMINATED BY ' '
LINES TERMINATED BY '\n'
IGNORE 1 LINES;

LOAD DATA LOCAL INFILE '/home/ec2-user/futurecart_case_priority_details.txt'
INTO TABLE futurecart_case_priority_details
FIELDS TERMINATED BY ' '
LINES TERMINATED BY '\n'
IGNORE 1 LINES;

LOAD DATA LOCAL INFILE '/home/ec2-user/futurecart_employee_details.txt'
INTO TABLE futurecart_employee_details
FIELDS TERMINATED BY ' '
LINES TERMINATED BY '\n'
IGNORE 1 LINES;

LOAD DATA LOCAL INFILE '/home/ec2-user/futurecart_product_details.txt'
```

INTO TABLE futurecart_product_details

FIELDS TERMINATED BY ' '

LINES TERMINATED BY '\n'

IGNORE 1 LINES;

LOAD DATA LOCAL INFILE '/home/ec2-user/futurecart_survey_question_details.txt'

INTO TABLE futurecart_survey_question_details

FIELDS TERMINATED BY ' '

LINES TERMINATED BY '\n'

IGNORE 1 LINES;

Cross check for count and run one or two select cmd to check data

```
MariaDB [futurecart_crm]> SELECT COUNT(*) FROM futurecart_employee_details;
ls LIMIT 5;
+----------+
| COUNT(*) |
+----------+
|   300024 |
+----------+
1 row in set (0.077 sec)
```

**ALTERNATIVE:- Clean the loading file and converted in csv and upload in table**

**Phase 5: Setup EMR Cluster**

- **Step 5.1: Launch EMR**
  - **Release**: EMR 6.15.0
  - **Applications**: Hive, Hadoop, Spark, Sqoop
  - **Instance Type**: m5.xlarge (3 nodes)
  - **Log URI**: s3://your-bucket/emr-logs/
  - **IAM Roles**: ec2-s3-full-access

---

**Phase 6: Transfer Data via Sqoop**

- **Step 6.1: SSH into EMR Master**

ssh -i your-key.pem hadoop@<EMR-Master-IP>

**Verify HDFS directories and create user directory if needed:**

hdfs dfs -ls

hdfs dfs -mkdir -p /user/ec2-user

hdfs dfs -chown ec2-user /user/ec2-user

**Launch Hive CLI and create/use the database:**

hive

**Inside Hive CLI:**

CREATE DATABASE IF NOT EXISTS dimension;

SHOW DATABASES;

USE dimension;

EXIT;

---

- **Step 6.2: Run Sqoop Import (Example: Calendar Table)**

```
sqoop import \
 --connect jdbc:mysql://172.31.8.1:3306/futurecart_crm \
 --username root \
 --password tekavade123 \
 --table futurecart_calendar_details \
 --hive-import \
 --hive-database dimension \
 --hive-table futurecart_calendar_details \
 --create-hive-table \
 --fields-terminated-by '\t' \
 -m 1 \
 --driver org.mariadb.jdbc.Driver
```

---

🔹 **Step 6.3: Import Remaining Tables**

**Repeat the Sqoop import command for all other tables, changing --table and --hive-table accordingly:**

```
sqoop import \
 --connect jdbc:mysql://172.31.8.1:3306/futurecart_crm \
 --username root \
 --password tekavade123 \
 --table futurecart_call_center_details \
 --hive-import \
 --hive-database dimension \
 --hive-table futurecart_call_center_details \
 --create-hive-table \
 --fields-terminated-by '\t' \
 -m 1 \
 --driver org.mariadb.jdbc.Driver
```

**Similarly for:**

- futurecart_case_category_details
- futurecart_case_country_details
- futurecart_case_priority_details
- futurecart_employee_details
- futurecart_product_details
- futurecart_survey_question_details

---

**Phase 7: Export Hive Tables to S3 via Spark**

🔹 **Step 7.1: Create Spark Script (export_hive_tables_to_s3.py)**

```
from pyspark.sql import SparkSession
```

```
def export_table(spark, hive_db, table_name, s3_path):
    full_table_name = f"{hive_db}.{table_name}"
    print(f"Exporting {full_table_name} to {s3_path} ...")
    # Read Hive table
    df = spark.table(full_table_name)
    # Write as Parquet to S3 (overwrite if exists)
    df.write.mode("overwrite").parquet(s3_path)
    print(f"Done exporting {full_table_name}")
def main():
    spark = SparkSession.builder \
        .appName("HiveToS3Export") \
        .enableHiveSupport() \
        .getOrCreate()
    hive_db = "dimension"
    s3_base_path = "s3://tbsm-destination/db/"
    tables = [
        "futurecart_calendar_details",
        "futurecart_call_center_details",
        "futurecart_case_category_details",
        "futurecart_case_country_details",
        "futurecart_case_priority_details",
        "futurecart_employee_details",
        "futurecart_product_details",
        "futurecart_survey_question_details"
    ]
    for table in tables:
        s3_path = f"{s3_base_path}{table}"
        export_table(spark, hive_db, table, s3_path)
```

```
    spark.stop()

if __name__ == "__main__":
    main()
```

🔹 **Step 7.2: Run Spark Job**

```
spark-submit export_hive_tables_to_s3.py
```

---

**Final Output**

- All 8 dimension tables are:
    - Persisted in EC2 MariaDB
    - Imported into Hive on EMR
    - Exported to S3 in Parquet format

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# Historical Data Ingestion

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**Overview**

- Generate 10 days of historical case & survey data as JSON Lines files locally on EMR.
- Upload JSON data to HDFS.
- Create Hive external tables on JSON data.
- Export Hive tables to S3 in Parquet format using Spark.

---

**Step 2.1: Generate Historical JSON Data**

1. **Create Python script to generate JSON data**

```
nano generate_historical_data.py
```

2. **Copy-paste this Python code into generate_historical_data.py:**

```
import os
import json
import random
from datetime import datetime, timedelta
NUM_DAYS = 10
CASES_PER_DAY = 100
SURVEYS_PER_DAY = 80
OUTPUT_DIR = "historical_data_jsonl"
def random_case_no():
    return str(random.randint(600000, 700000))
def random_timestamp(day_offset):
    date = datetime.now() - timedelta(days=day_offset)
    return date.strftime("%Y-%m-%d %H:%M:%S")
def generate_case(case_no, day_offset):
    return {
        "status": random.choice(["Open", "Closed"]),
```

```
        "category": f"CAT{random.randint(1,5)}",
        "sub_category": f"SCAT{random.randint(1,20)}",
        "last_modified_timestamp": random_timestamp(day_offset),
        "case_no": case_no,
        "create_timestamp": random_timestamp(day_offset),
        "created_employee_key": str(random.randint(200000, 300000)),
        "call_center_id": f"C-{random.randint(100,120)}",
        "product_code": str(random.randint(9000000, 9999999)),
        "country_cd": random.choice(["IN", "US", "BR", "DE", "AU"]),
        "communication_mode": random.choice(["Email", "Call", "Chat"])
    }
def generate_survey(case_no, day_offset):
    return {
        "survey_id": f"S-{random.randint(500000, 599999)}",
        "case_no": case_no,
        "survey_timestamp": random_timestamp(day_offset),
        "Q1": random.randint(1, 10),
        "Q2": random.randint(1, 10),
        "Q3": random.randint(1, 10),
        "Q4": random.choice(["Y", "N"]),
        "Q5": random.randint(1, 10)
    }
def ensure_dirs():
    os.makedirs(f"{OUTPUT_DIR}/cases", exist_ok=True)
    os.makedirs(f"{OUTPUT_DIR}/surveys", exist_ok=True)
def main():
    ensure_dirs()
    for day in range(1, NUM_DAYS + 1):
```

```
    case_nos = [random_case_no() for _ in range(CASES_PER_DAY)]
    cases = [generate_case(cn, day) for cn in case_nos]
    surveys = [generate_survey(cn, day) for cn in random.sample(case_nos,
SURVEYS_PER_DAY)]
    with open(f"{OUTPUT_DIR}/cases/case_data_day{day}.json", "w") as f:
      for record in cases:
        f.write(json.dumps(record) + "\n")
    with open(f"{OUTPUT_DIR}/surveys/survey_data_day{day}.json", "w") as f:
      for record in surveys:
        f.write(json.dumps(record) + "\n")
  print(f" ✅ JSON Lines generated for {NUM_DAYS} days in '{OUTPUT_DIR}/'")
if __name__ == "__main__":
  main()
```

3. **Run the script to generate JSON data locally**

```
python3 generate_historical_data.py
```

- This will create a folder historical_data_jsonl with two subfolders: cases and surveys.
- Each contains 10 JSON files — one for each day.

---

**Step 2.2: Upload JSON Data to HDFS**

1. **Create necessary HDFS directories (run these commands):**

```
sudo -u hdfs hdfs dfs -mkdir -p /data/historical/cases
sudo -u hdfs hdfs dfs -mkdir -p /data/historical/surveys
```

2. **Give your user ownership of these directories:**

```
sudo -u hdfs hdfs dfs -chown -R ec2-user:ec2-user /data/historical
```

3. **Upload JSON files to HDFS:**

```
hdfs dfs -put -f historical_data_jsonl/cases/*.json /data/historical/cases/
hdfs dfs -put -f historical_data_jsonl/surveys/*.json /data/historical/surveys/
```

---

**Step 2.3: Create Hive External Tables**

1. **Open Hive shell**

>>Hive
>>Create database database_name;

2. **Run these commands in Hive shell to create external tables**

```
CREATE EXTERNAL TABLE case_details (
  status STRING,
  category STRING,
  sub_category STRING,
  last_modified_timestamp STRING,
  case_no STRING,
  create_timestamp STRING,
  created_employee_key STRING,
  call_center_id STRING,
  product_code STRING,
  country_cd STRING,
  communication_mode STRING
)
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
LOCATION '/data/historical/cases';
```

---

```
CREATE EXTERNAL TABLE case_survey_details (
  survey_id STRING,
  case_no STRING,
  survey_timestamp STRING,
  Q1 INT,
  Q2 INT,
  Q3 INT,
```

```
  Q4 STRING,
  Q5 INT
)
ROW FORMAT SERDE 'org.openx.data.jsonserde.JsonSerDe'
LOCATION '/data/historical/surveys';
```

3. **Check the data loaded**

```
SELECT COUNT(*) FROM case_details;    (800)
SELECT COUNT(*) FROM case_survey_details;  (1000)
```

---

**Step 2.4: Export Hive Tables to S3 as Parquet Using Spark**

1. **Create Spark export script**

```
nano export_historical_to_s3.py
```

2. **Paste this Spark Python code**

```
from pyspark.sql import SparkSession
def main():
  spark = SparkSession.builder \
    .appName("ExportHistoricalToS3") \
    .enableHiveSupport() \
    .getOrCreate()
  tables = {
    "case_details": "s3://tbsm-core/historical/case/",
    "case_survey_details": "s3://tbsm-core/historical/survey/"
  }
  for table, path in tables.items():
    print(f"Exporting {table} to {path} ...")
    df = spark.sql(f"SELECT * FROM {table}")
    df.write.mode("overwrite").parquet(path)
    print(f"Exported {table} successfully.")
```

```
    spark.stop()

if __name__ == "__main__":
    main()
```

3. **Run the Spark job**

```
spark-submit export_historical_to_s3.py
```

---

**All done!**

- Historical data JSON generated locally.
- Data uploaded to HDFS.
- Hive tables created on JSON data.
- Data exported from Hive tables to S3 as Parquet.

## Real-Time Streaming

## EC2 → Kinesis → Spark Streaming on EMR → Redshift (No S3)

🔧 **Prerequisites**

- EC2 Instance with boto3 and Kinesis permissions
- EMR Cluster with Spark
- Redshift Serverless Workgroup created and Publicly Accessible
- IAM Role with Redshift and Kinesis access

---

**Step 1: Launch EC2 for Data Generation**

**1.1 Launch EC2 Instance**

- Amazon Linux 2
- Attach IAM Role with Kinesis write access
- Install packages:

sudo yum update -y

pip3 install boto3

**1.2 Upload 000000_0 and stream_to_kinesis.py**

Use scp or AWS Console to upload the files to your EC2.

**1.3 Edit your Python script**

In stream_to_kinesis.py, ensure:

stream_name = 'case-survey-stream'

region_name = 'ap-south-1'

**1.4 Run the generator**

python3 stream_to_kinesis.py

This continuously sends random case/survey JSON records to your Kinesis stream.

---

**Step 2: Kinesis Setup**

**2.1 Create Stream**

- Go to AWS Console > Kinesis > Data Streams

- Stream name: case-survey-stream
- 1 shard

---

**Step 3: EMR Setup with Spark**

**3.1 Launch EMR Cluster**

- Select **Amazon EMR 6.x**
- Applications: Select **Spark**, **Hadoop**
- Instance type: m5.xlarge (or t3.medium for testing)
- Edit networking:
    - Place in **same VPC** as Redshift
    - Set **Security Group** with **outbound to Redshift port 5439**

**3.2 SSH into EMR Master Node**

ssh -i your-key.pem hadoop@<EMR-MASTER-PUBLIC-IP>

**3.3 Create Spark Streaming script kinesis_to_red.py**

```
from pyspark.sql import SparkSession
from pyspark.sql.functions import from_json, col, expr
from pyspark.sql.types import StructType, StringType, IntegerType
# Initialize Spark Session
spark = SparkSession.builder.appName("KinesisToRedshift").getOrCreate()
spark.sparkContext.setLogLevel("ERROR")
# Define schema for case and survey records
case_schema = StructType() \
  .add("case_no", StringType()) \
  .add("create_timestamp", StringType()) \
  .add("last_modified_timestamp", StringType()) \
  .add("created_employee_key", StringType()) \
  .add("call_center_id", StringType()) \
  .add("status", StringType()) \
```

```
    .add("category", StringType()) \
    .add("sub_category", StringType()) \
    .add("communication_mode", StringType()) \
    .add("country_cd", StringType()) \
    .add("product_code", StringType())
survey_schema = StructType() \
    .add("survey_id", StringType()) \
    .add("case_no", StringType()) \
    .add("survey_timestamp", StringType()) \
    .add("Q1", IntegerType()) \
    .add("Q2", StringType()) \
    .add("Q3", IntegerType()) \
    .add("Q4", StringType()) \
    .add("Q5", IntegerType())
# Read from Kinesis Stream
raw_stream = spark.readStream \
    .format("aws-kinesis") \
    .option("kinesis.region", "ap-south-1") \
    .option("kinesis.streamName", "futurekart-tbsm") \
    .option("kinesis.consumerType", "GetRecords") \
    .option("kinesis.endpointUrl", "https://kinesis.ap-south-1.amazonaws.com") \
    .option("kinesis.startingposition", "LATEST") \
    .load()
# Parse JSON strings
json_str_df = raw_stream.selectExpr("CAST(data AS STRING) as json_data")
# Filter and parse Survey records
survey_df = json_str_df \
    .filter(expr("json_data LIKE '%survey_id%'")) \
```

```
    .withColumn("parsed", from_json(col("json_data"), survey_schema)) \
    .select("parsed.*")
# Filter and parse Case records
case_df = json_str_df \
    .filter(expr("NOT json_data LIKE '%survey_id%'")) \
    .withColumn("parsed", from_json(col("json_data"), case_schema)) \
    .select("parsed.*")
# Redshift connection details
redshift_jdbc_url = "jdbc:redshift://tbsm-wg.008673239246.ap-south-1.redshift-
serverless.amazonaws.com:5439/tbsm-red"
redshift_user = "admin"
redshift_password = "Tekavade123"
temp_s3_dir = "s3://tbsm-encore/redshift-temp/"
aws_iam_role = "arn:aws:iam::008673239246:role/Redshift-S3Role-tbsm"
# Batch write function
def write_to_redshift(df, batch_id, table_name, tempdir):
    if df.isEmpty():
        return
    print(f"Writing batch {batch_id} to Redshift table: {table_name}")
    df.write \
        .format("io.github.spark_redshift_community.spark.redshift") \
        .option("url", f"{redshift_jdbc_url}?user={redshift_user}&password={redshift_password}")
\
        .option("dbtable", table_name) \
        .option("tempdir", tempdir) \
        .option("aws_iam_role", aws_iam_role) \
        .mode("append") \
        .save()
```

```
# Write case data to Redshift
case_query = case_df.writeStream \
    .foreachBatch(lambda df, id: write_to_redshift(df, id, "public.case_table", "s3://tbsm-red/case/")) \
    .start()
# Write survey data to Redshift
survey_query = survey_df.writeStream \
    .foreachBatch(lambda df, id: write_to_redshift(df, id, "public.survey_table", "s3://tbsm-red/survey/")) \
    .start()
# Await termination
spark.streams.awaitAnyTermination()
```

**3.4 Submit the Spark Job**

```
spark-submit \
  --jars s3://awslabs-code-us-east-1/spark-sql-kinesis-connector/spark-streaming-sql-kinesis-connector_2.12-1.0.0.jar \
  --packages com.amazon.redshift:redshift-jdbc42:2.1.0.33,org.apache.spark:spark-avro_2.12:3.5.6,io.github.spark-redshift-community:spark-redshift_2.12:6.4.3-spark_3.5 \
  kinesis_stream_to_redshift.py
```

---

**Step 4: Redshift Setup**

**4.1 Create Tables**

In Redshift SQL editor:

```
CREATE TABLE case_table (
  case_no VARCHAR,
  status VARCHAR,
  category VARCHAR,
```

```
 sub_category VARCHAR,
 last_modified_timestamp VARCHAR,
 create_timestamp VARCHAR,
 created_employee_key VARCHAR,
 call_center_id VARCHAR,
 product_code VARCHAR,
 country_cd VARCHAR,
 communication_mode VARCHAR
);
CREATE TABLE survey_table (
 survey_id VARCHAR,
 case_no VARCHAR,
 survey_timestamp VARCHAR,
 Q1 INT,
 Q2 INT,
 Q3 INT,
 Q4 VARCHAR,
 Q5 INT
);
```

**4.2 Confirm Streaming Ingestion**

After ~1 min of running Spark job, run:

```
SELECT * FROM case_table ORDER BY create_timestamp DESC LIMIT 10;
SELECT * FROM survey_table ORDER BY survey_timestamp DESC LIMIT 10;
```

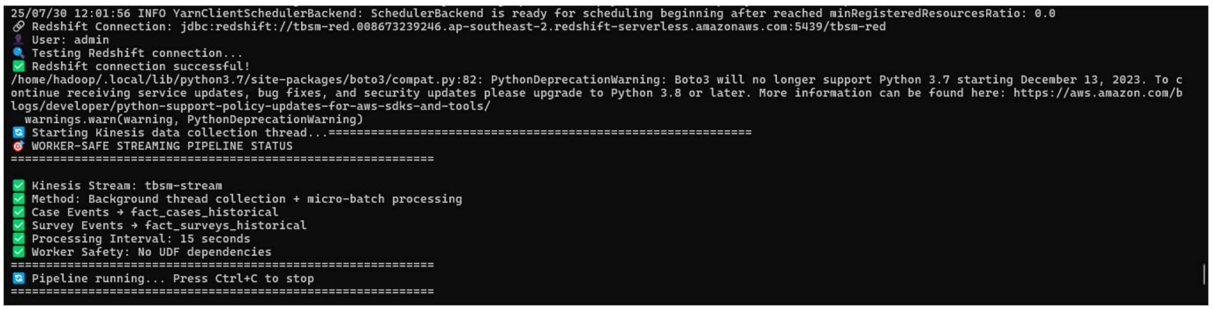
---

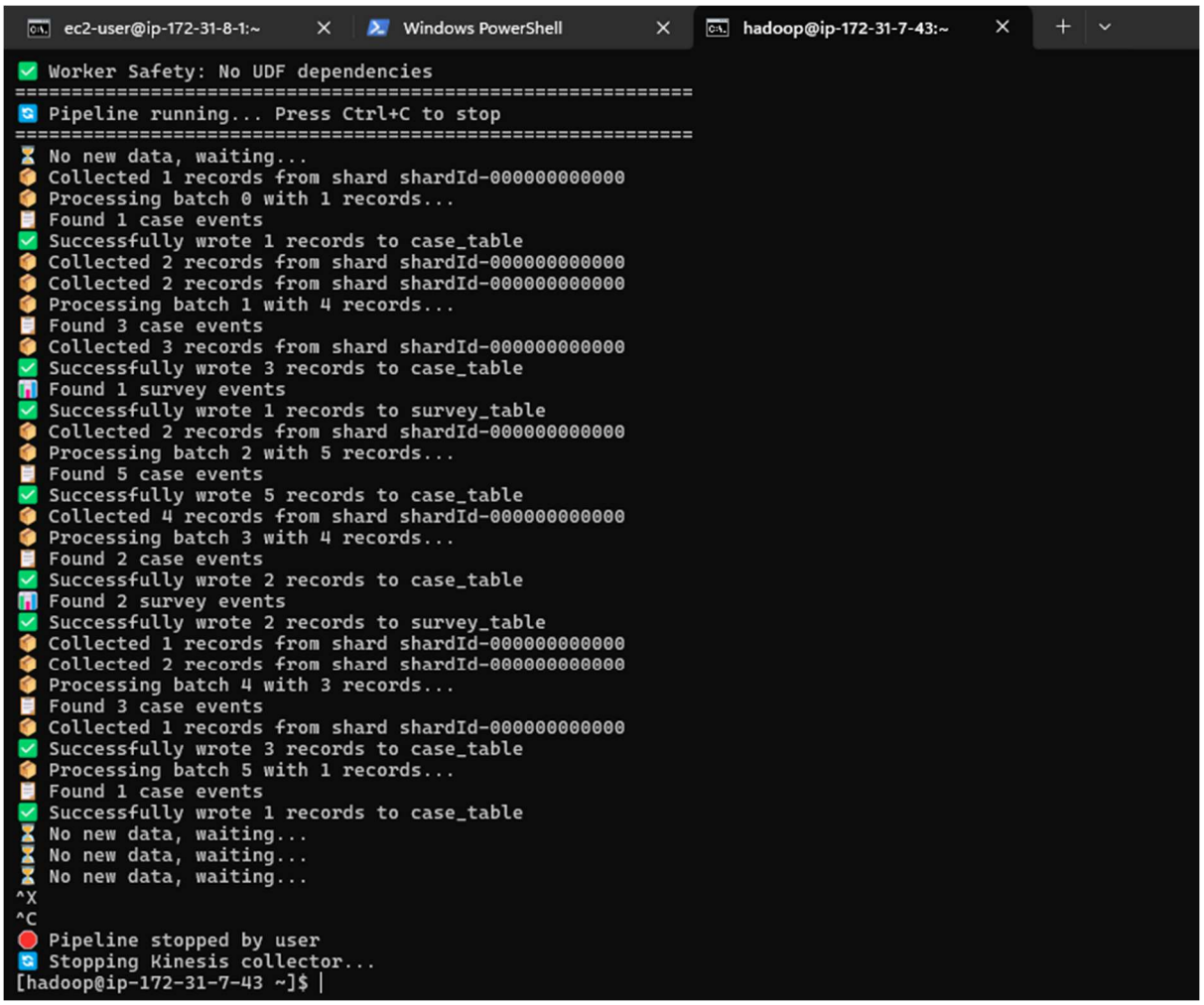
**You're Done**

You now have:

- Real-time data flowing from EC2 ➡️ Kinesis ➡️ EMR Spark ➡️ Redshift
- Case and Survey data written to Redshift

- Redshift ready for QuickSight or queries


ec2-user@ip-172-31-8-1:~
Windows PowerShell
hadoop@ip-172-31-7-43:~
✅ Worker Safety: No UDF dependencies
============================================================
🔄 Pipeline running... Press Ctrl+C to stop
============================================================
⏳ No new data, waiting...
📦 Collected 1 records from shard shardId-000000000000
📦 Processing batch 0 with 1 records...
📋 Found 1 case events
✅ Successfully wrote 1 records to case_table
📦 Collected 2 records from shard shardId-000000000000
📦 Collected 2 records from shard shardId-000000000000
📦 Processing batch 1 with 4 records...
📋 Found 3 case events
📦 Collected 3 records from shard shardId-000000000000
✅ Successfully wrote 3 records to case_table
📊 Found 1 survey events
✅ Successfully wrote 1 records to survey_table
📦 Collected 2 records from shard shardId-000000000000
📦 Processing batch 2 with 5 records...
📋 Found 5 case events
✅ Successfully wrote 5 records to case_table
📦 Collected 4 records from shard shardId-000000000000
📦 Processing batch 3 with 4 records...
📋 Found 2 case events
✅ Successfully wrote 2 records to case_table
📊 Found 2 survey events
✅ Successfully wrote 2 records to survey_table
📦 Collected 1 records from shard shardId-000000000000
📦 Collected 2 records from shard shardId-000000000000
📦 Processing batch 4 with 3 records...
📋 Found 3 case events
📦 Collected 1 records from shard shardId-000000000000
✅ Successfully wrote 3 records to case_table
📦 Processing batch 5 with 1 records...
📋 Found 1 case events
✅ Successfully wrote 1 records to case_table
⏳ No new data, waiting...
⏳ No new data, waiting...
⏳ No new data, waiting...
^X
^C
🛑 Pipeline stopped by user
🔄 Stopping Kinesis collector...
[hadoop@ip-172-31-7-43 ~]$

**Redshift Serverless & Analytical Queries**

**1. Redshift Serverless Setup**

- **Workgroup Name:** tbsm-red
- **Namespace Name:** tbsm-red1
- **Database Name:** tbsm-red
- **Admin User:** admin
- **Password:** Tekavade123

**IAM Role Details**

- **IAM Role Name:** tbsm-redshiftfullaccesss
- **Role ARN:** arn:aws:iam::008673239246:role/tbsm-redshiftfullaccesss
- **Attached Policies:**
    - AmazonRedshiftFullAccess
    - AmazonS3FullAccess
    - AmazonKinesisFullAccess

Ensure this IAM role is attached to your Redshift workgroup via **Workgroup > Permissions > Associate IAM Role**.

---

**2. Connect to Redshift Serverless Database**

---

**3. Create Public Schema (if not exists)**

```
CREATE SCHEMA IF NOT EXISTS public;
```

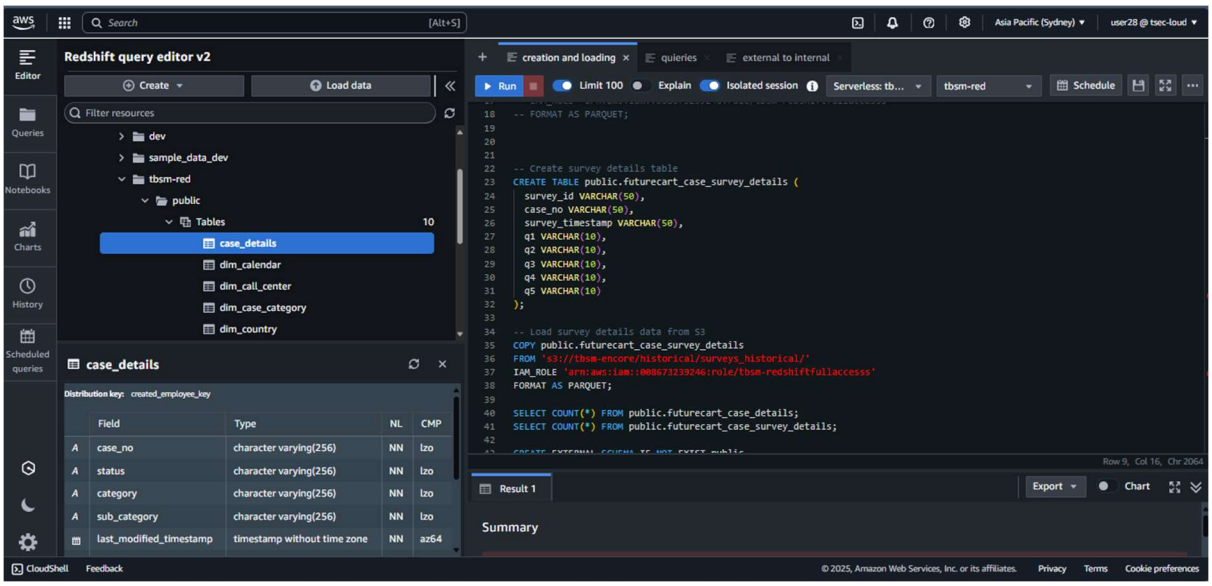
---

**4. Create Tables in public Schema**

Example: Create your main tables based on schema (adjust types as per your design):

```
CREATE TABLE public.case_details (
  case_no VARCHAR(256) NOT NULL,
  status VARCHAR(256) NOT NULL,
  category VARCHAR(256) NOT NULL,
```

```
 sub_category VARCHAR(256) NOT NULL,
 last_modified_timestamp TIMESTAMP NOT NULL,
 create_timestamp TIMESTAMP NOT NULL,
 created_employee_key VARCHAR(256) NOT NULL,
 call_center_id VARCHAR(256) NOT NULL,
 product_code VARCHAR(256) NOT NULL,
 country_cd VARCHAR(256) NOT NULL,
 communication_mode VARCHAR(256) NOT NULL
);

CREATE TABLE public.dim_case_category (
 category_key VARCHAR(256) NOT NULL,
 sub_category_key VARCHAR(256),
 category_description VARCHAR(512),
 sub_category_description VARCHAR(512),
 priority VARCHAR(256)
);

CREATE TABLE public.survey_details (
 survey_id VARCHAR(256) NOT NULL,
 case_no VARCHAR(256) NOT NULL,
 survey_timestamp TIMESTAMP NOT NULL,
 Q1 INT,
 Q2 INT,
 Q3 INT,
 Q4 VARCHAR(256),
 Q5 INT
);
```




**5. Upload Data from S3 to Redshift**

**COPY Command to Load Data into Redshift Tables**

**Example COPY command for CSV data:**

COPY public.case_details

FROM 's3://tbsm-encore/dimensional/casecases_historical/'

IAM_ROLE 'arn:aws:iam::008673239246:role/tbsm-redshiftfullaccesss'

FORMAT AS PARQUET;

**Repeat for each table:**

COPY public.dim_case_category

FROM 's3://tbsm-encore/dimensional/dim_case_category/'

IAM_ROLE 'arn:aws:iam::008673239246:role/tbsm-redshiftfullaccesss'

FORMAT AS PARQUET;

COPY public.survey_details

FROM 's3://tbsm-encore/dimensional/surveysurveys_historical/'

IAM_ROLE 'arn:aws:iam::008673239246:role/tbsm-redshiftfullaccesss'

FORMAT AS PARQUET;

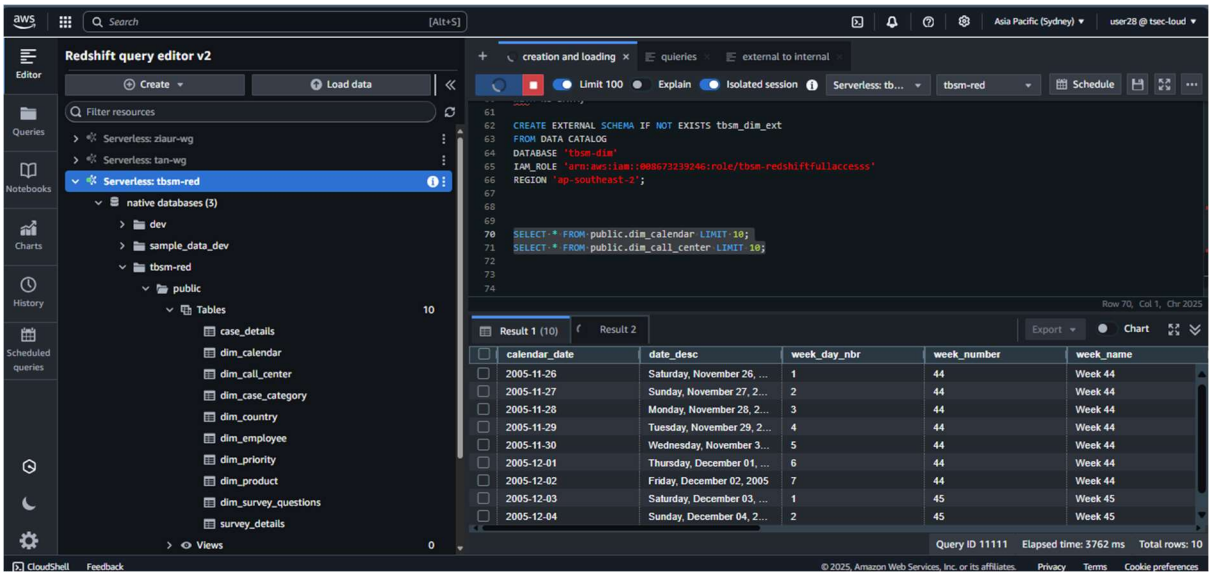
---

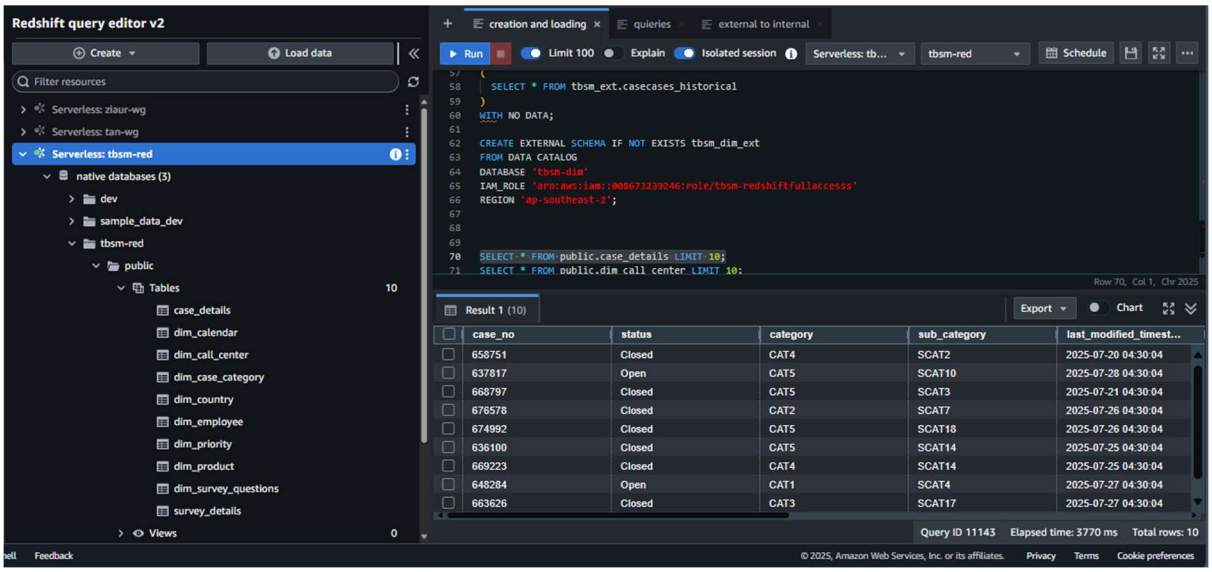
## 6. Verify Data Upload

SELECT COUNT(*) FROM public.case_details;

SELECT COUNT(*) FROM public.dim_case_category;

SELECT COUNT(*) FROM public.survey_details;




---

## 7. Run Analytical Queries

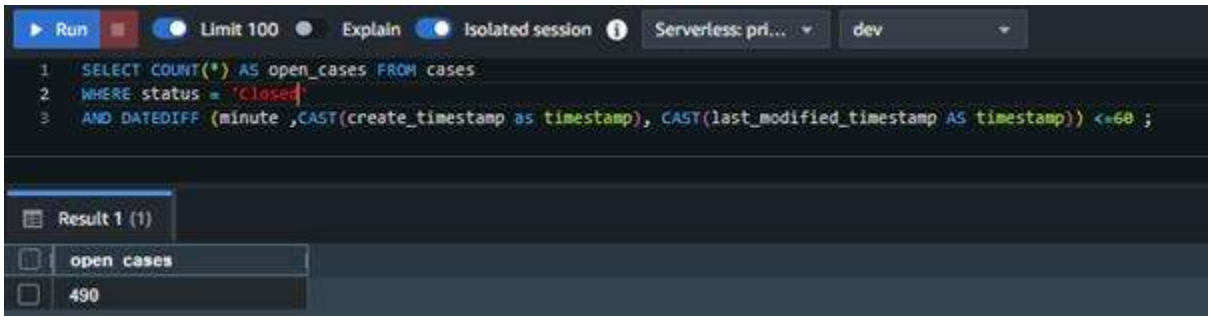
**-- 1. Total number of cases**

**SELECT COUNT(*) AS total_cases**

**FROM public.case_details;**

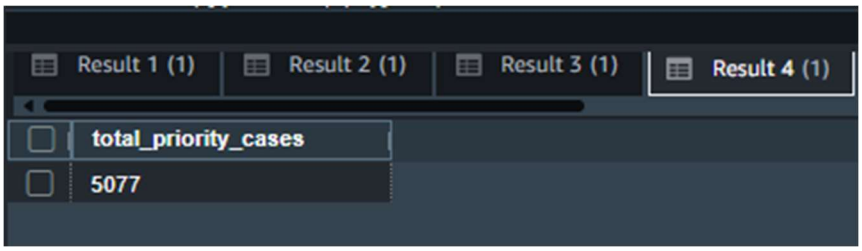

```
-- 2. Total open cases in the last 1 hour

SELECT COUNT(*) AS open_cases_last_1hr

FROM public.case_details

WHERE status = 'Open'

 AND create_timestamp >= DATEADD(hour, -1, GETDATE());
```


```
-- 3. Total closed cases in the last 1 hour

SELECT COUNT(*) AS closed_cases_last_1hr

FROM public.case_details

WHERE status = 'Closed'

 AND last_modified_timestamp >= DATEADD(hour, -1, GETDATE());
```




```
-- 4. Total priority cases (join with category)

SELECT COUNT(*) AS total_priority_cases

FROM public.case_details cd

JOIN public.dim_case_category ccat

 ON cd.category = ccat.category_key
```

```
WHERE ccat.priority IS NOT NULL;
```



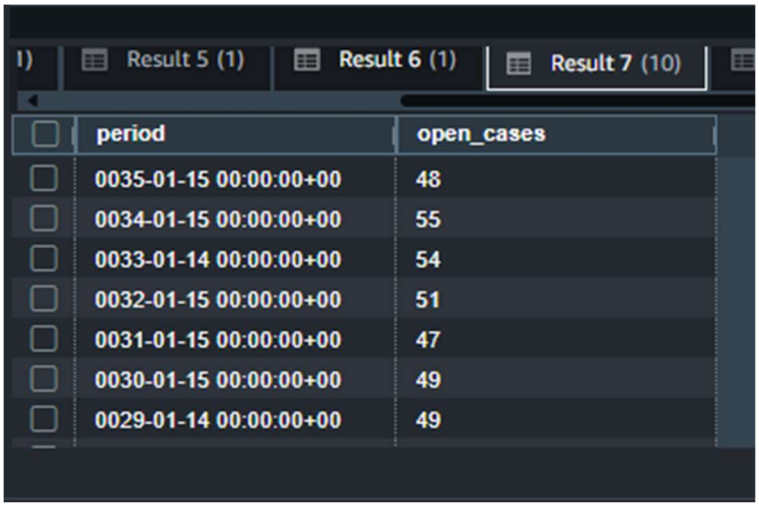

```
-- 5. Total positive and negative survey responses in the last 1 hour
SELECT
 SUM(
  CASE WHEN Q1 BETWEEN 8 AND 10 THEN 1 ELSE 0 END +
  CASE WHEN Q2 BETWEEN 8 AND 10 THEN 1 ELSE 0 END +
  CASE WHEN Q3 BETWEEN 8 AND 10 THEN 1 ELSE 0 END +
  CASE WHEN Q5 BETWEEN 8 AND 10 THEN 1 ELSE 0 END
 ) AS total_positive,
 SUM(
  CASE WHEN Q1 BETWEEN 1 AND 4 THEN 1 ELSE 0 END +
  CASE WHEN Q2 BETWEEN 1 AND 4 THEN 1 ELSE 0 END +
  CASE WHEN Q3 BETWEEN 1 AND 4 THEN 1 ELSE 0 END +
  CASE WHEN Q5 BETWEEN 1 AND 4 THEN 1 ELSE 0 END
 ) AS total_negative
FROM public.survey_details
WHERE survey_timestamp >= DATEADD(hour, -1, GETDATE());
-- 6. Total number of surveys in the last 1 hour
SELECT COUNT(*) AS total_surveys_last_1hr
FROM public.survey_details
WHERE survey_timestamp >= DATEADD(hour, -1, GETDATE());
```

```
SELECT COUNT(*) AS total_surveys
FROM survey
WHERE survey_timestamp IS NOT NULL
AND DATEDIFF(minute, CAST(survey_timestamp AS TIMESTAMP), CAST('2025-07-25 12:15:49' AS TIMESTAMP)) <= 60;
```

Result 1 (1)

| total_surveys |
|---|
| 240 |

```
-- 7. Total open cases by day
SELECT
 DATE_TRUNC('day', create_timestamp) AS period,
 COUNT(*) AS open_cases
FROM public.case_details
WHERE status = 'Open'
GROUP BY 1
ORDER BY 1 DESC;
```

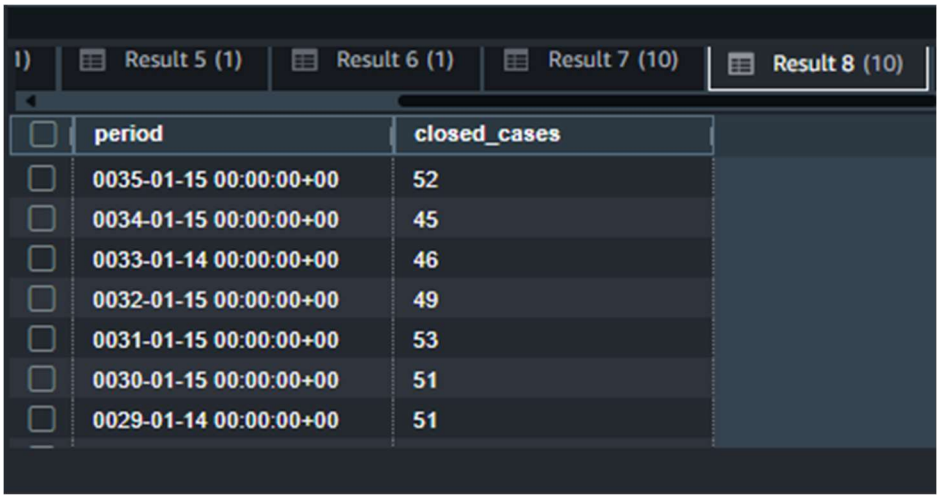


Result 5 (1) | Result 6 (1) | Result 7 (10)

| period | open_cases |
|---|---|
| 0035-01-15 00:00:00+00 | 48 |
| 0034-01-15 00:00:00+00 | 55 |
| 0033-01-14 00:00:00+00 | 54 |
| 0032-01-15 00:00:00+00 | 51 |
| 0031-01-15 00:00:00+00 | 47 |
| 0030-01-15 00:00:00+00 | 49 |
| 0029-01-14 00:00:00+00 | 49 |

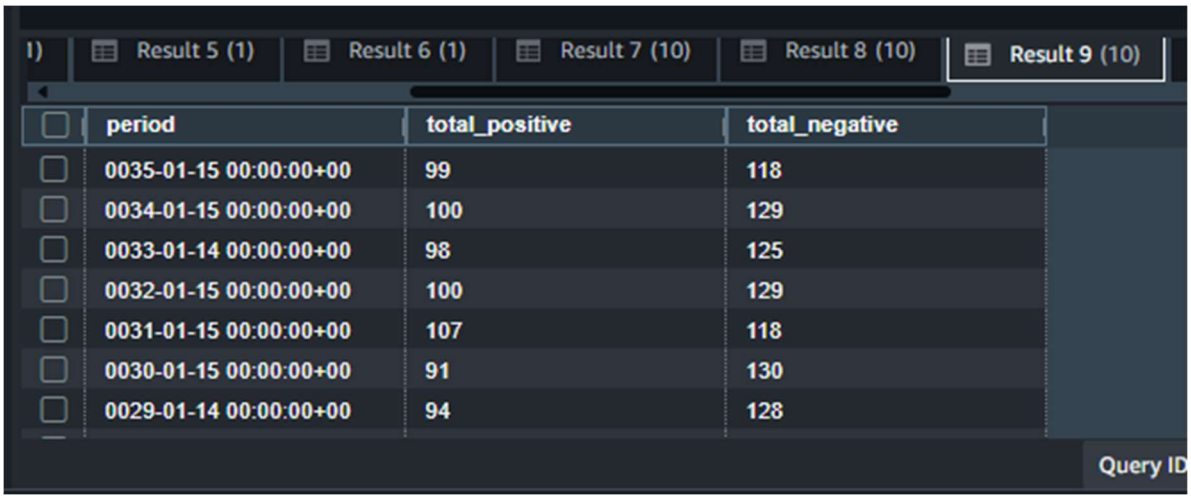
```
-- 8. Total closed cases by day
SELECT
 DATE_TRUNC('day', last_modified_timestamp) AS period,
 COUNT(*) AS closed_cases
FROM public.case_details
WHERE status = 'Closed'
```

```
GROUP BY 1
ORDER BY 1 DESC;
```

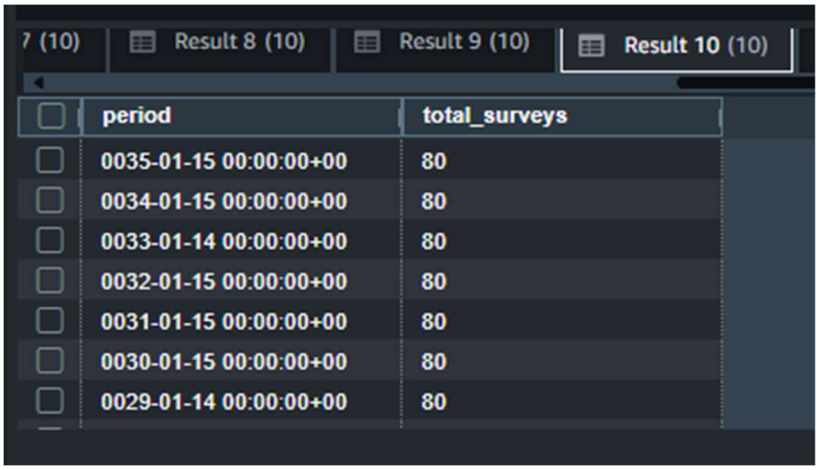



| period | closed_cases |
|---|---|
| 0035-01-15 00:00:00+00 | 52 |
| 0034-01-15 00:00:00+00 | 45 |
| 0033-01-14 00:00:00+00 | 46 |
| 0032-01-15 00:00:00+00 | 49 |
| 0031-01-15 00:00:00+00 | 53 |
| 0030-01-15 00:00:00+00 | 51 |
| 0029-01-14 00:00:00+00 | 51 |

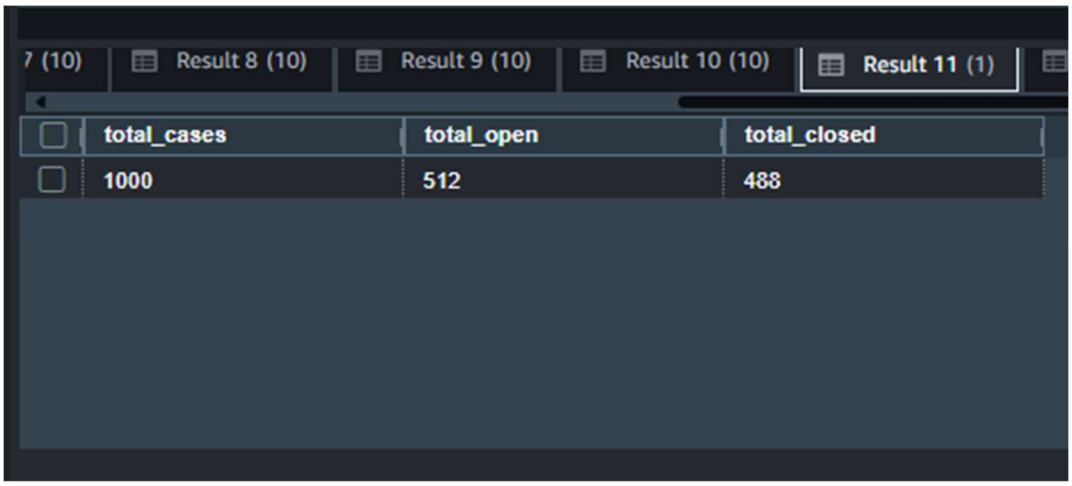
```
-- 9. Total positive and negative survey responses by day
SELECT
 DATE_TRUNC('day', survey_timestamp) AS period,
 SUM(
  CASE WHEN Q1 BETWEEN 8 AND 10 THEN 1 ELSE 0 END +
  CASE WHEN Q2 BETWEEN 8 AND 10 THEN 1 ELSE 0 END +
  CASE WHEN Q3 BETWEEN 8 AND 10 THEN 1 ELSE 0 END +
  CASE WHEN Q5 BETWEEN 8 AND 10 THEN 1 ELSE 0 END
 ) AS total_positive,
 SUM(
  CASE WHEN Q1 BETWEEN 1 AND 4 THEN 1 ELSE 0 END +
  CASE WHEN Q2 BETWEEN 1 AND 4 THEN 1 ELSE 0 END +
  CASE WHEN Q3 BETWEEN 1 AND 4 THEN 1 ELSE 0 END +
  CASE WHEN Q5 BETWEEN 1 AND 4 THEN 1 ELSE 0 END
 ) AS total_negative
FROM public.survey_details
GROUP BY 1
ORDER BY 1 DESC;
```




```
-- 10. Total number of surveys by day
SELECT
  DATE_TRUNC('day', survey_timestamp) AS period,
  COUNT(*) AS total_surveys
FROM public.survey_details
GROUP BY 1
ORDER BY 1 DESC;
```

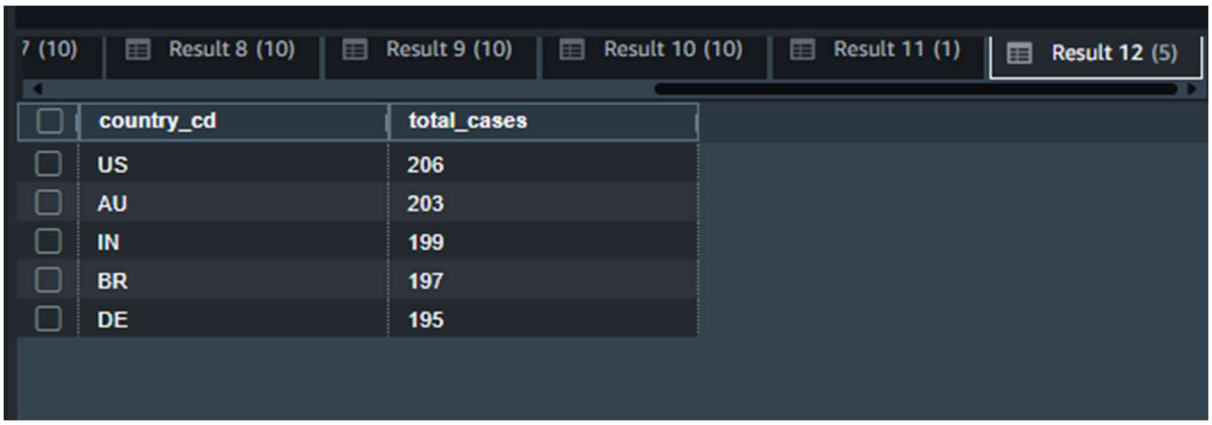



```
-- 11. Total open and closed cases out of all cases
SELECT
  COUNT(*) AS total_cases,
  SUM(CASE WHEN status = 'Open' THEN 1 ELSE 0 END) AS total_open,
  SUM(CASE WHEN status = 'Closed' THEN 1 ELSE 0 END) AS total_closed
FROM public.case_details;
```




**-- 12. Total number of cases received by country**

```
SELECT
 country_cd,
 COUNT(*) AS total_cases
FROM public.case_details
GROUP BY country_cd
ORDER BY total_cases DESC;
```




THANK YOU!

-if any doubt email me- yashtekavade@gmail.com