Co-op Superstore Database Report

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Github:- https://github.com/Deepakvishwakarma1/Data_mining_and_discovery.git

-:Introduction to the Data Generation Process:-

The Co-op Superstore database was generated programmatically using Python. The following libraries and techniques were employed to create realistic and comprehensive data:

- Faker Library: Used for generating names, dates, and textual data.

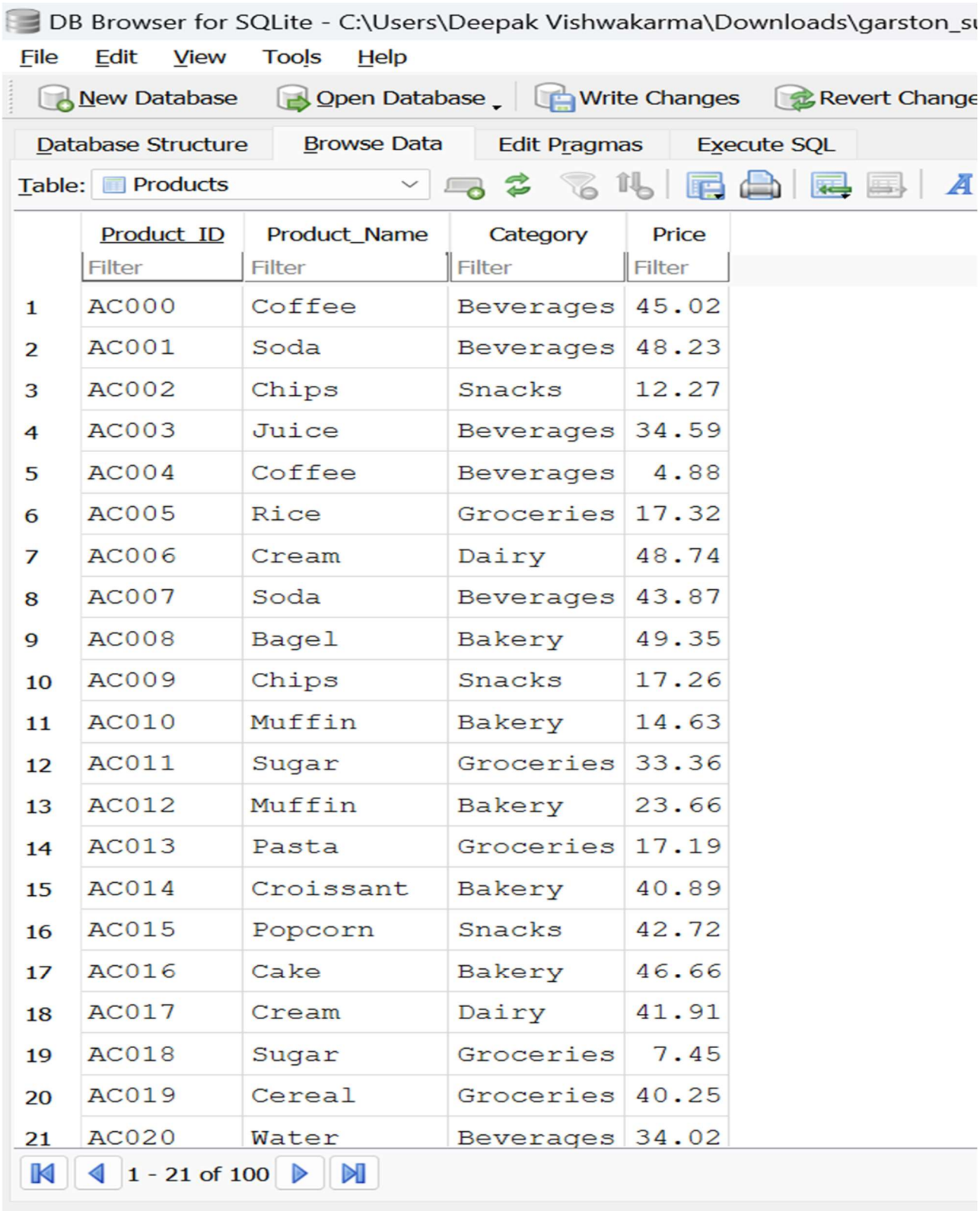
- Random Module: Used to assign randomized attributes like 'Category', 'Role', 'Postcode', and numeric values such as 'Price' and 'Hourly_Rate'.

- Custom Scripts: Ensured the generation of unique alphanumeric IDs (e.g., 'AC001' for Product_ID), deliberate missing values (e.g., NULL Postcode in Customers), and realistic duplicate data in fields like Product_Name and Role.

```
!pip install faker
import sqlite3
import random
from faker import Faker

# Initialize Faker for realistic data
fake = Faker()

# Connect to SQLite
conn = sqlite3.connect('garston_superstore.db')
cursor = conn.cursor()

```

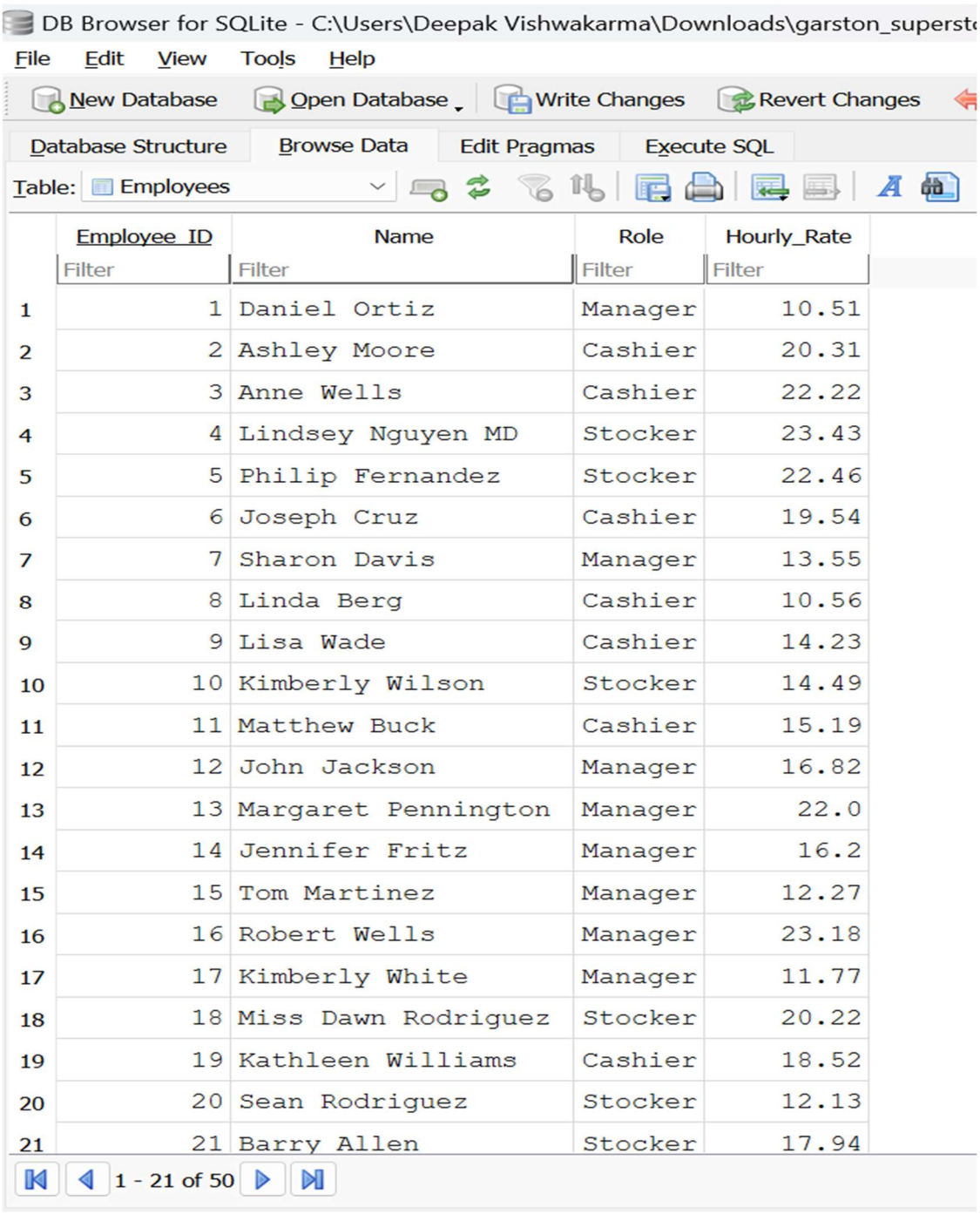
-:The database consists of four tables:-

1. Products Table: Central repository for product details, including categories and prices.



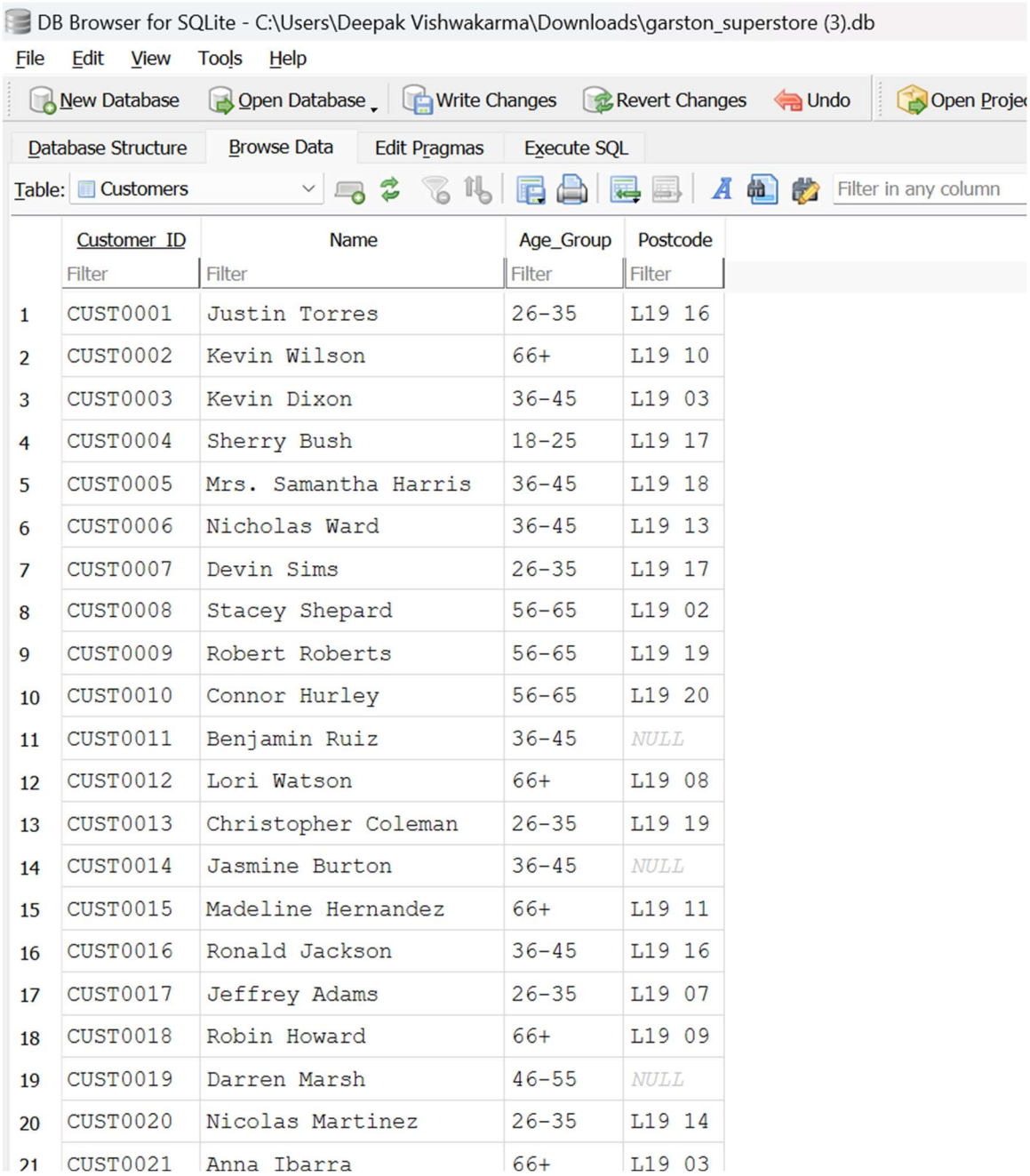
	Product_ID	Product_Name	Category	Price
	Filter	Filter	Filter	Filter
1	AC000	Coffee	Beverages	45.02
2	AC001	Soda	Beverages	48.23
3	AC002	Chips	Snacks	12.27
4	AC003	Juice	Beverages	34.59
5	AC004	Coffee	Beverages	4.88
6	AC005	Rice	Groceries	17.32
7	AC006	Cream	Dairy	48.74
8	AC007	Soda	Beverages	43.87
9	AC008	Bagel	Bakery	49.35
10	AC009	Chips	Snacks	17.26
11	AC010	Muffin	Bakery	14.63
12	AC011	Sugar	Groceries	33.36
13	AC012	Muffin	Bakery	23.66
14	AC013	Pasta	Groceries	17.19
15	AC014	Croissant	Bakery	40.89
16	AC015	Popcorn	Snacks	42.72
17	AC016	Cake	Bakery	46.66
18	AC017	Cream	Dairy	41.91
19	AC018	Sugar	Groceries	7.45
20	AC019	Cereal	Groceries	40.25
21	AC020	Water	Beverages	34.02

2. Employees Table: Stores workforce information like roles and wage.



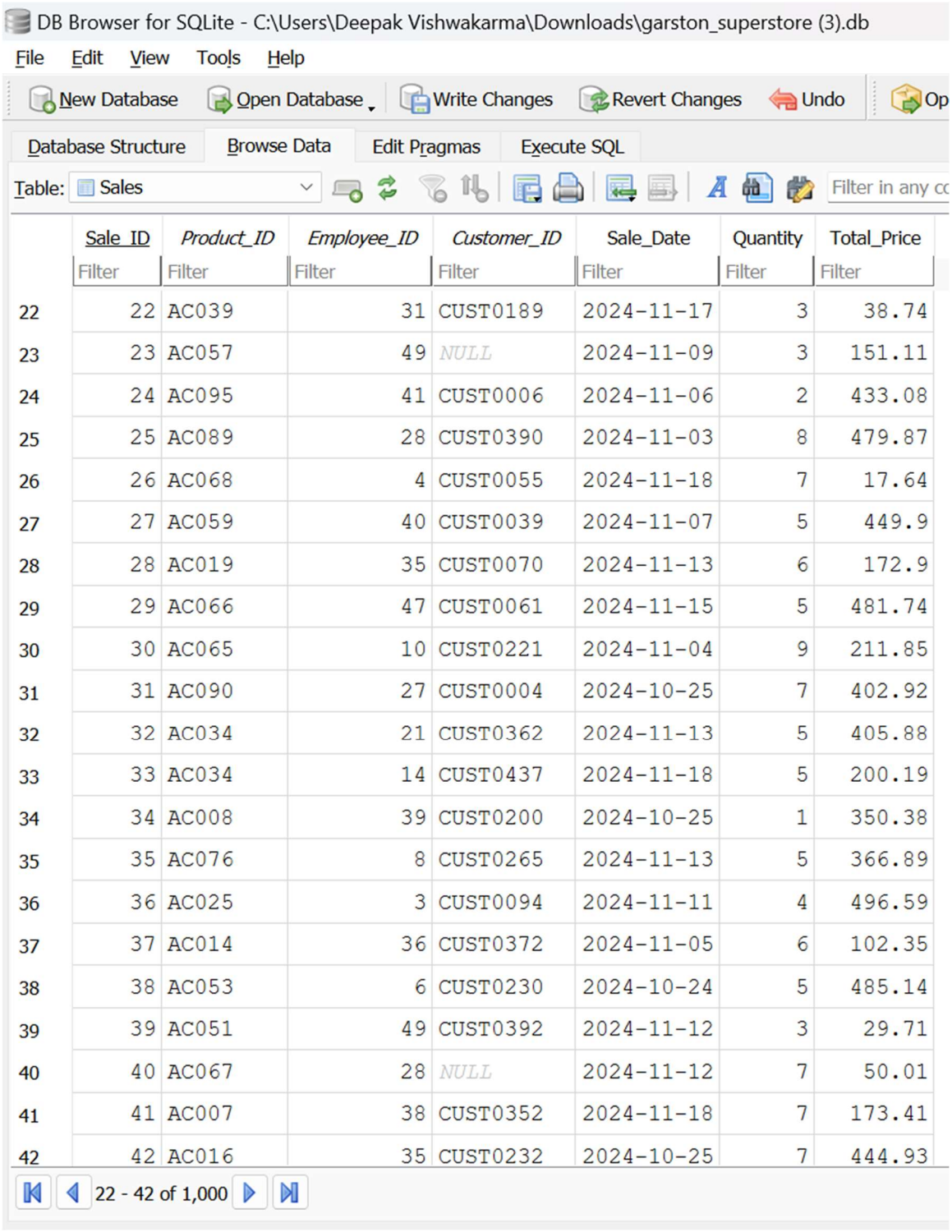
	Employee_ID	Name	Role	Hourly_Rate
	Filter	Filter	Filter	Filter
1	1	Daniel Ortiz	Manager	10.51
2	2	Ashley Moore	Cashier	20.31
3	3	Anne Wells	Cashier	22.22
4	4	Lindsey Nguyen MD	Stocker	23.43
5	5	Philip Fernandez	Stocker	22.46
6	6	Joseph Cruz	Cashier	19.54
7	7	Sharon Davis	Manager	13.55
8	8	Linda Berg	Cashier	10.56
9	9	Lisa Wade	Cashier	14.23
10	10	Kimberly Wilson	Stocker	14.49
11	11	Matthew Buck	Cashier	15.19
12	12	John Jackson	Manager	16.82
13	13	Margaret Pennington	Manager	22.0
14	14	Jennifer Fritz	Manager	16.2
15	15	Tom Martinez	Manager	12.27
16	16	Robert Wells	Manager	23.18
17	17	Kimberly White	Manager	11.77
18	18	Miss Dawn Rodriguez	Stocker	20.22
19	19	Kathleen Williams	Cashier	18.52
20	20	Sean Rodriguez	Stocker	12.13
21	21	Barry Allen	Stocker	17.94

3. Customers Table: Captures demographic details and spending habits.



	Customer_ID	Name	Age_Group	Postcode
	Filter	Filter	Filter	Filter
1	CUST0001	Justin Torres	26-35	L19 16
2	CUST0002	Kevin Wilson	66+	L19 10
3	CUST0003	Kevin Dixon	36-45	L19 03
4	CUST0004	Sherry Bush	18-25	L19 17
5	CUST0005	Mrs. Samantha Harris	36-45	L19 18
6	CUST0006	Nicholas Ward	36-45	L19 13
7	CUST0007	Devin Sims	26-35	L19 17
8	CUST0008	Stacey Shepard	56-65	L19 02
9	CUST0009	Robert Roberts	56-65	L19 19
10	CUST0010	Connor Hurley	56-65	L19 20
11	CUST0011	Benjamin Ruiz	36-45	NULL
12	CUST0012	Lori Watson	66+	L19 08
13	CUST0013	Christopher Coleman	26-35	L19 19
14	CUST0014	Jasmine Burton	36-45	NULL
15	CUST0015	Madeline Hernandez	66+	L19 11
16	CUST0016	Ronald Jackson	36-45	L19 16
17	CUST0017	Jeffrey Adams	26-35	L19 07
18	CUST0018	Robin Howard	66+	L19 09
19	CUST0019	Darren Marsh	46-55	NULL
20	CUST0020	Nicolas Martinez	26-35	L19 14
21	CUST0021	Anna Ibarra	66+	L19 03

4. Sales Table: Links the other tables to record transactional data.



	Sale_ID	Product_ID	Employee_ID	Customer_ID	Sale_Date	Quantity	Total_Price
	Filter	Filter	Filter	Filter	Filter	Filter	Filter
22	22	AC039	31	CUST0189	2024-11-17	3	38.74
23	23	AC057	49	NULL	2024-11-09	3	151.11
24	24	AC095	41	CUST0006	2024-11-06	2	433.08
25	25	AC089	28	CUST0390	2024-11-03	8	479.87
26	26	AC068	4	CUST0055	2024-11-18	7	17.64
27	27	AC059	40	CUST0039	2024-11-07	5	449.9
28	28	AC019	35	CUST0070	2024-11-13	6	172.9
29	29	AC066	47	CUST0061	2024-11-15	5	481.74
30	30	AC065	10	CUST0221	2024-11-04	9	211.85
31	31	AC090	27	CUST0004	2024-10-25	7	402.92
32	32	AC034	21	CUST0362	2024-11-13	5	405.88
33	33	AC034	14	CUST0437	2024-11-18	5	200.19
34	34	AC008	39	CUST0200	2024-10-25	1	350.38
35	35	AC076	8	CUST0265	2024-11-13	5	366.89
36	36	AC025	3	CUST0094	2024-11-11	4	496.59
37	37	AC014	36	CUST0372	2024-11-05	6	102.35
38	38	AC053	6	CUST0230	2024-10-24	5	485.14
39	39	AC051	49	CUST0392	2024-11-12	3	29.71
40	40	AC067	28	NULL	2024-11-12	7	50.01
41	41	AC007	38	CUST0352	2024-11-18	7	173.41
42	42	AC016	35	CUST0232	2024-10-25	7	444.93

-:Schema overview of the Database:-

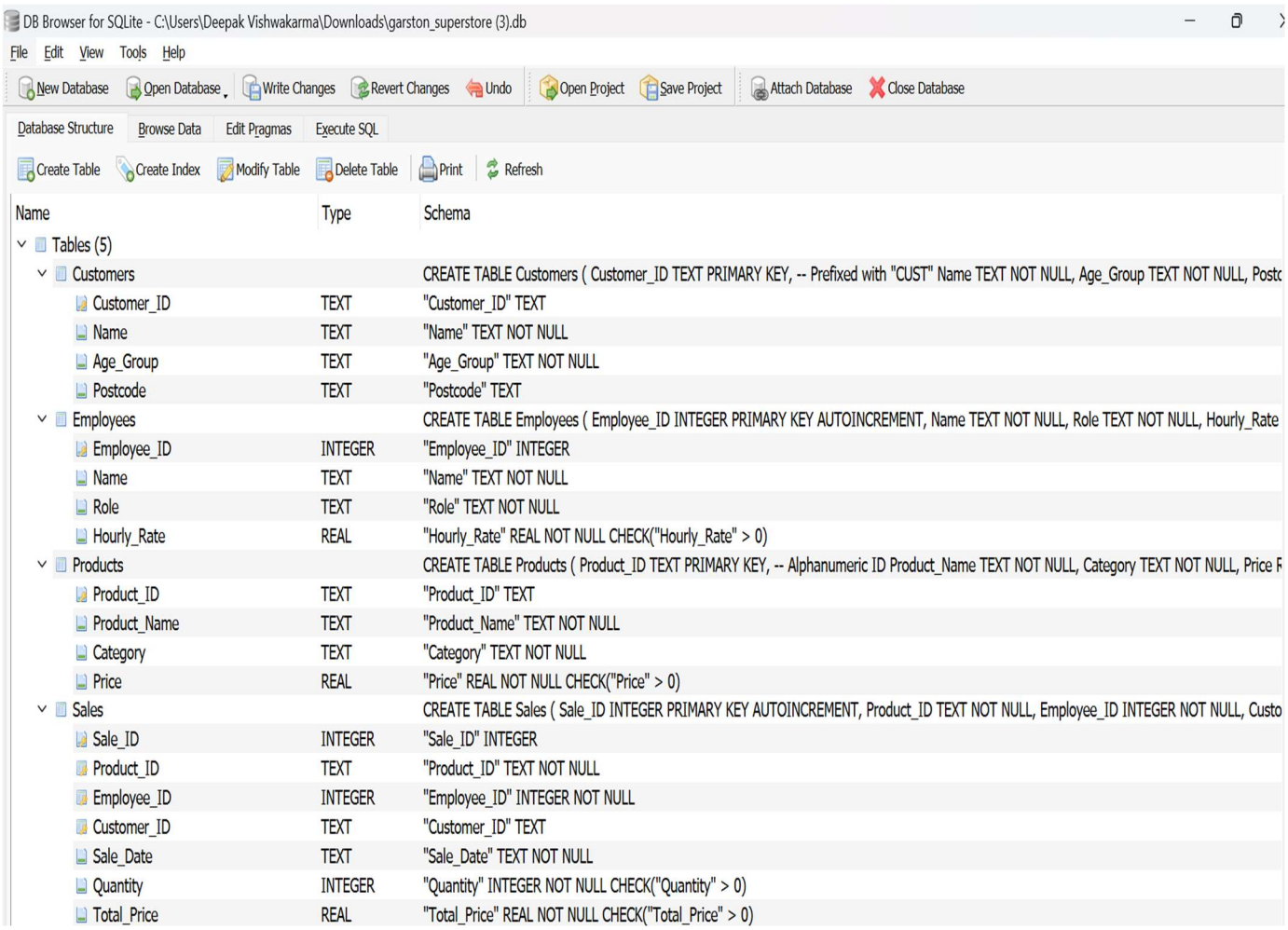
Graphical Representation of the data:-

Products (Product_ID, Product_Name, Category, Price)
↳ Referenced by: Sales(Product_ID)

Employees (Employee_ID, Name, Role, Hourly_Rate)
↳ Referenced by: Sales(Employee_ID)

Customers (Customer_ID, Name, Age_Group, Postcode)
↳ Referenced by: Sales(Customer_ID)

Sales (Sale_ID, Product_ID, Employee_ID, Customer_ID, Sale_Date, Quantity, Total_Price)



-:Textual Schema Overview:-

- **Products Table:**
- Product_ID: TEXT, Primary Key (e.g., 'AC001').
- Product_Name: TEXT, Realistic names like 'Bread'.
- Category: TEXT, Nominal data such as 'Bakery'.
- Price: REAL, Ratio data (>0).

- **Employees Table:**
- Employee_ID: INTEGER, Primary Key (AUTOINCREMENT).
- Name: TEXT, Employee names.
- Role: TEXT, Nominal data (e.g., 'Manager').
- Hourly_Rate: REAL, Ratio data (>0).

- **Customers Table:**
- Customer_ID: TEXT, Primary Key prefixed with 'CUST' (e.g., 'CUST001').
- Name: TEXT, Customer names.
- Age_Group: TEXT, Ordinal data (e.g., '18-25').
- Postcode: TEXT, Nominal data with ~5% NULL values.

- **Sales Table:**
- Sale_ID: INTEGER, Primary Key (AUTOINCREMENT).
- Product_ID: TEXT, Foreign Key referencing Products.
- Employee_ID: INTEGER, Foreign Key referencing Employees.
- Customer_ID: TEXT, Foreign Key referencing Customers, with ~10% NULL values.
- Sale_Date: TEXT, Interval data for recent transactions.
- Quantity: INTEGER, Ratio data (>0).
- Total_Price: REAL, Ratio data (>0).

-:Justification for Separate Tables:-

- **Products Table**:
  - Stores product details centrally to avoid redundancy.
  - Categories (e.g., 'Groceries') aid in filtering and inventory analysis.

- **Employees Table:**
  - Tracks roles and wages, critical for payroll and performance evaluation.
- **Customers Table:**
  - Facilitates segmentation by 'Age_Group'.
  - Includes NULL Postcodes to simulate real-world missing data scenarios.

- **Sales Table:**
  - Links products, employees, and customers, capturing all transactional details.
  - NULL Customer_IDs represent sales to unregistered customers (~10%).

-:Ethical and Data Privacy Discussion:-

The database emphasizes ethical considerations and data privacy:
- **Synthetic Data:** All data is generated programmatically to avoid real-world identifiers.
- **Anonymization:** Attributes like 'Postcode' and 'Name' are fictional and non-unique, preventing traceability.
- **Missing Data:** NULL values are intentionally inserted for realism.
- **Excluded PII:** Sensitive data like email addresses and phone numbers is deliberately omitted.

-:Foreign and Composite Keys:-

Foreign Keys:
- Sales.Product_ID → Products.Product_ID
- Sales.Employee_ID → Employees.Employee_ID
- Sales.Customer_ID → Customers.Customer_ID

Composite Keys:

- While no explicit composite keys are implemented, foreign key relationships ensure relational integrity and prevent redundancy.

-:Data Types Representation:-

The database includes all major data types:

- **Nominal:** Product_Name, Category, Customer_ID, Postcode.
- **Ordinal:** Age_Group, Sale_ID, Employee_ID.
- **Interval:** Sale_Date.
- **Ratio:** Price, Quantity, Hourly_Rate, Total_Price.

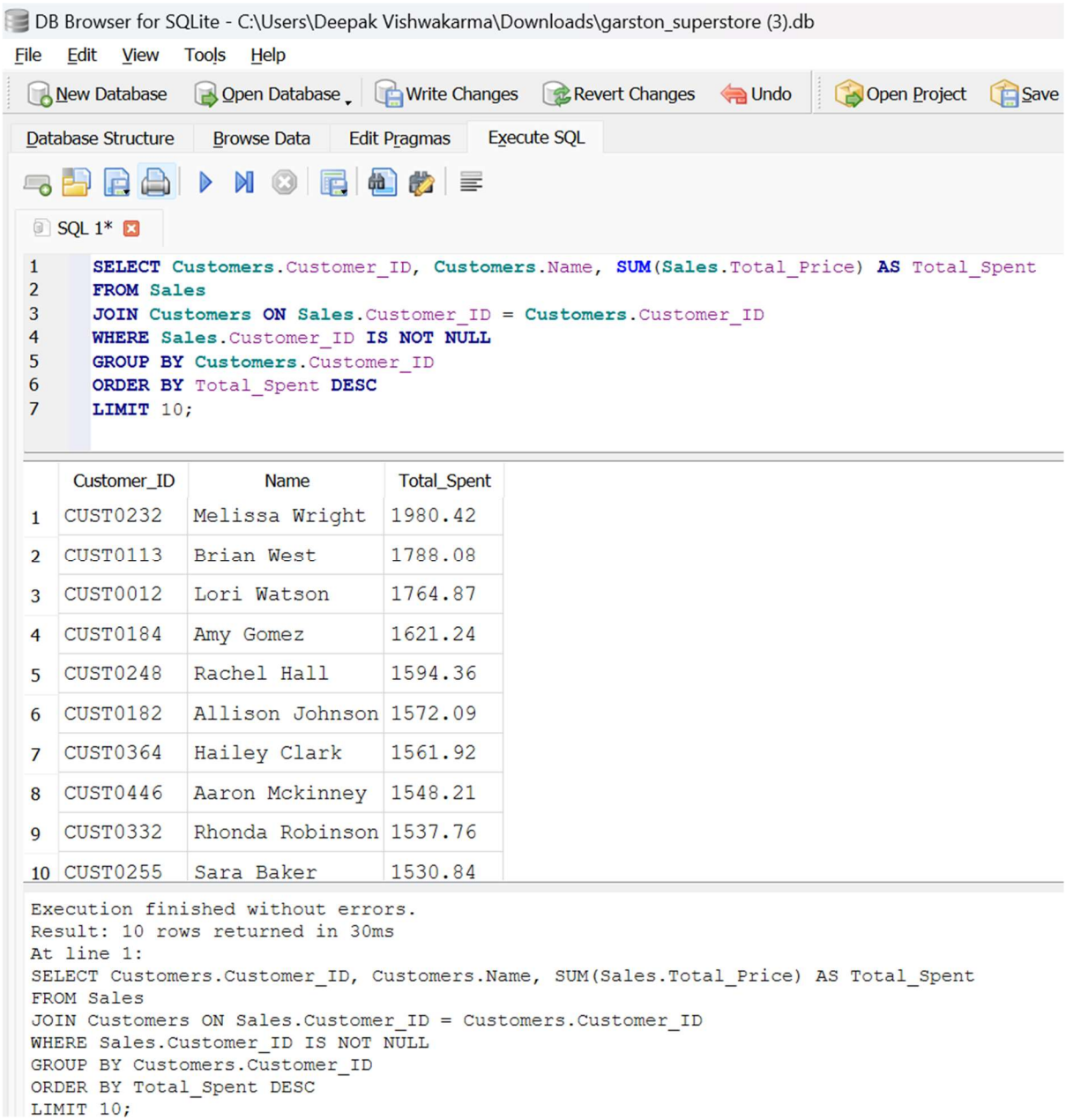
-:Missing and Duplicate Data:-

The database deliberately incorporates missing and duplicate data:

- **Missing Data**:
  - ~5% NULL Postcode values in Customers.
  - ~10% NULL Customer_ID values in Sales.
- **Duplicate Data**:
  - Common Role values in Employees (e.g., multiple 'Cashiers').
  - Overlapping Product_Names across Categories (e.g., 'Bread' in 'Bakery').

-:Example Queries and Results:-

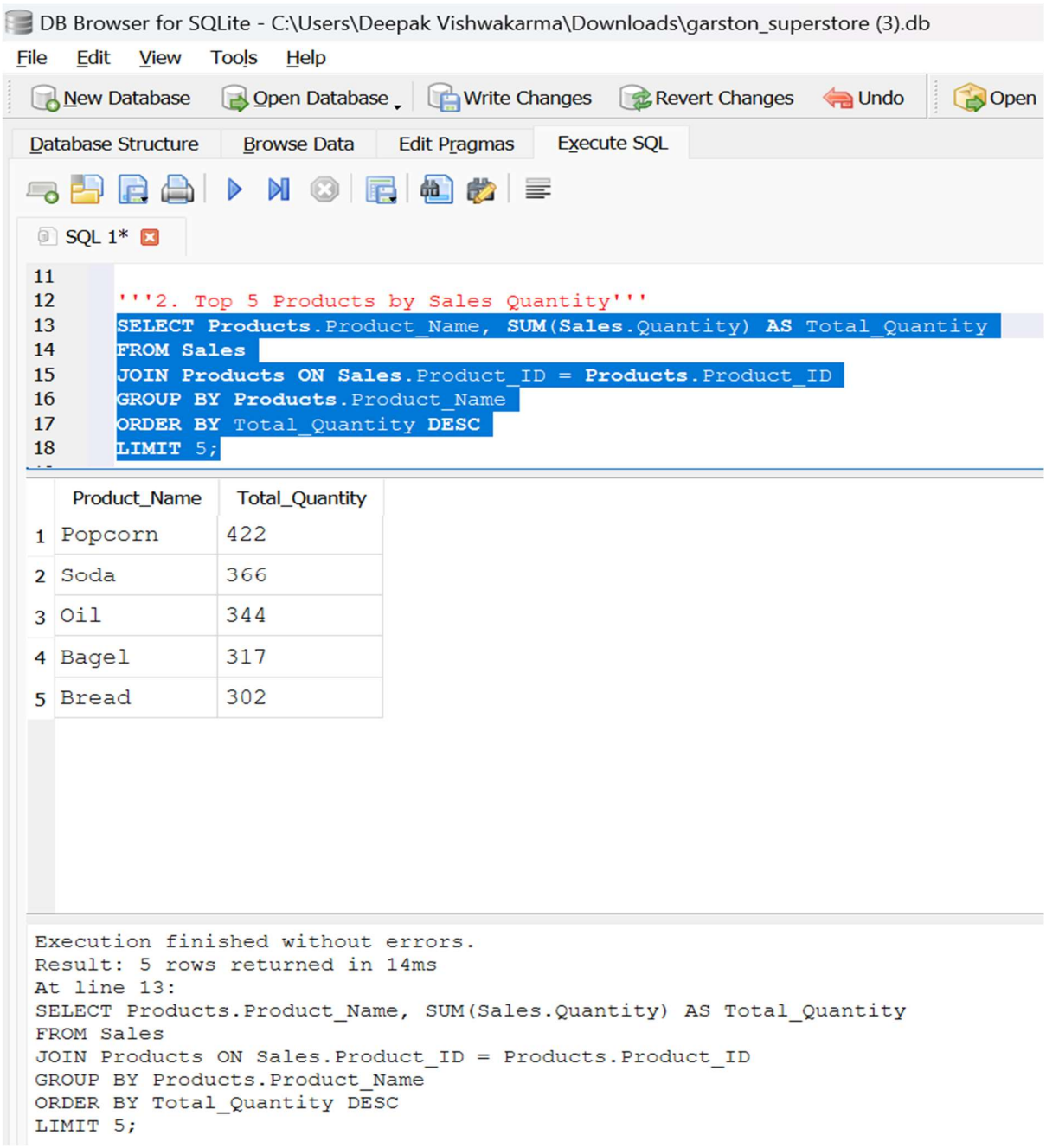
1. Top 10 Customers by Total Spend:-



Insights:-

- Helps identify high-value customers, which can inform marketing and loyalty programs.
- Allows for segmentation of customers based on total spend, enabling personalized offers.

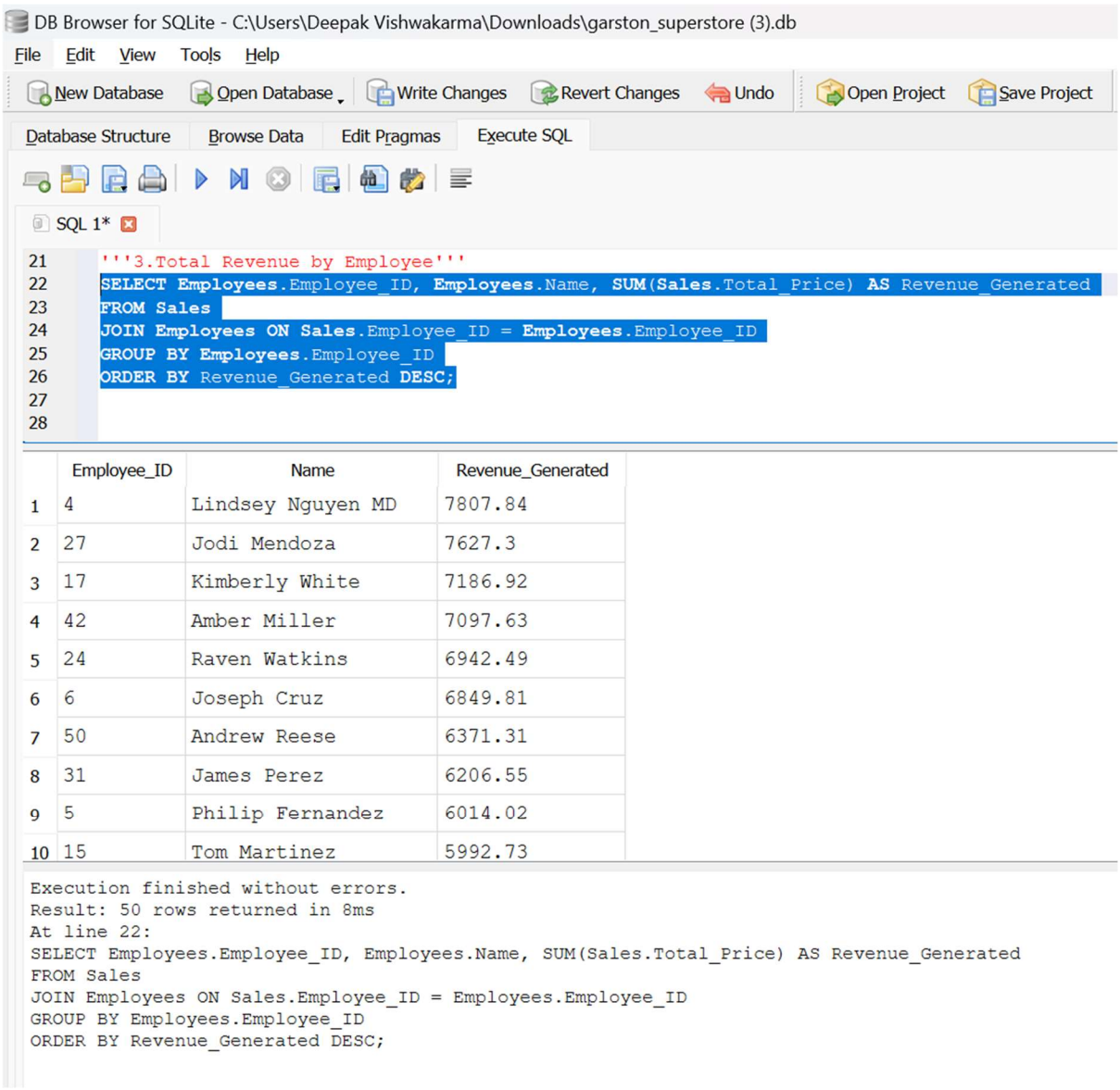
2. Top 5 Products by Sales Quantity:-



Insights:-

- Helps identify the most popular products, which can inform restocking decisions and marketing campaigns.
- Insights into sales patterns, such as which categories (e.g., Bakery, Snacks) are performing best.

3. Total Revenue by Employee:-

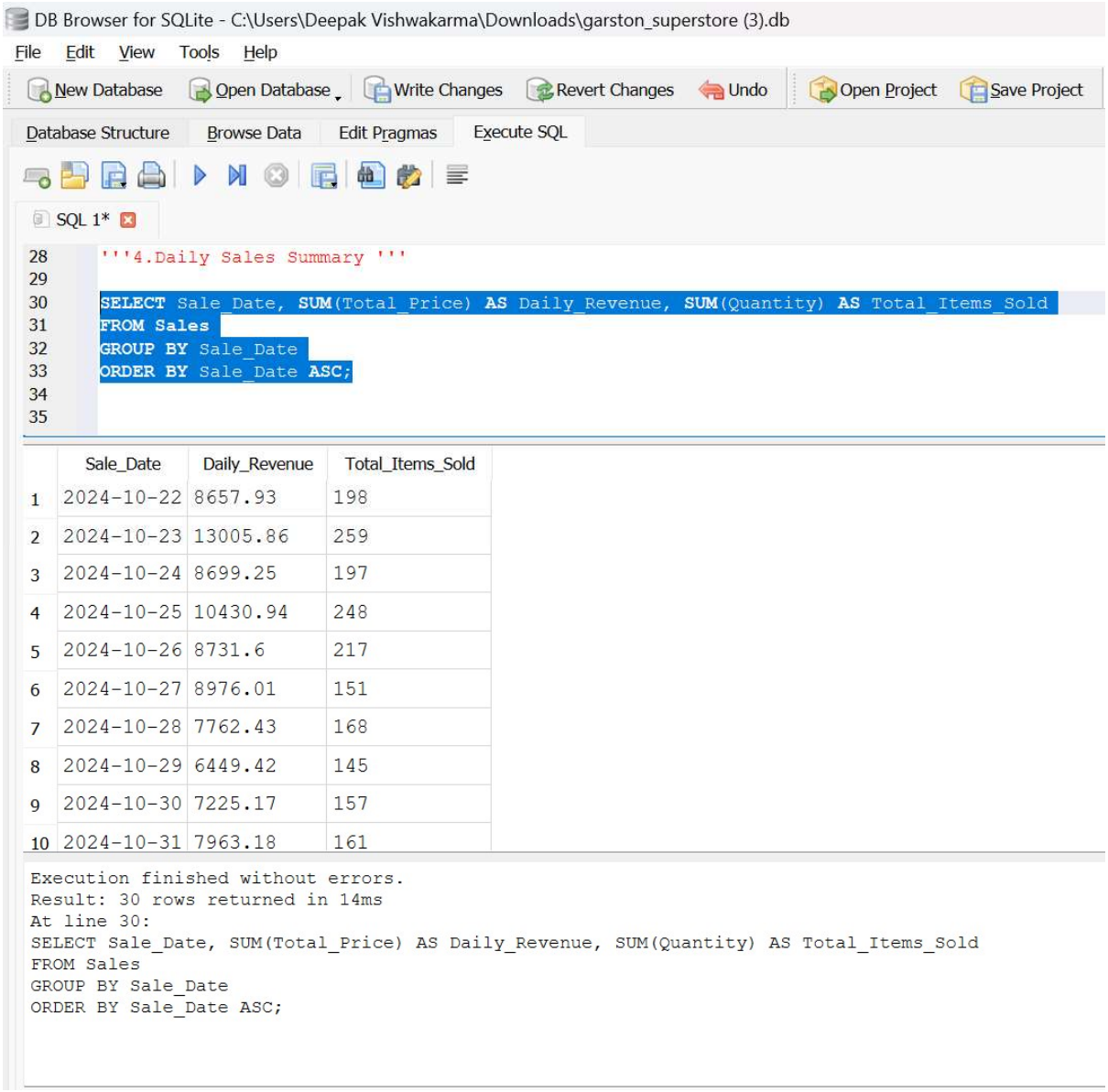


	Employee_ID	Name	Revenue_Generated
1	4	Lindsey Nguyen MD	7807.84
2	27	Jodi Mendoza	7627.3
3	17	Kimberly White	7186.92
4	42	Amber Miller	7097.63
5	24	Raven Watkins	6942.49
6	6	Joseph Cruz	6849.81
7	50	Andrew Reese	6371.31
8	31	James Perez	6206.55
9	5	Philip Fernandez	6014.02
10	15	Tom Martinez	5992.73

Insights:-

- Measures employee performance by tracking how much revenue each employee contributes to the store.
- Can be used for performance evaluation and reward allocation.

4. Daily Sales Summary:-

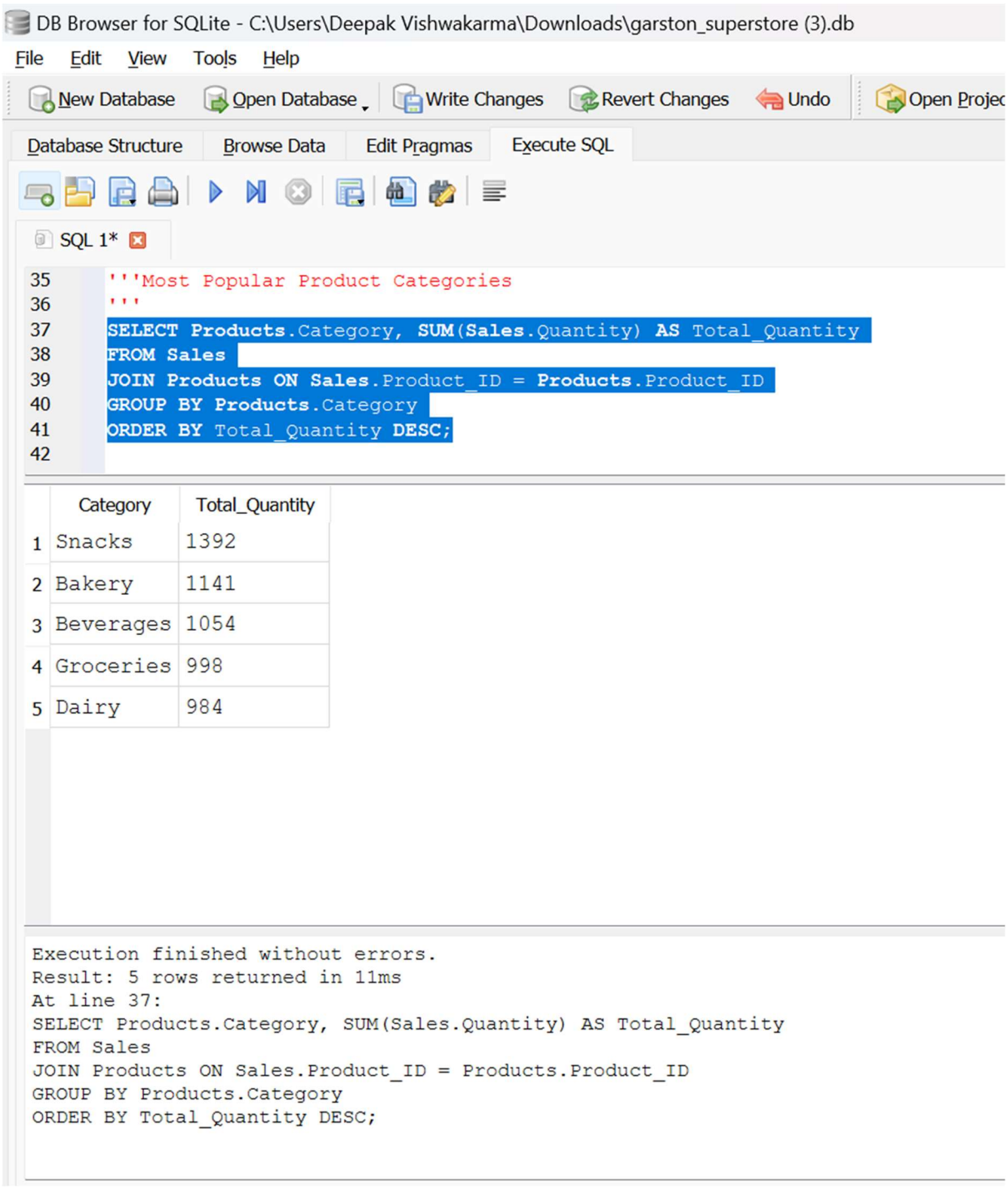


	Sale_Date	Daily_Revenue	Total_Items_Sold
1	2024-10-22	8657.93	198
2	2024-10-23	13005.86	259
3	2024-10-24	8699.25	197
4	2024-10-25	10430.94	248
5	2024-10-26	8731.6	217
6	2024-10-27	8976.01	151
7	2024-10-28	7762.43	168
8	2024-10-29	6449.42	145
9	2024-10-30	7225.17	157
10	2024-10-31	7963.18	161

Insights:-

- Allows for trend analysis, helping to identify peak sales days, seasonal patterns, or sales anomalies.
- Useful for financial reporting and operational planning.

5. Most Popular Product Categories:-



Insights:-

- Provides insights into which product categories are selling the most, aiding inventory management and targeted marketing.
- Helps to identify trends in consumer preferences.

-:Conclusion:-

The Co-op Superstore database is a well-structured and carefully crafted system that captures essential aspects of store operations, such as product management, employee records, customer details, and sales transactions. It follows best practices in relational database design, with a focus on normalization, the use of meaningful constraints, and strong relationships through foreign keys. The data is generated synthetically, ensuring it remains realistic while also upholding high ethical standards and ensuring privacy. The database is designed to offer detailed analytical capabilities, providing valuable insights into product performance, top customers, and sales trends. In summary, this database is a powerful tool for streamlining and improving supermarket management and operations.

{Guided By:- Prof. John Evans} **{Submitted By:- Deepak Vishwakarma}**

Thank You!