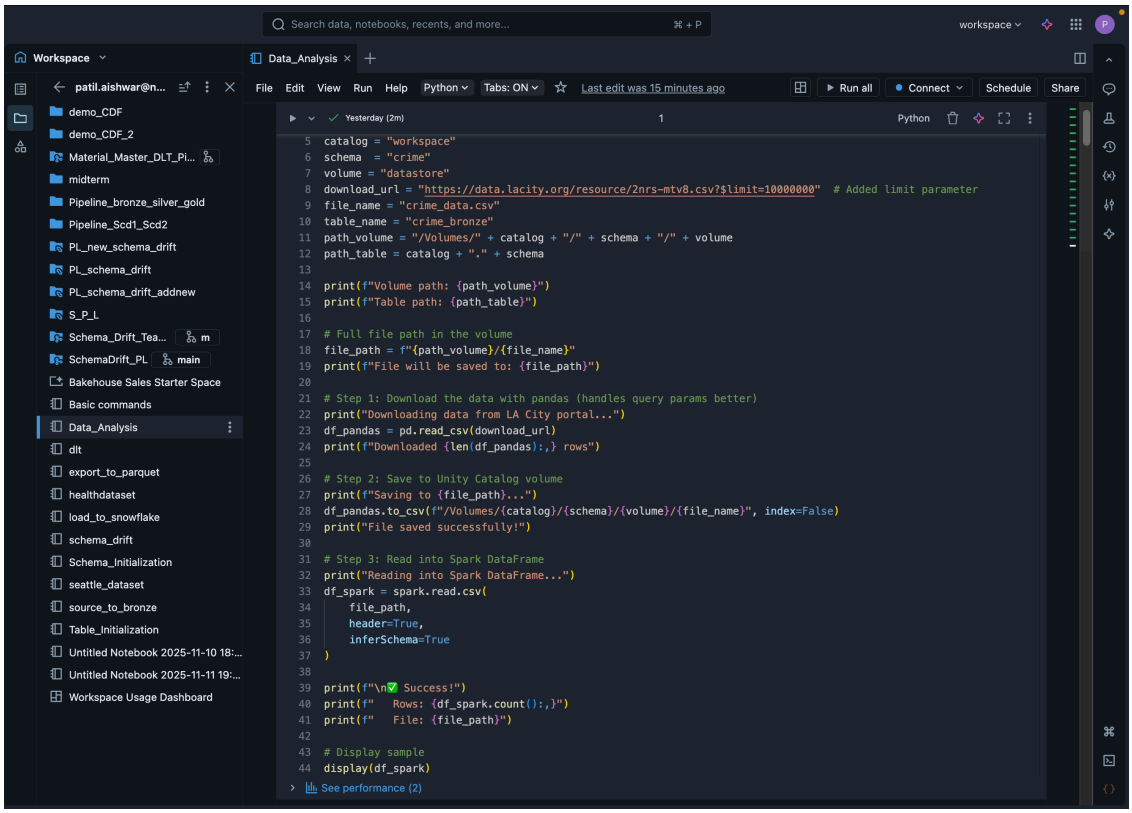
LA Crime Analysis Pipeline

Section 1: Data Ingestion from LA City Portal

Downloaded crime incident data from LA City's open data API and store it in Databricks Unity Catalog Volume
catalog = "workspace" schema = "crime" volume = "datastore"



Downloaded via pandas to handle API query parameters and download full dataset
Saved to Unity Catalog Volume - Persists CSV file to /Volumes/workspace/crime/datastore/crime_data.csv
Load into Spark DataFrame - Reads CSV into Spark with schema inference for distributed processing;
And then created Bronze Table - Registers data as workspace.crime.crime_bronze table

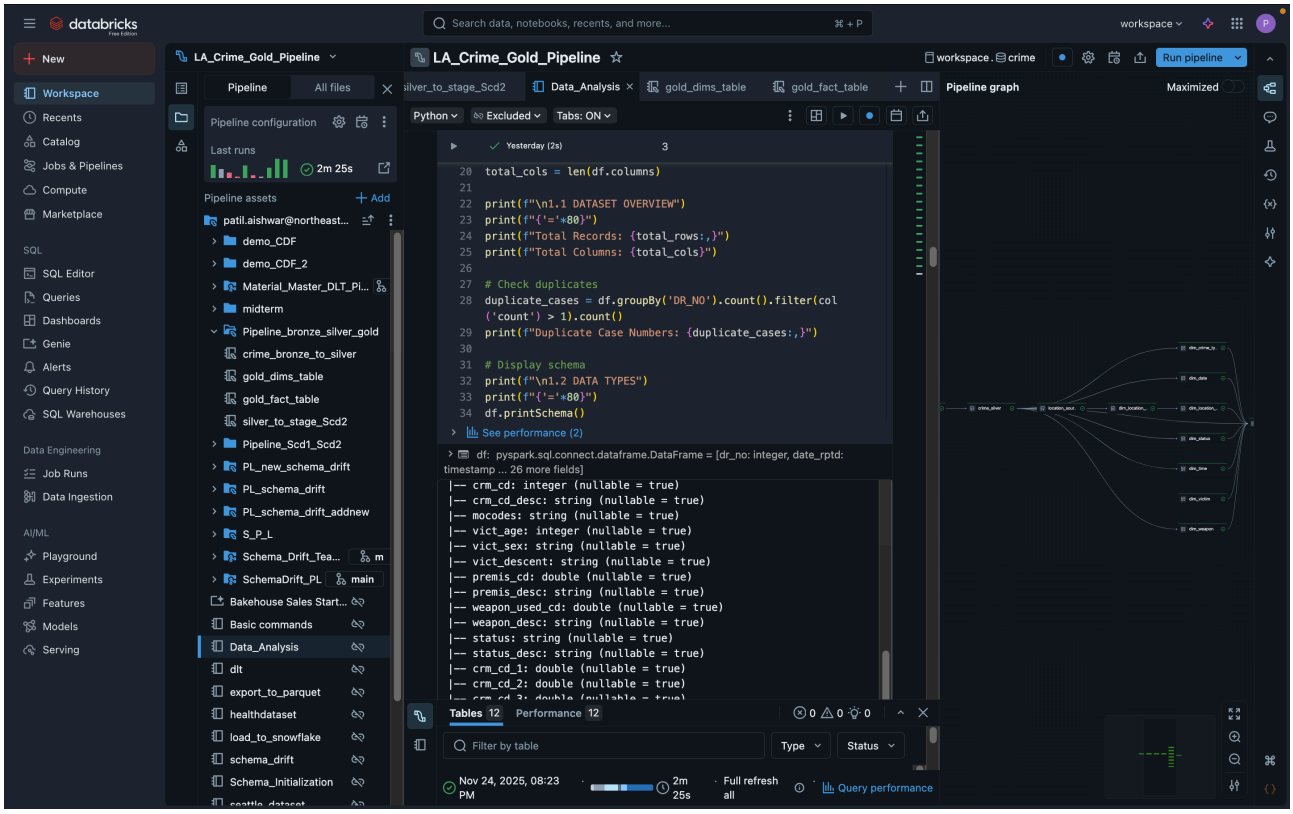
Expected Output:

- Dataset: ~1 million crime incident records
- Columns: 28 attributes covering incident details, location, victim demographics, and case status

Dataset Overview

Checks Performed:

- Total row count and column count
- Primary key integrity (duplicate DR_NO detection)
- Schema validation (column names and data types)


databricks
Search data, notebooks, recents, and more...
workspace
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Workspace
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Data_Analysis
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Pipeline graph
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Tabs: ON
Yesterday (2s)
3
20 total_cols = len(df.columns)
21
22 print(f"\n1.1 DATASET OVERVIEW")
23 print(f"{'='*80}")
24 print(f"Total Records: {total_rows:,}")
25 print(f"Total Columns: {total_cols}")
26
27 # Check duplicates
28 duplicate_cases = df.groupBy('DR_NO').count().filter(col
('count') > 1).count()
29 print(f"Duplicate Case Numbers: {duplicate_cases:,}")
30
31 # Display schema
32 print(f"\n1.2 DATA TYPES")
33 print(f"{'='*80}")
34 df.printSchema()
See performance (2)
df: pyspark.sql.connect.dataframe.DataFrame = [dr_no: integer, date_rptd:
timestamp ... 26 more fields]
|-- crm_cd: integer (nullable = true)
|-- crm_cd_desc: string (nullable = true)
|-- mocodes: string (nullable = true)
|-- vict_age: integer (nullable = true)
|-- vict_sex: string (nullable = true)
|-- vict_descent: string (nullable = true)
|-- premis_cd: double (nullable = true)
|-- premis_desc: string (nullable = true)
|-- weapon_used_cd: double (nullable = true)
|-- weapon_desc: string (nullable = true)
|-- status: string (nullable = true)
|-- status_desc: string (nullable = true)
|-- crm_cd_1: double (nullable = true)
|-- crm_cd_2: double (nullable = true)
Tables 12
Performance 12
Filter by table
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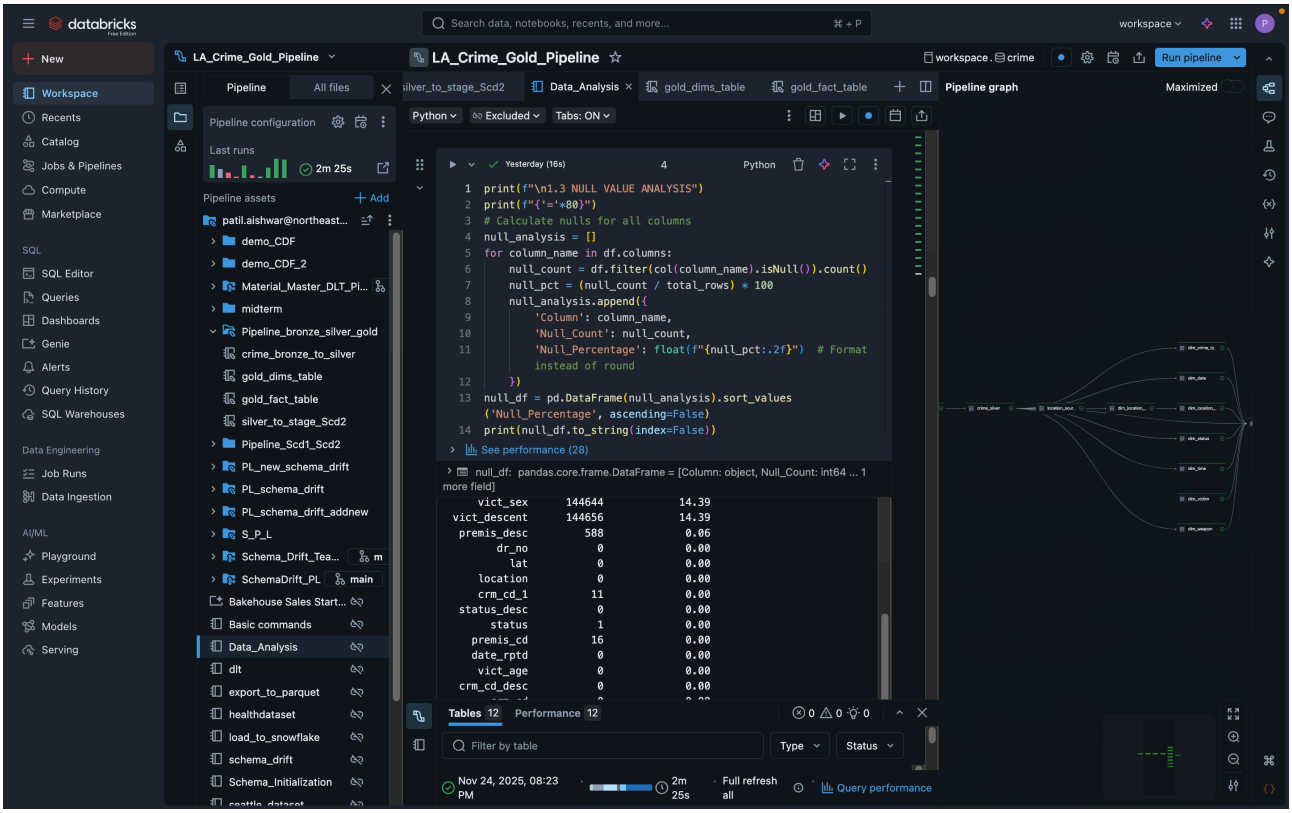
Full refresh all
Query performance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4
Python
1 print(f"\n1.3 NULL VALUE ANALYSIS")
2 print(f"{'='*80}")
3 # Calculate nulls for all columns
4 null_analysis = []
5 for column_name in df.columns:
6 null_count = df.filter(col(column_name).isNull()).count()
7 null_pct = (null_count / total_rows) * 100
8 null_analysis.append({
9 'Column': column_name,
10 'Null_Count': null_count,
11 'Null_Percentage': float(f"{null_pct:.2f}") # Format
instead of round
12 })
13 null_df = pd.DataFrame(null_analysis).sort_values
('Null_Percentage', ascending=False)
14 print(null_df.to_string(index=False))
See performance (28)
null_df: pandas.core.frame.DataFrame = [Column: object, Null_Count: int64 ... 1
more field]
vict_sex 144644 14.39
vict_descent 144656 14.39
premis_desc 588 0.06
dr_no 0 0.00
lat 0 0.00
location 0 0.00
crm_cd_1 11 0.00
status_desc 0 0.00
status 1 0.00
premis_cd 16 0.00
date_rptd 0 0.00
vict_age 0 0.00
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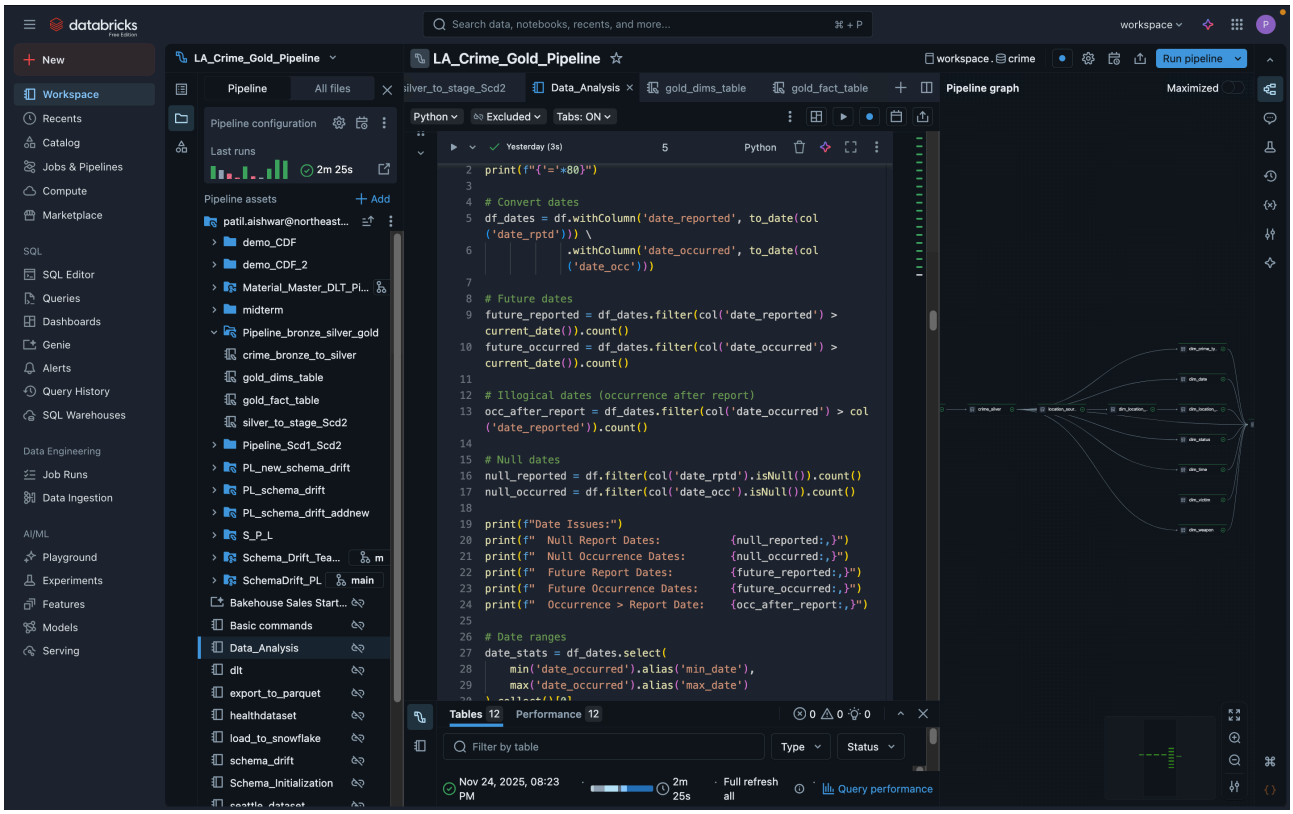


Data Types Analysis

Used Spark's printSchema() to display column names, data types, and nullable status.

Key Observations:

- Date fields (date_rptd, date_occ) - String format requiring conversion
- Time field (time_occ) - Integer in military time format (0-2359)
- Geographic fields (lat, lon) - Double precision required for mapping
- Demographic fields (vict_age, vict_sex, vict_descent) - Mixed types requiring standardization

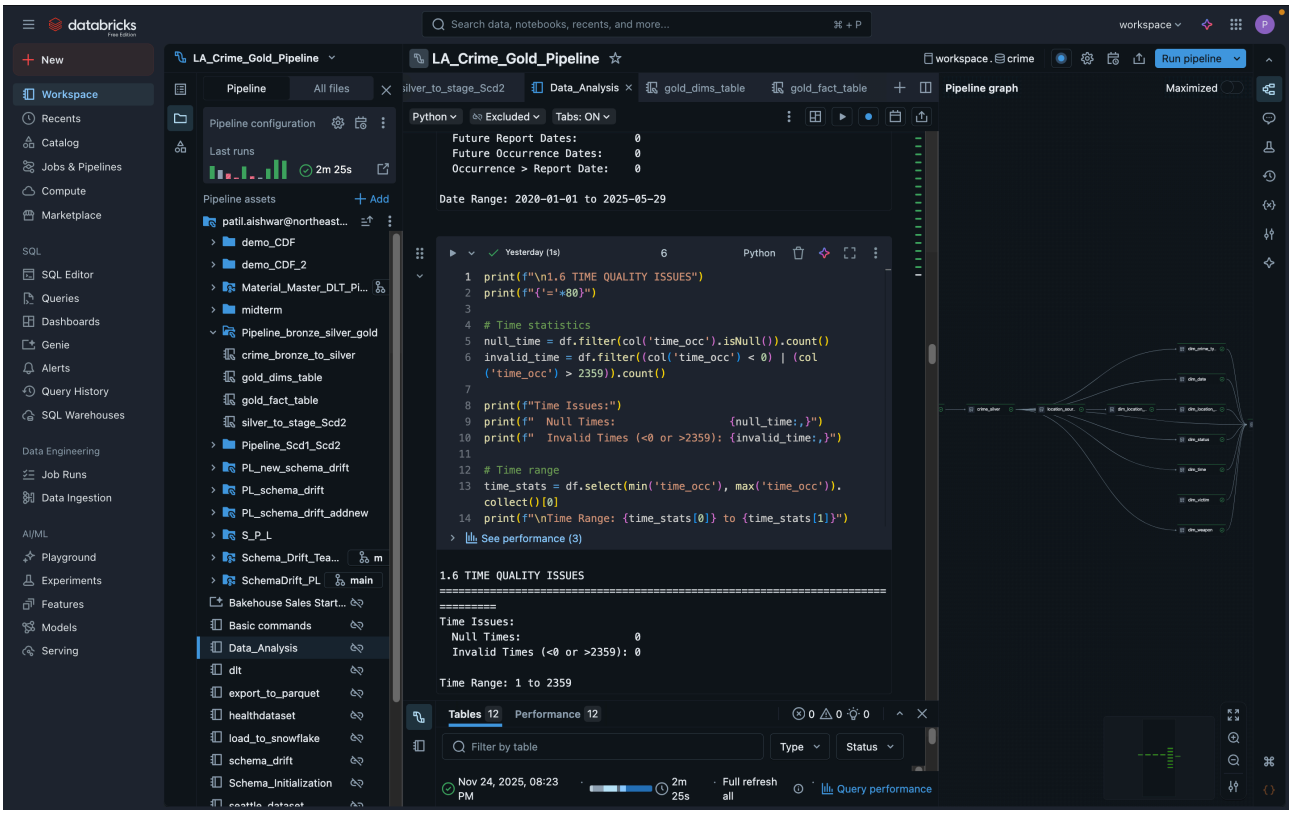
NULL Value Analysis

- Iterates through all 28 columns
- Counts NULL values per column
- Calculates NULL percentage relative to total rows
- Sorts by NULL percentage (descending)

Date Quality Issues

Validation Checks:

1. NULL Date Detection: Missing date_rptd or date_occ values
2. Future Date Detection: Crimes reported/occurred in the future (impossible - data error)
3. Logical Timeline Validation: date_occurred ≤ date_reported (crime can't be reported before it happened)



Time Quality Issues
Validation Rules:

- Format: Military time (24-hour format without colon)
- Valid Range: 0000 to 2359
- NULL Times: Missing time_occ values
- Invalid Times: Values < 0 or > 2359 (impossible times)

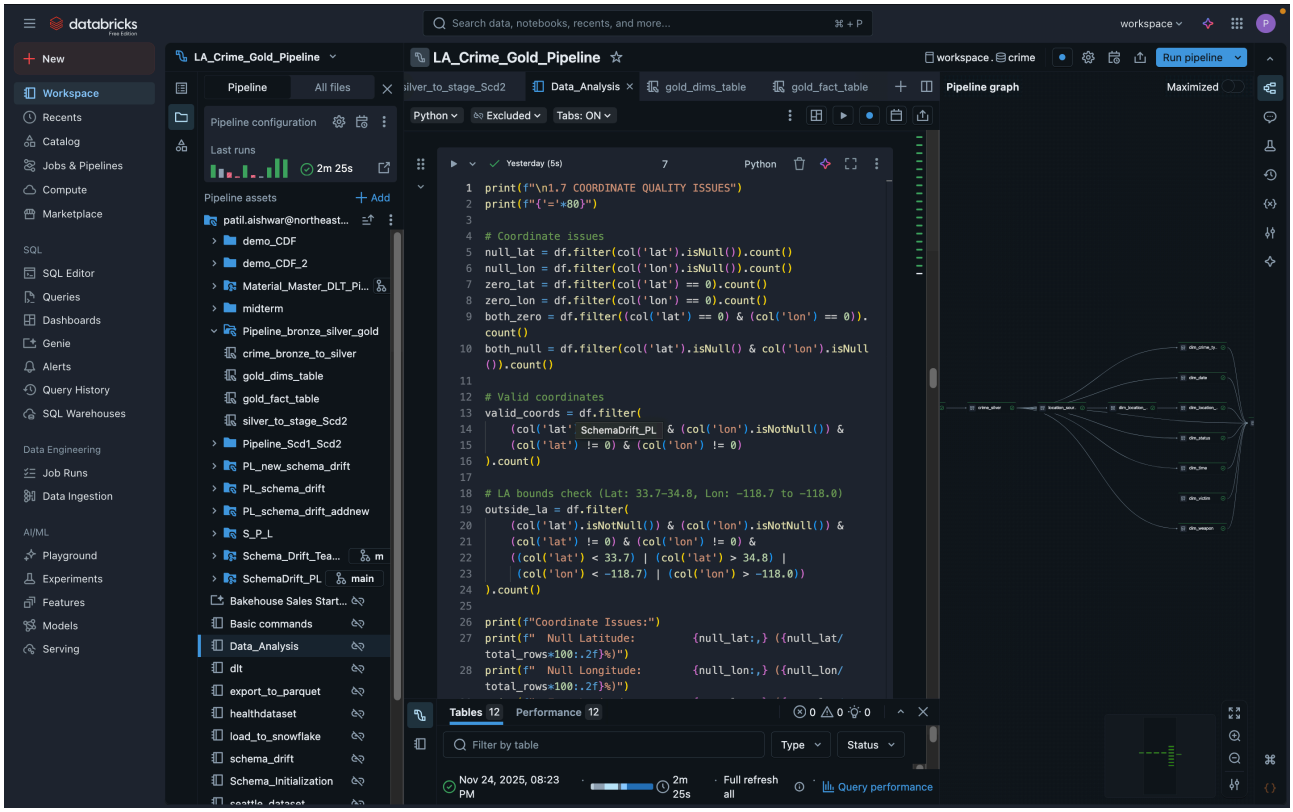
Geographic Data Quality Issues

LA Geographic Boundaries:

- Latitude Range: 33.7°N to 34.8°N
- Longitude Range: -118.7°W to -118.0°W

Quality Issues Detected:

1. NULL Coordinates: Missing latitude/longitude values
2. Zero Coordinates (0, 0): Placeholder values indicating missing location data (points to Gulf of Guinea, Africa)

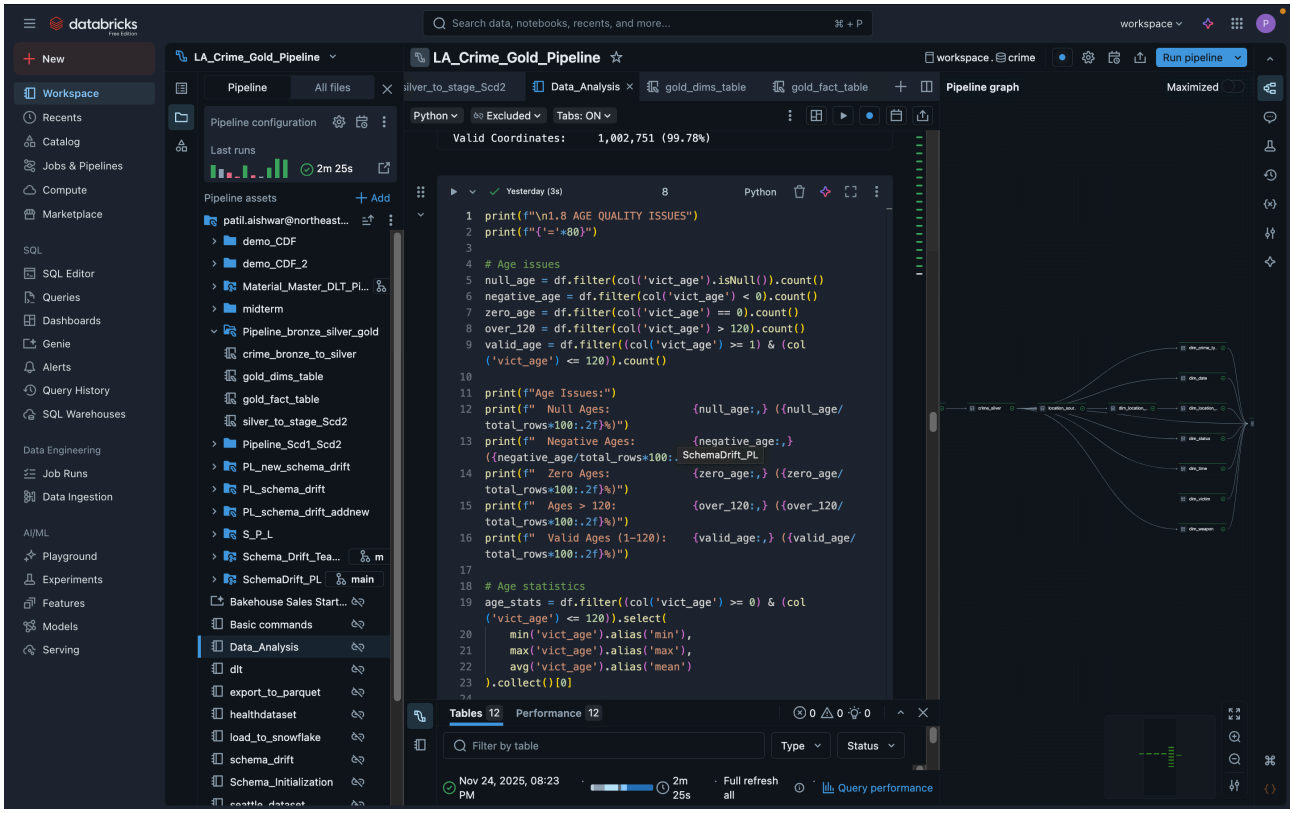


Victim Age Quality Issues

Valid Age Range: 1 to 120 years

Invalid Patterns Detected:

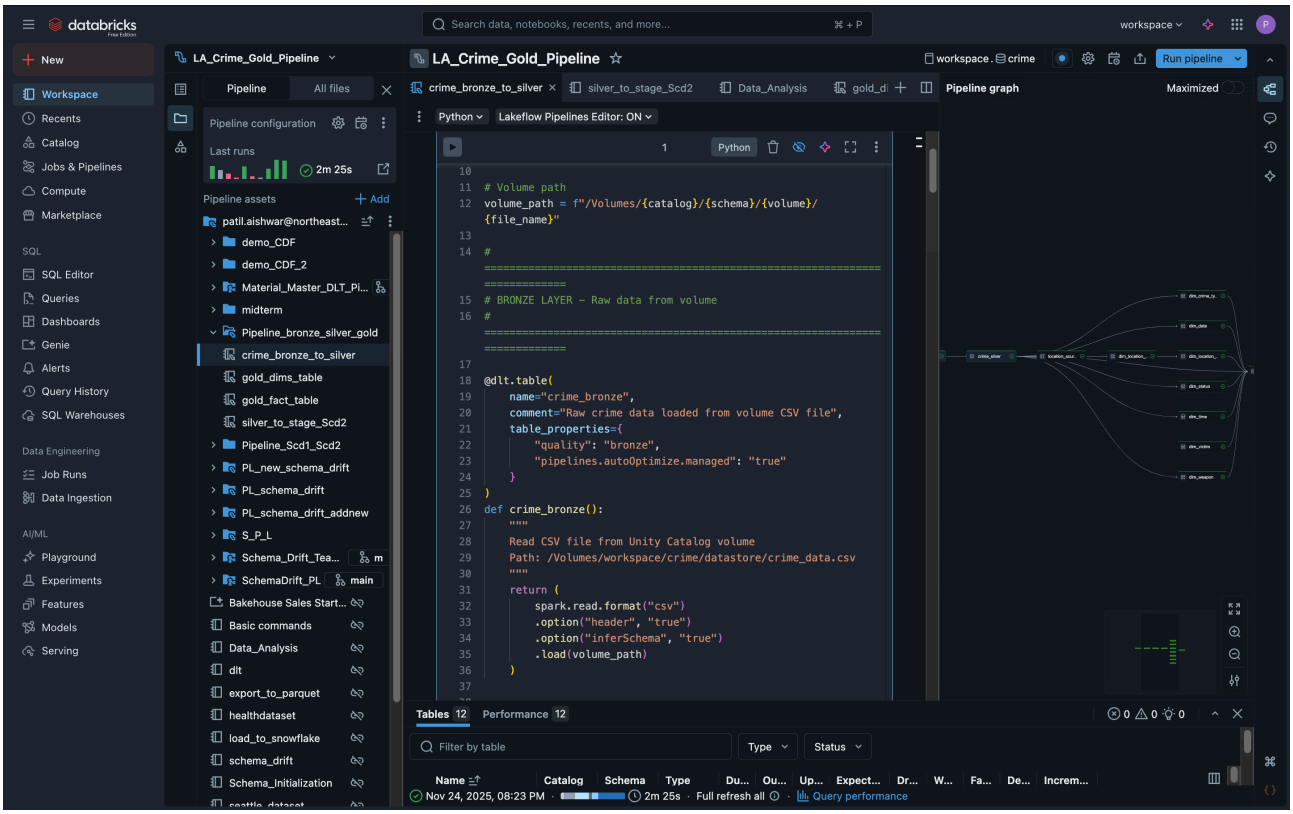
1. Negative Ages: Data entry errors (impossible values)
2. Zero Ages: Placeholder for unknown victim age
3. NULL Ages: Missing demographic data
4. Ages > 120: Unrealistic values (data errors or placeholder codes)



Bronze Layer: Ingesting raw CSV data from Unity Catalog Volume into DLT-managed table
Silver Layer: Data cleaning and transforming

Create a DLT-managed table that reads raw CSV data from Unity Catalog Volume with no transformations.

Source: /Volumes/workspace/crime/datastore/crime_data.csv
Target: workspace.crime.crime_bronze (DLT-managed table)



Expected Output

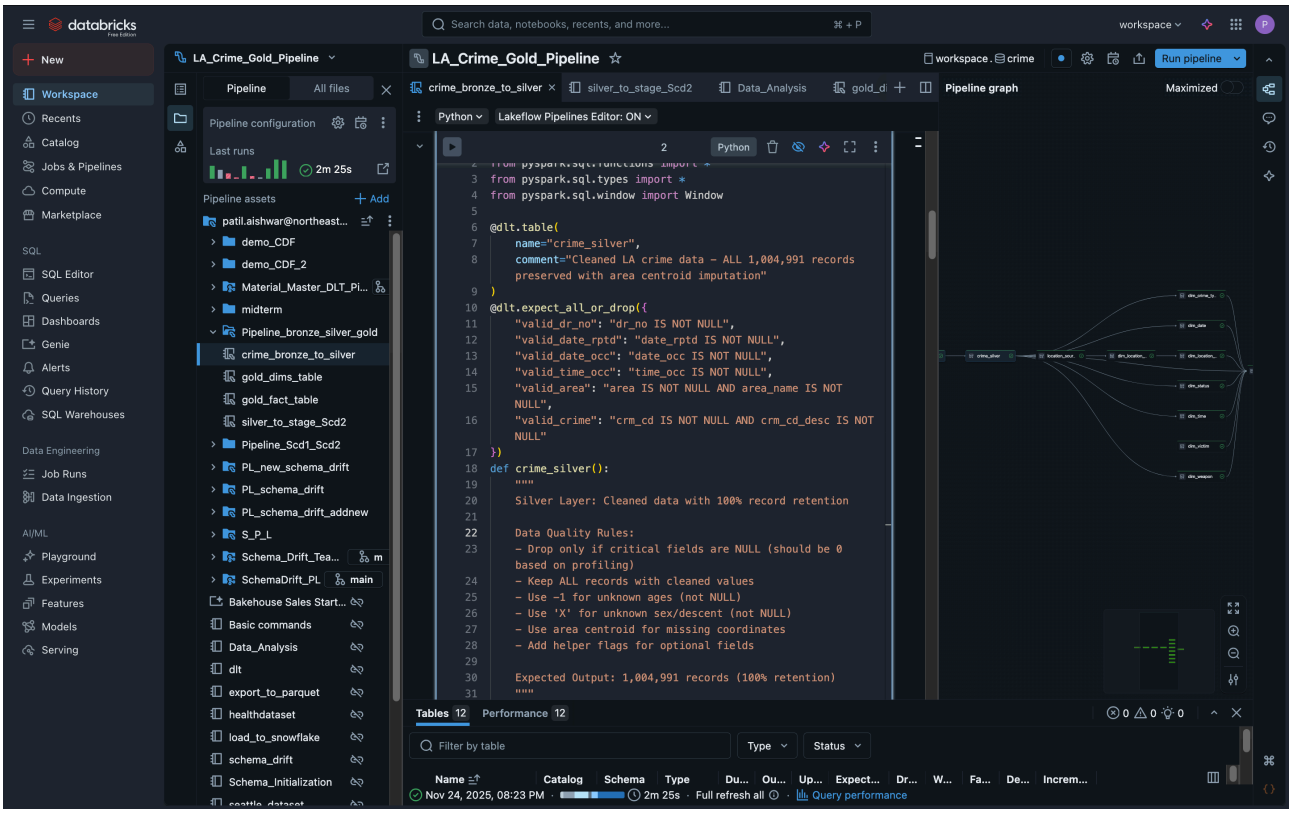
- Records: 1,004,991 crime incidents (all records from CSV)
- Columns: 28 original attributes
- Quality: Raw data, no transformations applied
- Table Type: DLT-managed Delta table

Silver Layer - Data Cleaning & Transformation

Transform raw Bronze data into clean, analysis-ready Silver layer with:

- 100% record retention - No data loss
- Standardized values - Consistent encoding for unknown/missing data
- Geographic imputation - Area centroid assignment for missing coordinates
- Quality flags - Enable flexible filtering in Gold layer

Result: Clean, unified dataset ready for dimensional modeling with NO data loss.

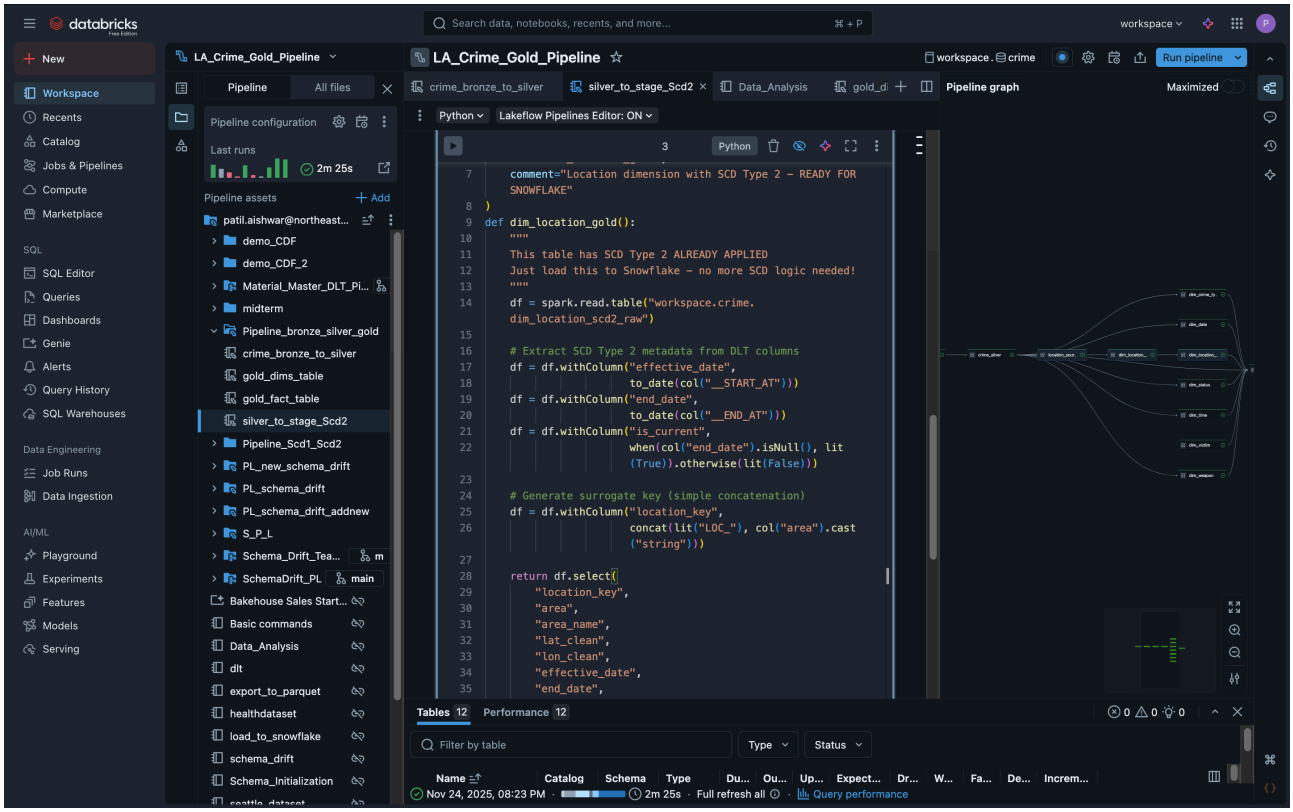


SCD Type 2 for Location

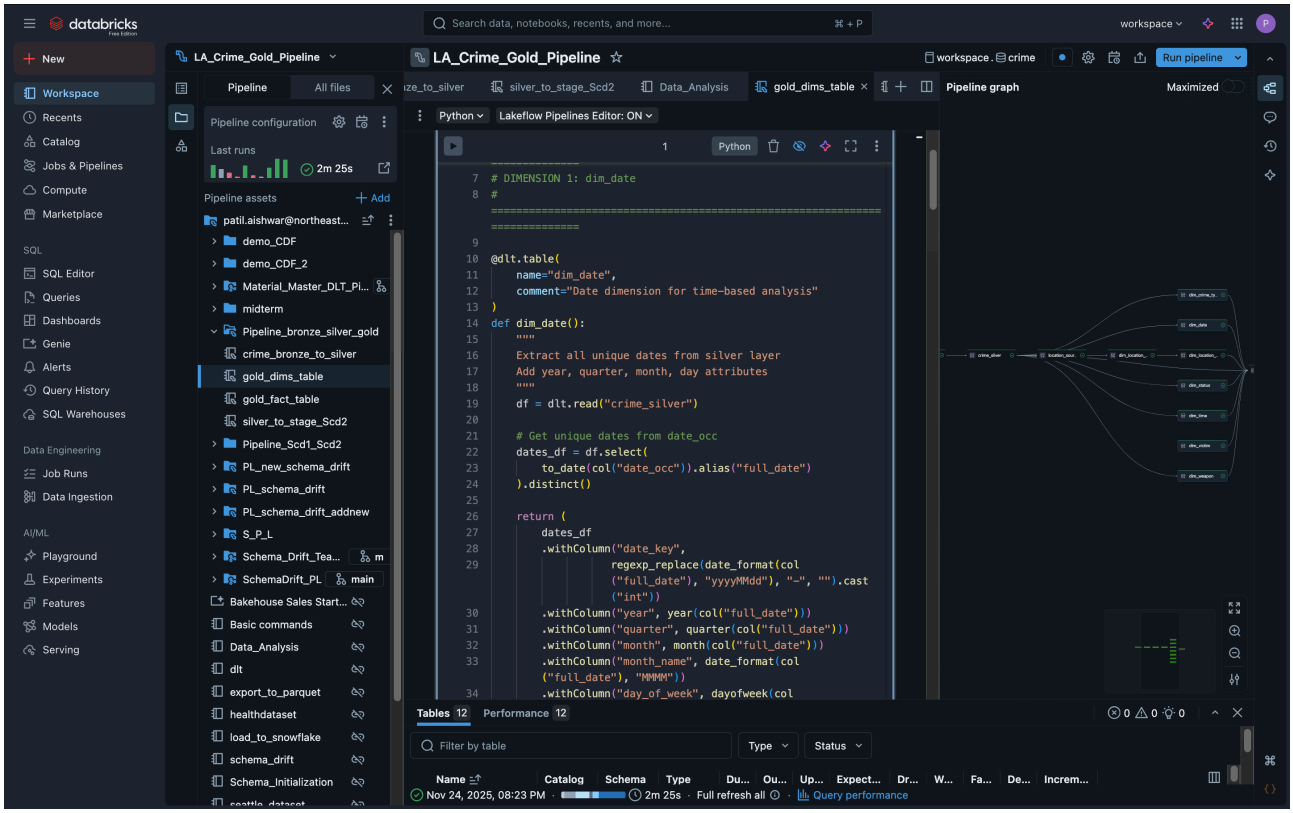
We felt that Location data can change over time in the LA crime dataset, so that's why we thought sad 2 was needed here

SCD Type 2 preserves this history by:

- Creating a new record when location attributes change (new lat/lon or area_name)
- Marking old records as is_current = False with an end_date



Gold Layer Dimensions: Loaded all the remaining six dimension apart from location



Dimension Tables

1. dim_date - Date Dimension
Purpose: Enable time-series analysis for crime trends (yearly, quarterly, monthly, daily patterns)
Source: Unique date_occ values from Silver layer
Grain: One row per unique date
Key Attributes:

- date_key (PK) - Integer format: YYYYMMDD (e.g., 20230615)
- full_date - Full date value
- year, quarter, month, month_name - Hierarchical attributes
- day_of_week (1=Sunday, 7=Saturday), day_name - Day analysis
- created_by, created_dt - Metadata

2. dim_time - Time of Day Dimension
Purpose: Analyze crime patterns by time of day and time periods
Source: Unique time_occ values from Silver layer
Grain: One row per unique military time value (0000-2359)
Key Attributes:

- time_key (PK) - Integer: military time (e.g., 1430 = 2:30 PM)
- time_occ - Original time value
- time_period - Classification: Morning (6:00-11:59), Afternoon (12:00-16:59), Evening (17:00-20:59), Night (21:00-5:59)
- created_by, created_dt - Metadata

3. dim_crime_type - Crime Classification Dimension
Purpose: Categorize crimes by type code and FBI classification
Source: Unique crm_cd and crm_cd_desc from Silver layer
Grain: One row per unique crime code
Key Attributes:

- crime_type_key (PK) - Same as crm_cd (crime code)
- crm_cd - Crime code (e.g., 624 = Battery - Simple Assault)
- crm_cd_desc - Crime description
- part_1_2 - FBI Uniform Crime Reporting classification:
  - 1 = Part I crimes (serious: murder, rape, robbery, burglary, etc.)
  - 2 = Part II crimes (less serious: simple assault, vandalism, etc.)
- created_by, created_dt - Metadata

4. dim_weapon - Weapon Classification Dimension
Purpose: Track weapons used in crimes
Source: Unique weapon_used_cd_clean and weapon_desc_clean from Silver layer
Grain: One row per unique weapon code
Key Attributes:

- weapon_key (PK) - Same as weapon_used_cd
- weapon_used_cd - Weapon code (0 = no weapon, 400 = firearm, etc.)
- weapon_desc - Weapon description (cleaned with "NO WEAPON/UNKNOWN" for nulls)
- created_by, created_dt - Metadata

5. dim_victim - Victim Demographics Dimension
Purpose: Analyze crime patterns by victim age groups and sex
Source: Pre-generated combinations of age groups and sex categories
Grain: One row per unique age_group + sex combination
Key Attributes:

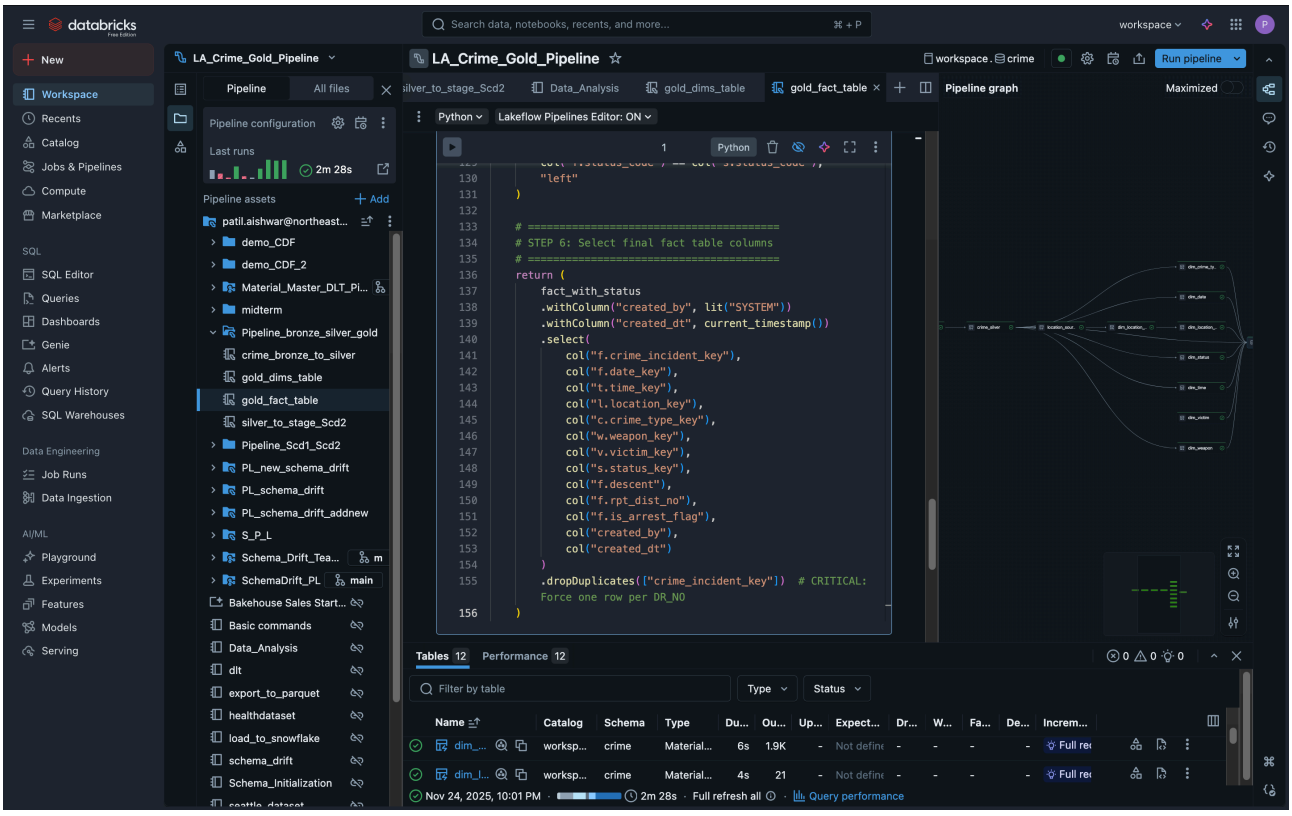
- victim_key (PK) - Sequential integer (1-18)

- age_group - Categorical: Unknown, 0-17 (Juvenile), 18-25 (Young Adult), 26-35 (Adult), 36-50 (Middle Age), 51+ (Senior)
- sex - M (Male), F (Female), X (Unknown)
- created_by, created_dt - Metadata

6. dim_status - Case Status Dimension
Purpose: Track investigation and arrest status
Source: Unique status_clean and status_desc from Silver layer
Grain: One row per unique status code
Key Attributes:

- status_key (PK) - Sequential integer (auto-generated)
- status_code - Status code (IC, AA, JA, JO, etc.)
- status_desc - Status description
    - IC = Investigation Continues (active case)
    - AA = Adult Arrest
    - JA = Juvenile Arrest
    - JO = Juvenile Other
- created_by, created_dt - Metadata

Gold Layer Fact Table



Fact Table Design

Grain: One row per crime incident (uniquely identified by DR_NO)

Fact Table Type
Transaction Fact Table - Records individual crime events at the most granular level

Fact Table Schema

Dimension Foreign Keys (7)

Column	Type	References
date_key	Integer	dim_date.date_key
time_key	Integer	dim_time.time_key
location_key	String	dim_location.location_key
crime_type_key	Integer	dim_crime_type.crime_type_key
weapon_key	Integer	dim_weapon.weapon_key
victim_key	Integer	dim_victim.victim_key
status_key	Integer	dim_status.status_key

Degenerate Dimensions (2)

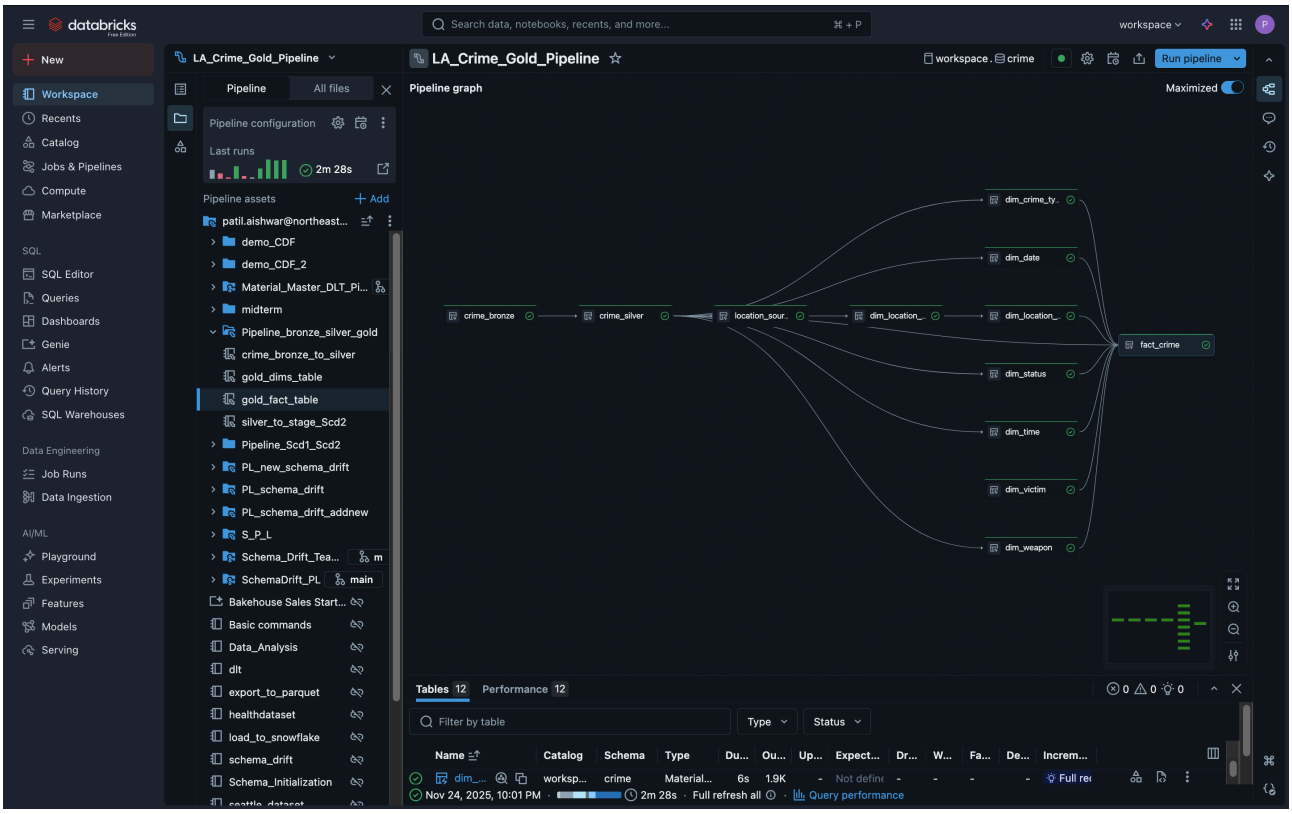
Column	Type
crime_incident_key	String
descent	String
rpt_dist_no	Integer

Fact Measures (1)

Column	Type	Purpose
is_arrest_flag	Boolean	Whether crime resulted in arrest (AA or JA status)

Metadata (2)

Column	Type	Purpose
created_by	String	"SYSTEM" - audit trail
created_dt	Timestamp	When record was loaded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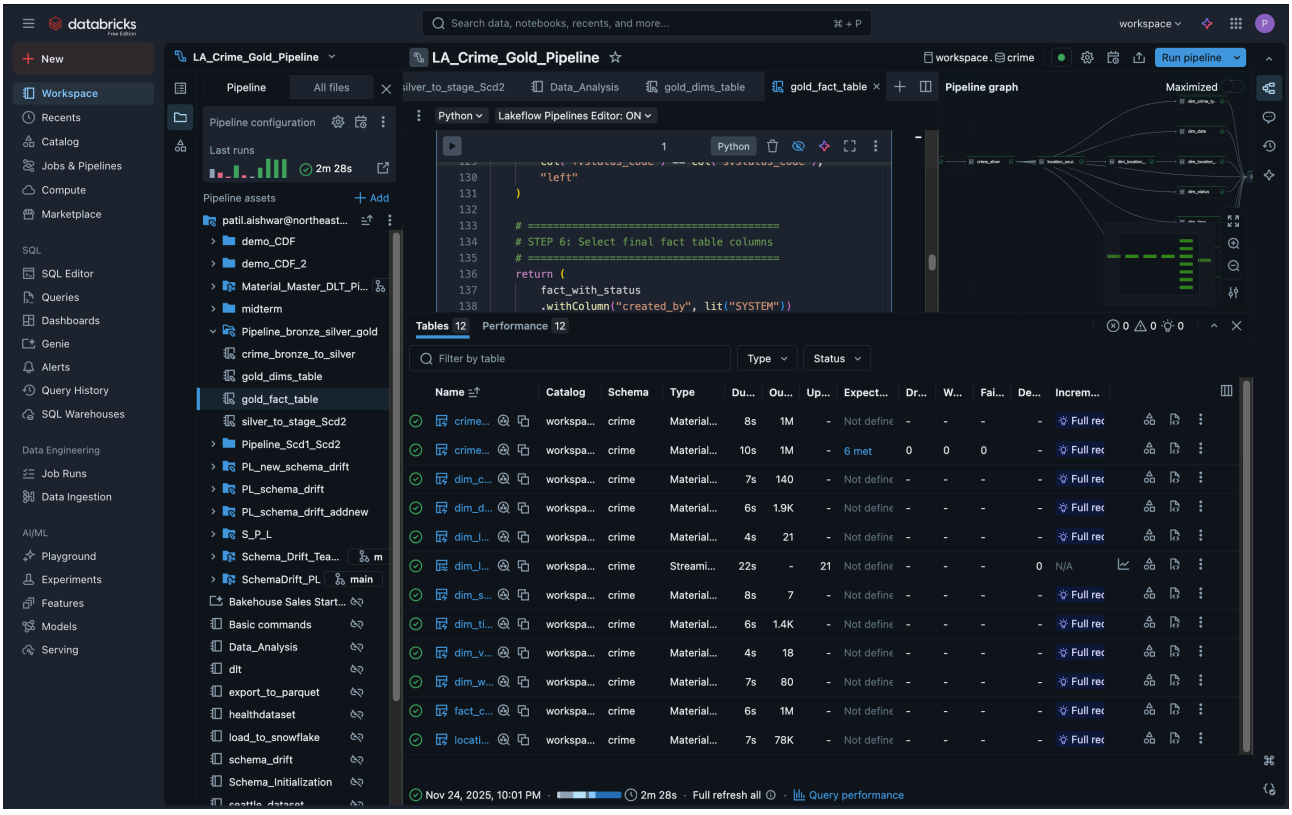
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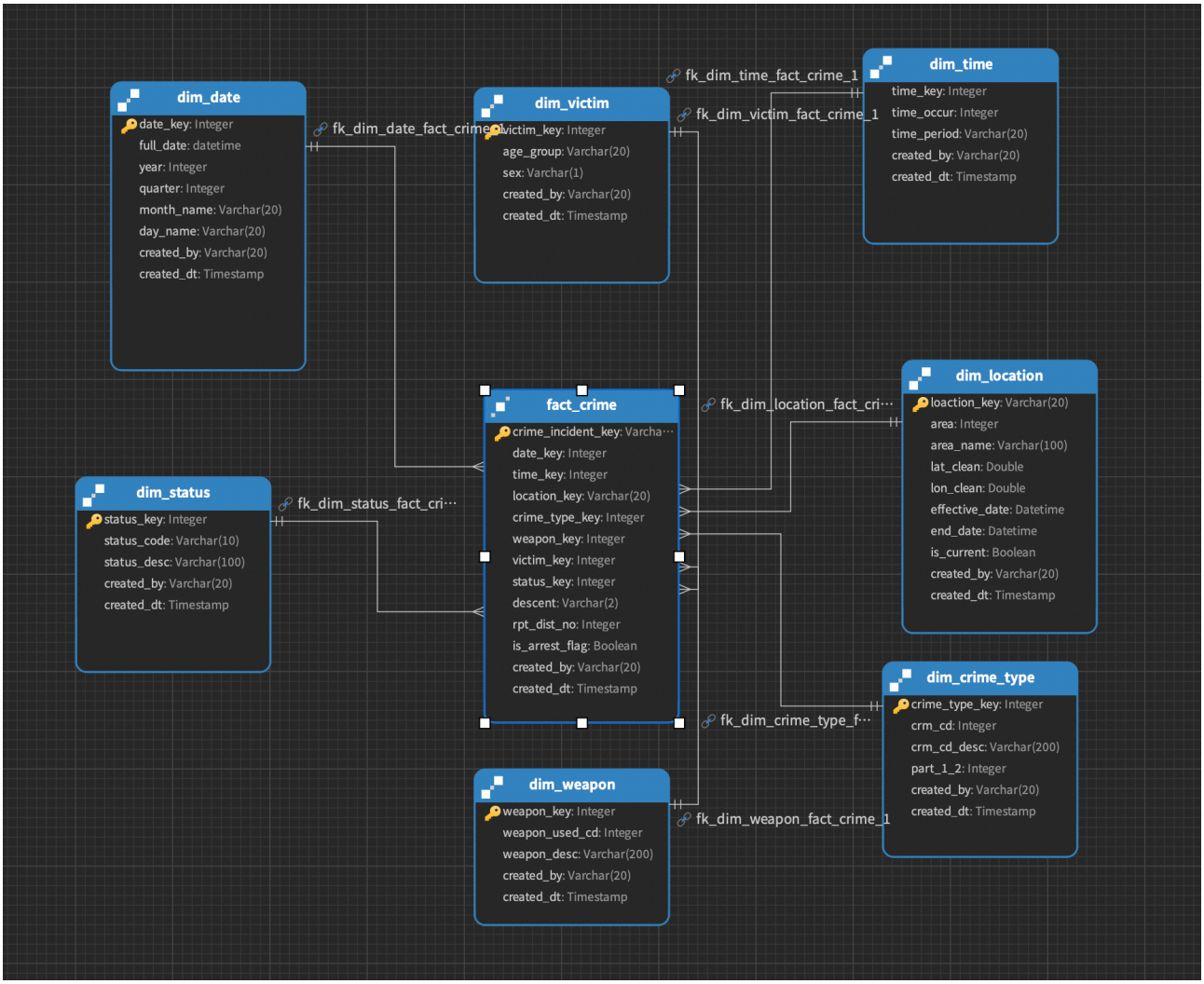
This is the revised dimension model that we created

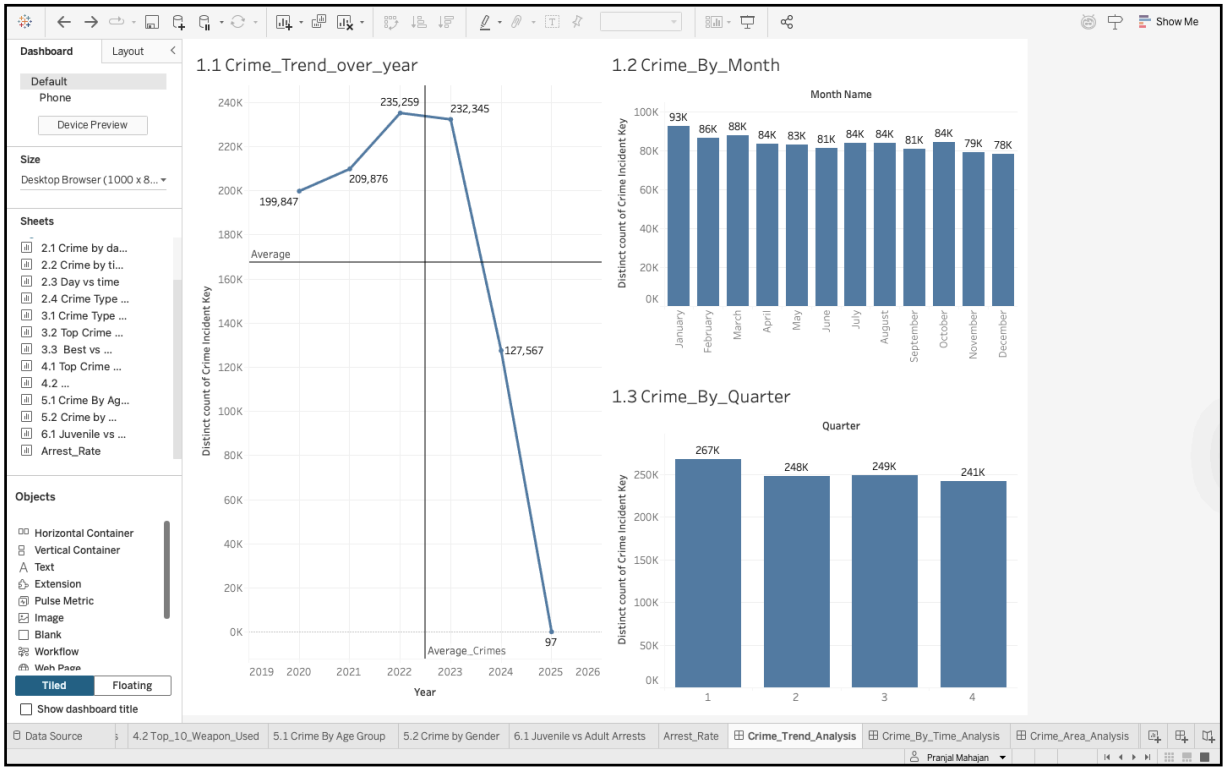


We established a connection between Tableau and Databricks, imported all dimension and fact tables, configured the dimensional relationships, and developed visualizations to address the following business requirements:

Business Questions:

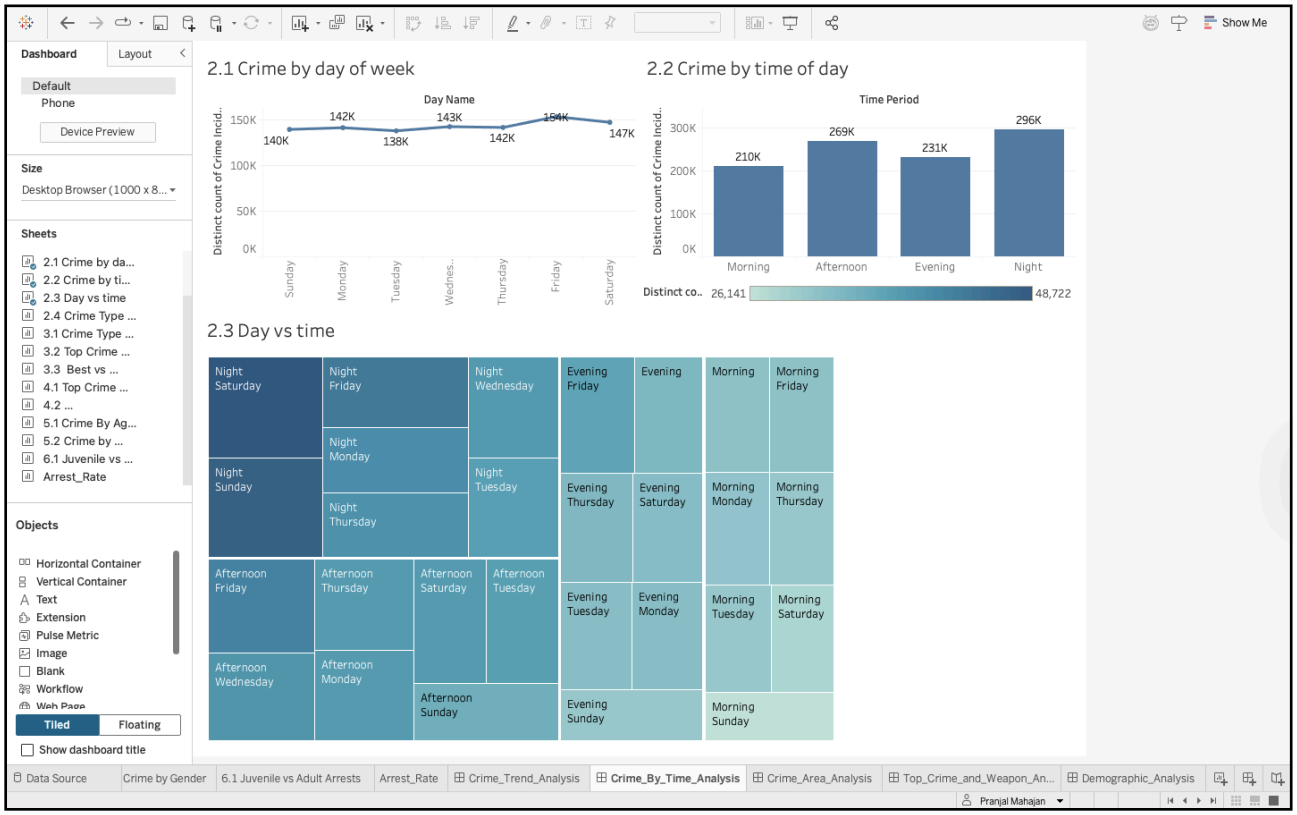
Crime Rates Over Time:

- **What is the overall trend in crime rates over the years?**
- **How have crime rates changed on a monthly basis?**
- **How have crime rates changed on a quarterly basis?**



Day Time and Week Factors:

- **Is there a correlation between the day of the week and the number of reported crimes?**
- **Do certain types of crimes tend to occur at specific times of the day?**

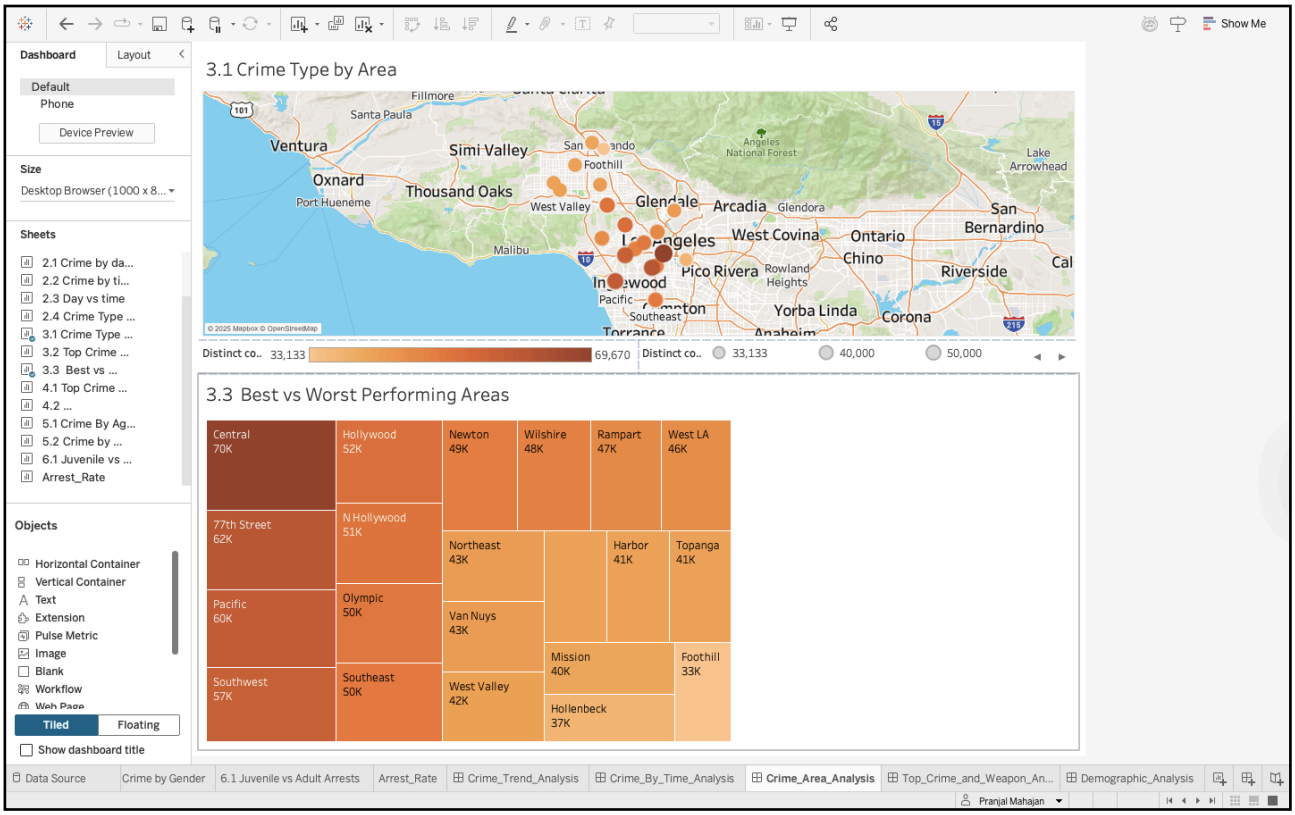


Crime by Location:

- **Where are the high-crime areas in Los Angeles?**

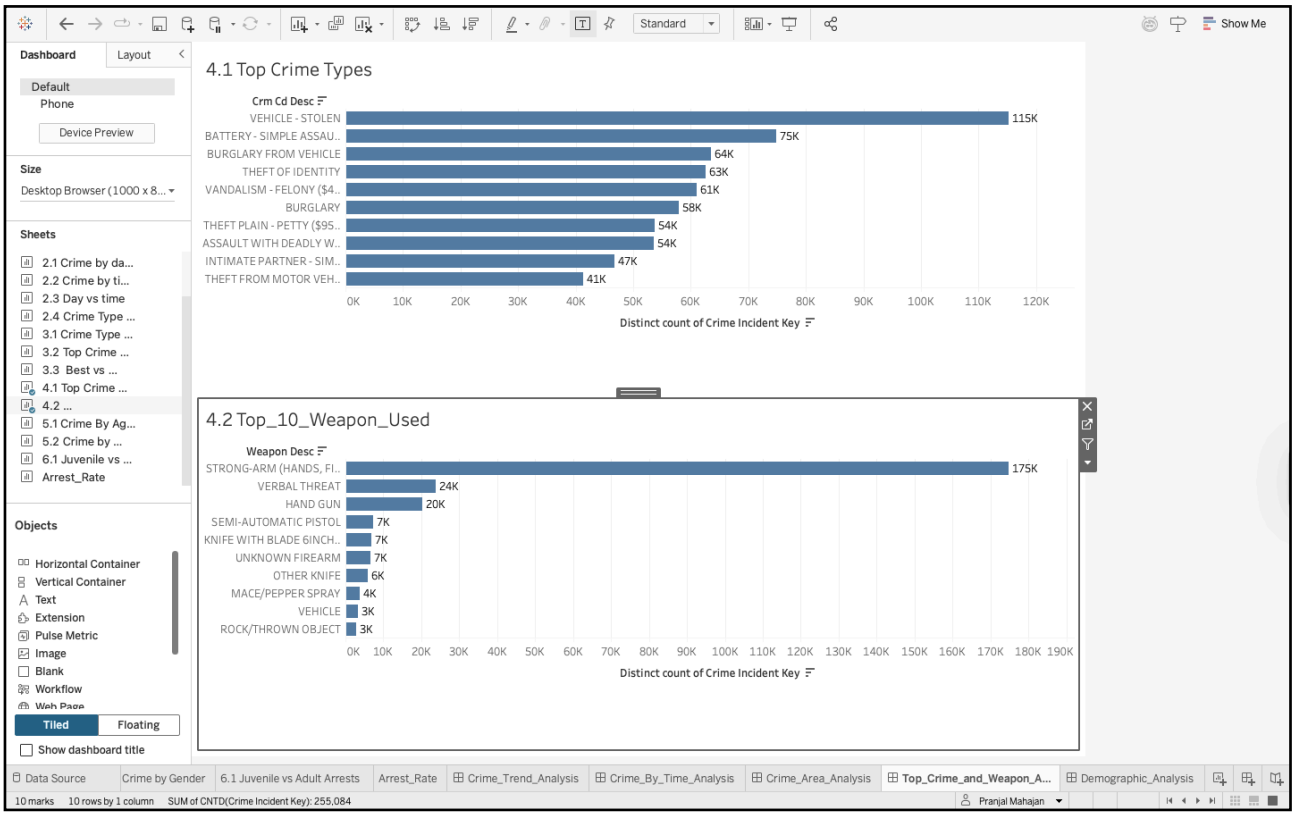
We want to know (your inferences on):

- **By seeing the geo map, what are the crime hotspots?**
- **Can you identify areas where Los Angeles performs better or worse in terms of crime rates?**



Types of Crime:

- **What are the most commonly used weapons in reported crimes?**



Demographic Analysis:

• Show in the visualization the age patterns in crime.

• Show in the visualization the gender-related patterns in crime.

Arrests Ratio:

• What percentage of reported crimes result in Juvenile, Adult arrests?