```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import calendar
from datetime import datetime
import numpy as np
import mysql.connector

db = mysql.connector.connect(host = "localhost",
                             user = "root",
                             password = "Nivetha-arunjp",
                             database = "ecommerce")

cur = db.cursor()
```

1. List unique cities where customers are located.

```
query = """ select distinct customer_city from customers """

cur.execute(query)

data = cur.fetchall()
df = pd.DataFrame(data, columns = ['Customer_City'])
df.head()
```

```
           Customer_City
0                 franca
1  sao bernardo do campo
2              sao paulo
3        mogi das cruzes
4               campinas
```

2. Count the number of orders placed in 2017.

```
query = """ select count(order_id) from orders where
year(order_purchase_timestamp) = 2017  """

cur.execute(query)

data = cur.fetchall()
"total orders placed in 2017 are", data[0][0]
```

```
('total orders placed in 2017 are', 45101)
```

3. Find the total sales per category.

```
query = """ WITH distinct_order_items AS (
    SELECT DISTINCT order_id, product_id, price
    FROM order_items
),
distinct_payments AS (
    SELECT DISTINCT order_id, payment_value
    FROM payments
),
item_payment_combined AS (
    SELECT doi.product_id, dp.payment_value
    FROM distinct_order_items doi
    JOIN distinct_payments dp ON doi.order_id = dp.order_id
)

SELECT
    p.product_category AS category,
    ROUND(SUM(ipc.payment_value), 2) AS total_sales
FROM item_payment_combined ipc
JOIN products p ON ipc.product_id = p.product_id
GROUP BY p.product_category """

cur.execute(query)

data = cur.fetchall()
df = pd.DataFrame(data, columns = ['Category', 'Sales'])
df
```

```
                       Category       Sales
0                     telephony   406549.62
1                bed table bath  1453936.81
2          computer accessories  1146724.92
3          Furniture Decoration  1021687.60
4                     perfumery   469457.76
..                          ...         ...
69               cds music dvds      954.99
70                   La Cuisine     2579.41
71  Fashion Children's Clothing      785.67
72                     PC Gamer     1717.05
73       insurance and services      324.51

[74 rows x 2 columns]
```

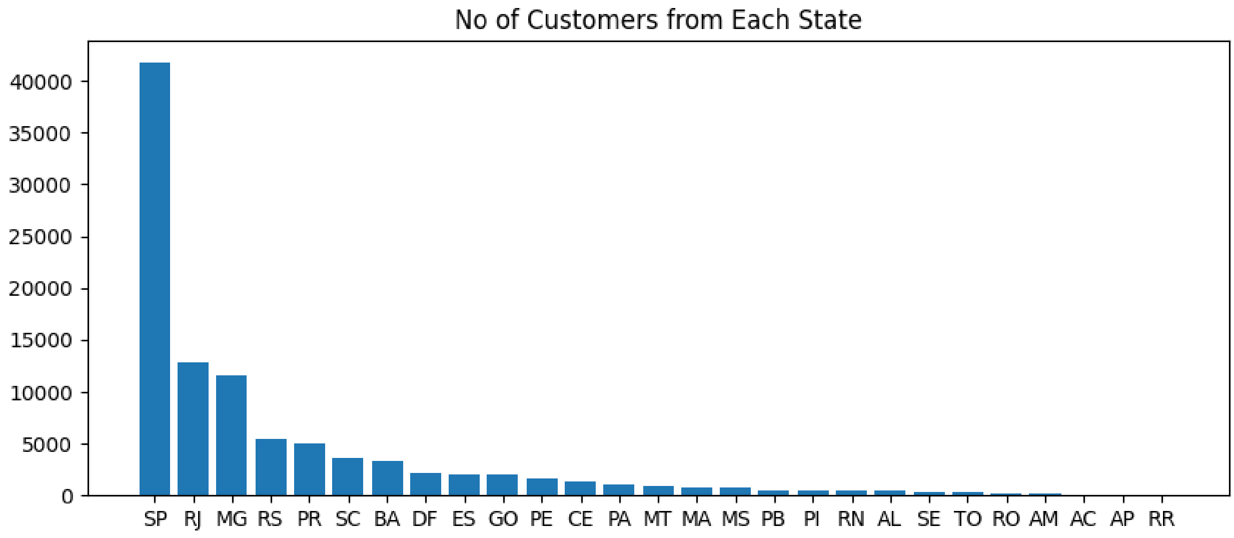
4. Calculate the percentage of orders that were paid in installments.

```
query = """ select (sum(payment_installments >=1))/count(*)*100 from
payments """
cur.execute(query)

data = cur.fetchall()
"the percentage of orders that were paid in installments is", data[0]
[0]
```

```
('the percentage of orders that were paid in installments is',
 Decimal('99.9981'))
```

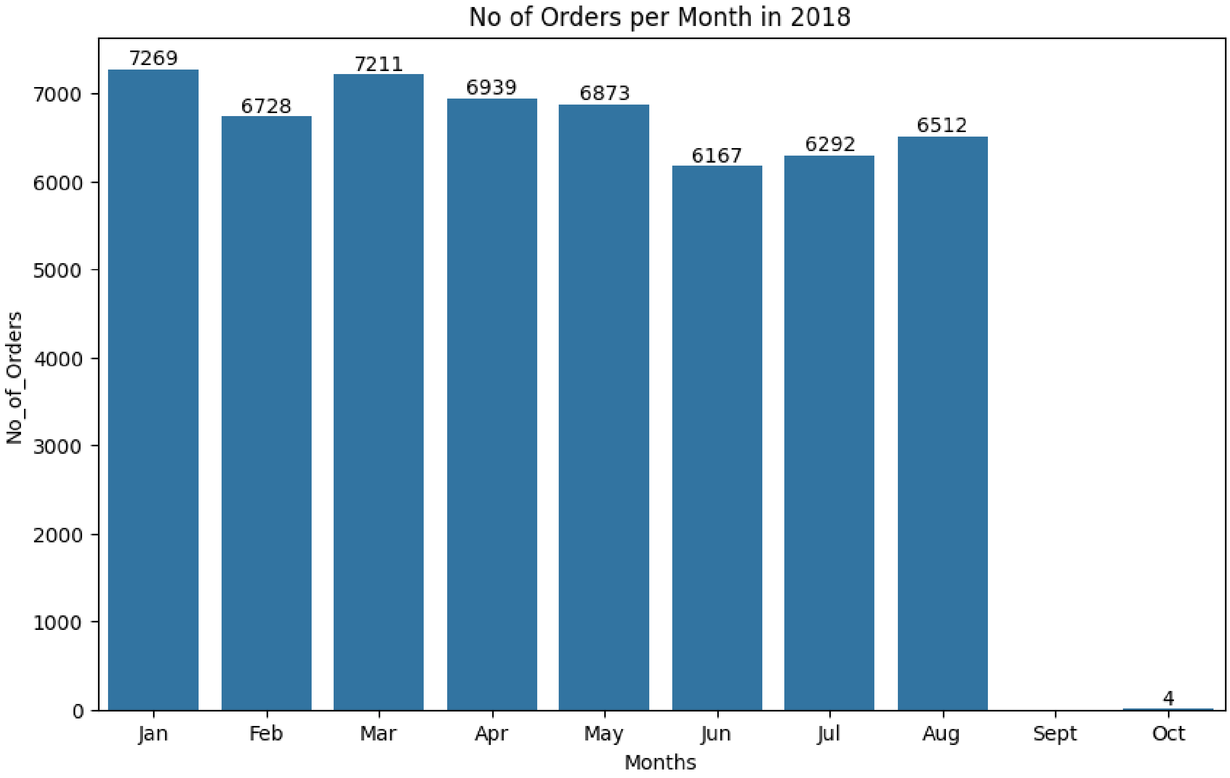
5. Count the number of customers from each state.

```
query = """ select customer_state, count(customer_id)
from customers
group by customer_state """
cur.execute(query)

data = cur.fetchall()
df = pd.DataFrame(data, columns=['State','Customer_Count'])
df = df.sort_values(by = 'Customer_Count', ascending = False)
plt.figure(figsize=(10,4))
plt.bar(df['State'], df['Customer_Count'])
plt.title("No of Customers from Each State")
plt.show()
```



6. Calculate the number of orders per month in 2018.

```
query = """ select monthname(order_purchase_timestamp),
count(order_id)
from orders where order_purchase_timestamp = 2018
group by monthname(order_purchase_timestamp)"""

cur.execute(query)

data = cur.fetchall()
df = pd.DataFrame(data, columns = ['Months','No_of_Orders'])
df['Months'] = df['Months'].apply(lambda x: datetime.strptime(x,
'%B').strftime('%b'))

month_order= ['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug',
'Sept', 'Oct']

plt.figure(figsize=(10,6))
ax = sns.barplot(x = df["Months"], y = df["No_of_Orders"], data = df,
order = month_order)
ax.bar_label(ax.containers[0])
plt.title("No of Orders per Month in 2018")
plt.show()
```



7. Find the average number of products per order, grouped by customer city.

```
query = """WITH distinct_order_items AS (
    SELECT DISTINCT order_id, product_id
    FROM order_items
),
product_count_per_order AS (
    SELECT order_id, COUNT(product_id) AS product_count
    FROM distinct_order_items
    GROUP BY order_id
),
order_customer_city AS (
    SELECT o.order_id, c.customer_city
    FROM orders o
    JOIN customers c ON o.customer_id = c.customer_id
)

SELECT
    occ.customer_city,
    ROUND(AVG(pco.product_count), 2) AS avg_products_per_order
FROM product_count_per_order pco
JOIN order_customer_city occ ON pco.order_id = occ.order_id
GROUP BY occ.customer_city
ORDER BY avg_products_per_order DESC """

cur.execute(query)

data = cur.fetchall()
df = pd.DataFrame(data, columns = ['Customer_City', 'Average_Orders'])
df.head(10)
```

```
     Customer_City Average_Orders
0   padre carvalho           7.00
1          picarra           4.00
2       curralinho           4.00
3  teixeira soares           3.00
4             ipua           2.75
5      celso ramos           2.50
6        pauliceia           2.00
7       nova hartz           2.00
8   doutor ulysses           2.00
9   senador cortes           2.00
```

8. Calculate the percentage of total revenue contributed by each product category.

```
query = """ WITH distinct_order_items AS (
    SELECT DISTINCT order_id, product_id
    FROM order_items
),
distinct_payments AS (
    SELECT DISTINCT order_id, payment_value
    FROM payments
),
joined_data AS (
    SELECT doi.product_id, dp.payment_value
    FROM distinct_order_items doi
    JOIN distinct_payments dp ON doi.order_id = dp.order_id
),
category_sales AS (
    SELECT
        p.product_category AS category,
        SUM(jd.payment_value) AS category_revenue
    FROM joined_data jd
    JOIN products p ON jd.product_id = p.product_id
    GROUP BY p.product_category
),
total_revenue AS (
    SELECT SUM(category_revenue) AS total FROM category_sales
)

SELECT
    cs.category,
    ROUND((cs.category_revenue * 100.0 / tr.total), 2) AS
revenue_percentage
FROM category_sales cs, total_revenue tr
ORDER BY revenue_percentage DESC;
 """



cur.execute(query)

data = cur.fetchall()
df = pd.DataFrame(data, columns = ['Category', 'Percentage
Distribution'])
df.head(10)
```

```
               Category  Percentage Distribution
0         HEALTH BEAUTY                     8.88
1        bed table bath                     8.65
2       Watches present                     8.03
```

```
3         sport leisure                     7.15
4  computer accessories                     6.82
5  Furniture Decoration                     6.08
6            housewares                     4.89
7            Cool Stuff                     4.37
8            automotive                     4.26
9          Garden tools                     3.69
```

9. Identify the correlation between product price and the number of times a product has been purchased.

```
query = """ select p.product_category, count(distinct
oi.product_id,oi.order_id), round(avg(oi.price),2)
from products p
join order_items oi on
p.product_id = oi.product_id
group by p.product_category order by p.product_category desc """

cur.execute(query)

data = cur.fetchall()
df = pd.DataFrame(data, columns = ['Category', 'Order Count',
'Price'])
df.head()

arr1 = df['Order Count']
arr2 = df['Price']

a = np.corrcoef([arr1,arr2])
print(" the correlation between the product price and the number of
times a product purchased is", a[0][1])
```

```
 the correlation between the product price and the number of times a
product purchased is -0.10448921163702476
```

10. Calculate the total revenue generated by each seller, and rank them by revenue.

```
query = """ WITH distinct_order_items AS (
    SELECT DISTINCT order_id, seller_id, product_id
    FROM order_items
),
distinct_payments AS (
    SELECT DISTINCT order_id, payment_value
    FROM payments
),
seller_revenue_data AS (
    SELECT doi.seller_id, dp.payment_value
    FROM distinct_order_items doi
    JOIN distinct_payments dp ON doi.order_id = dp.order_id
),
seller_revenue AS (
    SELECT
        s.seller_id,
        SUM(srd.payment_value) AS total_revenue
    FROM seller_revenue_data srd
    JOIN sellers s ON srd.seller_id = s.seller_id
    GROUP BY s.seller_id
)

SELECT
    seller_id,
    ROUND(total_revenue, 2) AS total_revenue,
    RANK() OVER (ORDER BY total_revenue DESC) AS revenue_rank
FROM seller_revenue
ORDER BY revenue_rank """

cur.execute(query)
data = cur.fetchall()
df = pd. DataFrame(data, columns = ['Seller_ID','Revenue','Rank'])
df.head()
```

```
                          Seller_ID    Revenue  Rank
0  4a3ca9315b744ce9f8e9374361493884  271189.74     1
1  7c67e1448b00f6e969d365cea6b010ab  257388.49     2
2  4869f7a5dfa277a7dca6462dcf3b52b2  257263.34     3
3  53243585a1d6dc2643021fd1853d8905  234594.81     4
4  da8622b14eb17ae2831f4ac5b9dab84a  231693.69     5
```

11. Calculate the moving average of order values for each customer over their order history.

```
query = """ WITH distinct_orders AS (
    SELECT DISTINCT
        o.customer_id,
        o.order_id,
        p.payment_value,
        o.order_purchase_timestamp
    FROM orders o
    JOIN payments p ON o.order_id = p.order_id
),
ordered_orders AS (
    SELECT
        customer_id,
        order_id,
        payment_value,
        order_purchase_timestamp,
        ROW_NUMBER() OVER (PARTITION BY customer_id ORDER BY
order_purchase_timestamp) AS order_num
    FROM distinct_orders
),
moving_avg AS (
    SELECT
        customer_id,
        order_purchase_timestamp,
        payment_value,
        ROUND(AVG(payment_value) OVER (
            PARTITION BY customer_id
            ORDER BY order_num
            ROWS BETWEEN 2 PRECEDING AND CURRENT ROW
        ), 2) AS moving_avg_order_value
    FROM ordered_orders
)

SELECT * FROM moving_avg
ORDER BY customer_id """

cur.execute(query)
data = cur.fetchall()
df = pd. DataFrame(data, columns =
['Customer_ID','Order_Timestamp','Price','Moving Average'])
df
```

```
                             Customer_ID      Order_Timestamp   Price  
\
0       00012a2ce6f8dcda20d059ce98491703  2017-11-14 16:08:26  114.74

1       000161a058600d5901f007fab4c27140  2017-07-16 09:40:32   67.41

2       0001fd6190edaaf884bcaf3d49edf079  2017-02-28 11:06:43  195.42

3       0002414f95344307404f0ace7a26f1d5  2017-08-16 13:09:20  179.35

4       000379cdec625522490c315e70c7a9fb  2018-04-02 13:42:17  107.01

...                                  ...                  ...     ...

103266  fffecc9f79fd8c764f843e9951b11341  2018-03-29 16:59:26    0.64
```

```
103267  fffeda5b6d849fbd39689bb92087f431  2018-05-22 13:36:02   63.13

103268  ffff42319e9b2d713724ae527742af25  2018-06-13 16:57:05  214.13

103269  ffffa3172527f765de70084a7e53aae8  2017-09-02 11:53:32   45.50

103270  ffffe8b65bbe3087b653a978c870db99  2017-09-29 14:07:03   18.37


        Moving Average
0               114.74
1                67.41
2               195.42
3               179.35
4               107.01
...                ...
103266           27.12
103267           63.13
103268          214.13
103269           45.50
103270           18.37

[103271 rows x 4 columns]
```

12. Calculate the cumulative sales per month for each year.

```
query = """ WITH monthly_sales AS (
    SELECT
        YEAR(o.order_purchase_timestamp) AS order_year,
        MONTH(o.order_purchase_timestamp) AS order_month,
        SUM(DISTINCT p.payment_value) AS monthly_sales
    FROM orders o
    JOIN payments p ON o.order_id = p.order_id
    GROUP BY YEAR(o.order_purchase_timestamp),
MONTH(o.order_purchase_timestamp)
),
cumulative_sales AS (
    SELECT
        order_year,
        order_month,
        monthly_sales,
        SUM(monthly_sales) OVER (
            PARTITION BY order_year
            ORDER BY order_month
            ROWS BETWEEN UNBOUNDED PRECEDING AND CURRENT ROW
        ) AS cumulative_sales
    FROM monthly_sales
)

SELECT
    order_year,
    order_month,
    monthly_sales,
    ROUND(cumulative_sales, 2) AS cumulative_sales
FROM cumulative_sales
ORDER BY order_year, order_month """

cur.execute(query)
data = cur.fetchall()
df = pd. DataFrame(data, columns = ['Year','Month','Sales','Cumulative
Sales'])
df
```

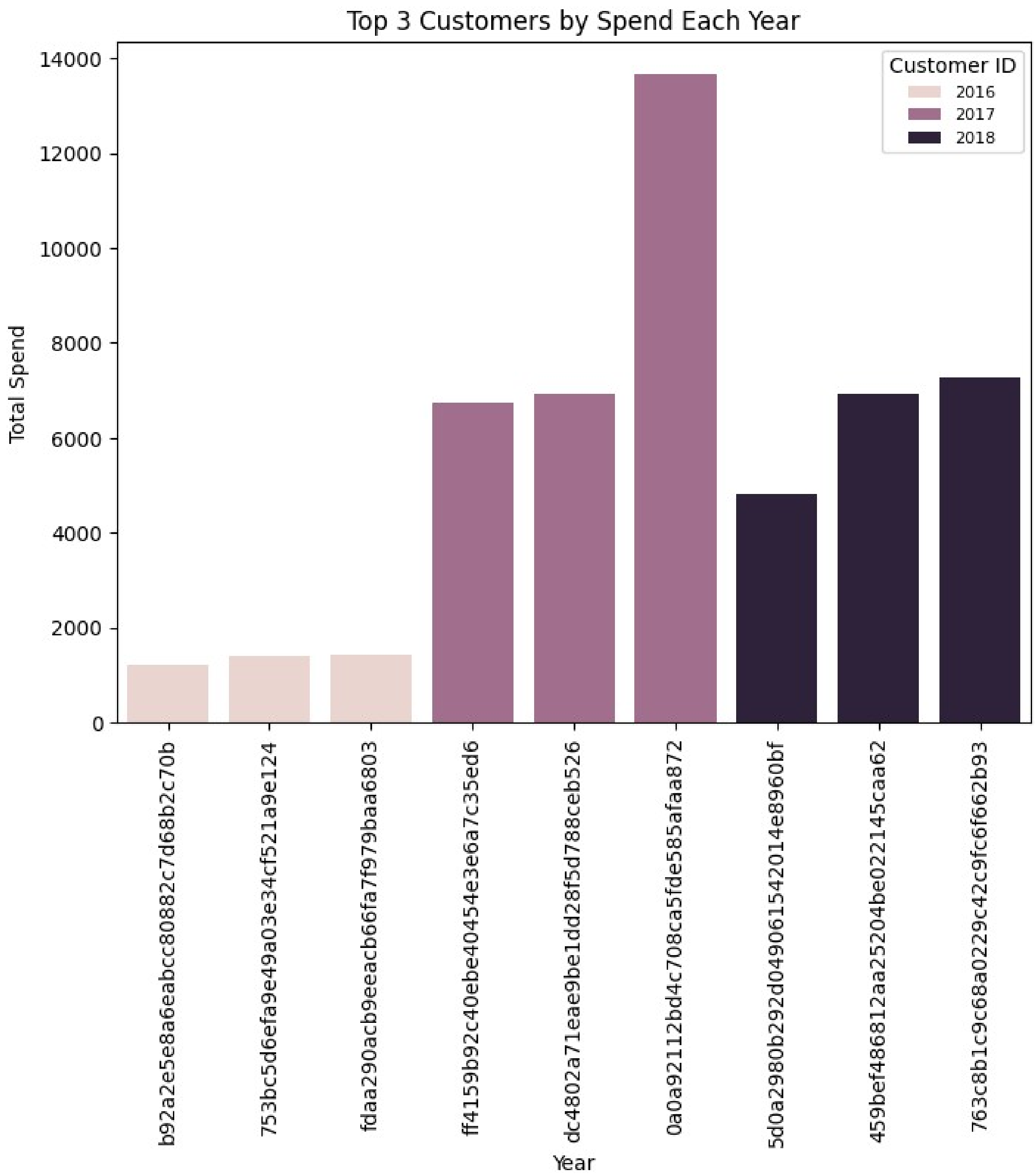
```
    Year  Month          Sales  Cumulative Sales
0   2016      9     252.239994            252.24
1   2016     10   55379.960037          55632.20
2   2016     12      19.620001          55651.82
3   2017      1  122628.520095         122628.52
4   2017      2  252840.189707         375468.71
5   2017      3  373576.479756         749045.19
6   2017      4  352872.829841        1101918.02
7   2017      5  484773.930227        1586691.95
8   2017      6  395519.030382        1982210.98
9   2017      7  434337.579863        2416548.56
10  2017      8  510292.640042        2926841.20
11  2017      9  566847.230360        3493688.43
12  2017     10  600322.420186        4094010.85
13  2017     11  868663.619959        4962674.47
14  2017     12  627272.669885        5589947.14
15  2018      1  784639.359469         784639.36
16  2018      2  698751.360006        1483390.72
17  2018      3  884408.719452        2367799.44
18  2018      4  882028.050555        3249827.49
19  2018      5  897287.410337        4147114.90
20  2018      6  848065.400578        4995180.30
21  2018      7  846513.729134        5841694.03
22  2018      8  782948.190654        6624642.22
23  2018      9    4260.330132        6628902.55
24  2018     10     589.669998        6629492.22
```

13. Calculate the year-over-year growth rate of total sales.

```
query = """ with a as(select year(orders.order_purchase_timestamp) as 
years,
round(sum(payments.payment_value),2) as payment from orders join 
payments
on orders.order_id = payments.order_id
group by years order by years)

select years, ((payment - lag(payment,1) over(order by years)) /
               lag(payment, 1) over(order by years)) * 100 from a """

cur.execute(query)
data = cur.fetchall()
df = pd.DataFrame(data, columns = ["Years", "YoY % Growth"])
df

   Years  YoY % Growth
0   2016           NaN
1   2017  12112.703761
2   2018     20.000924
```

14. Identify the top 3 customers who spent the most money in each year.

```
query = """ WITH customer_yearly_spend AS (
    SELECT
        c.customer_id,
        c.customer_unique_id,
        YEAR(o.order_purchase_timestamp) AS order_year,
        ROUND(SUM(DISTINCT p.payment_value), 2) AS total_spent
    FROM customers c
    JOIN orders o ON c.customer_id = o.customer_id
    JOIN payments p ON o.order_id = p.order_id
    GROUP BY c.customer_id, c.customer_unique_id, 
YEAR(o.order_purchase_timestamp)
),
ranked_customers AS (
    SELECT *,
        RANK() OVER (PARTITION BY order_year ORDER BY total_spent 
DESC) AS ranked
    FROM customer_yearly_spend
)
SELECT
    order_year,
    customer_unique_id,
    total_spent,
    ranked
FROM ranked_customers
WHERE ranked <= 3
ORDER BY order_year, ranked desc"""

cur.execute(query)
data = cur.fetchall()
df = pd.DataFrame(data, columns =
['Year','Customer_ID','Total_Spend','Rank'])

plt.figure(figsize=(8, 6))
barplot = sns.barplot(data=df, x='Customer_ID', y='Total_Spend',
hue='Year')

plt.legend(title='Customer ID', prop={'size': 8})
plt.title("Top 3 Customers by Spend Each Year")
plt.ylabel("Total Spend")
plt.xlabel("Year")
plt.xticks(rotation=90)
plt.show()
```



Top 3 Customers by Spend Each Year
Customer ID
2016
2017
2018
Total Spend
14000
12000
10000
8000
6000
4000
2000
0
b92a2e5e8a6eabcc80882c7d68b2c70b
753bc5d6efa9e49a03e34cf521a9e124
fdaa290acb9eeacb66fa7f979baa6803
ff4159b92c40ebe40454e3e6a7c35ed6
dc4802a71eae9be1dd28f5d788ceb526
0a0a92112bd4c708ca5fde585afaa872
5d0a2980b292d049061542014e8960bf
459bef486812aa25204be022145caa62
763c8b1c9c68a0229c42c9fc6f662b93
Year

15. Calculate the retention rate of customers, defined as the percentage of customers who make another purchase within 6 months of their first purchase

```
query = """ WITH first_orders AS (
  SELECT customer_id,
         MIN(order_purchase_timestamp) AS first_order_date
  FROM orders
  GROUP BY customer_id
),
repeat_orders AS (
  SELECT DISTINCT o.customer_id, o.order_id,
o.order_purchase_timestamp
  FROM orders o
  JOIN first_orders f ON o.customer_id = f.customer_id
  WHERE o.order_purchase_timestamp > f.first_order_date
    AND o.order_purchase_timestamp <= DATE_ADD(f.first_order_date,
INTERVAL 6 MONTH)
),
retained_customers AS (
  SELECT DISTINCT customer_id
  FROM repeat_orders
)
SELECT
  ROUND(COUNT(DISTINCT r.customer_id) * 100.0 / COUNT(DISTINCT
f.customer_id), 2) AS retention_rate_percentage
FROM first_orders f
LEFT JOIN retained_customers r ON f.customer_id = r.customer_id """

cur.execute(query)
data = cur.fetchall()
data
```

```
[(Decimal('0.00'),)]
```

From the above result we conlcude that none of the customers made a repeat purchase within 6 months of their first purchase.