```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import mysql.connector


db = mysql.connector.connect(host = "localhost",
                            username = "root",
                            password = "Rama@307",
                            database = "ecommerce")

cur = db.cursor()
```

List all unique cities where customers are located.

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

cur.execute(query)
data1 = cur.fetchall()
df = pd.DataFrame(data1,columns=["Customer_city"])
df
```

```
              Customer_city
0                    franca
1     sao bernardo do campo
2                 sao paulo
3           mogi das cruzes
4                  campinas
...                     ...
4114                 siriji
4115    natividade da serra
4116           monte bonito
4117             sao rafael
4118       eugenio de castro

[4119 rows x 1 columns]
```

Count the number of orders placed in 2017.

```
query = """select count(order_id) from orders where
year(order_purchase_timestamp) = 2017 """
cur.execute(query)
data2 = cur.fetchall()

data2[0][0]
```

```
45101
```

Find the total sales per category.

```
query = """ select upper(products.product_category) category,
            round(sum(payments.payment_value),2) sales
            from products join orders_items
            on products.product_id = orders_items.product_id
            join payments
            on payments.order_id = orders_items.order_id
            group by category
            """

cur.execute(query)
data3 = cur.fetchall()
data3
df = pd.DataFrame(data3,columns = ["Category","Sales"])
df
```

```
                        Category       Sales
0                      PERFUMERY   506738.66
1           FURNITURE DECORATION  1430176.39
2                      TELEPHONY   486882.05
3    FASHION BAGS AND ACCESSORIES  218158.28
4                  BED TABLE BATH  1712553.67
..                           ...         ...
69                 CDS MUSIC DVDS     1199.43
70                     LA CUISINE     2913.53
71    FASHION CHILDREN'S CLOTHING      785.67
72                       PC GAMER     2174.43
73          INSURANCE AND SERVICES      324.51

[74 rows x 2 columns]
```

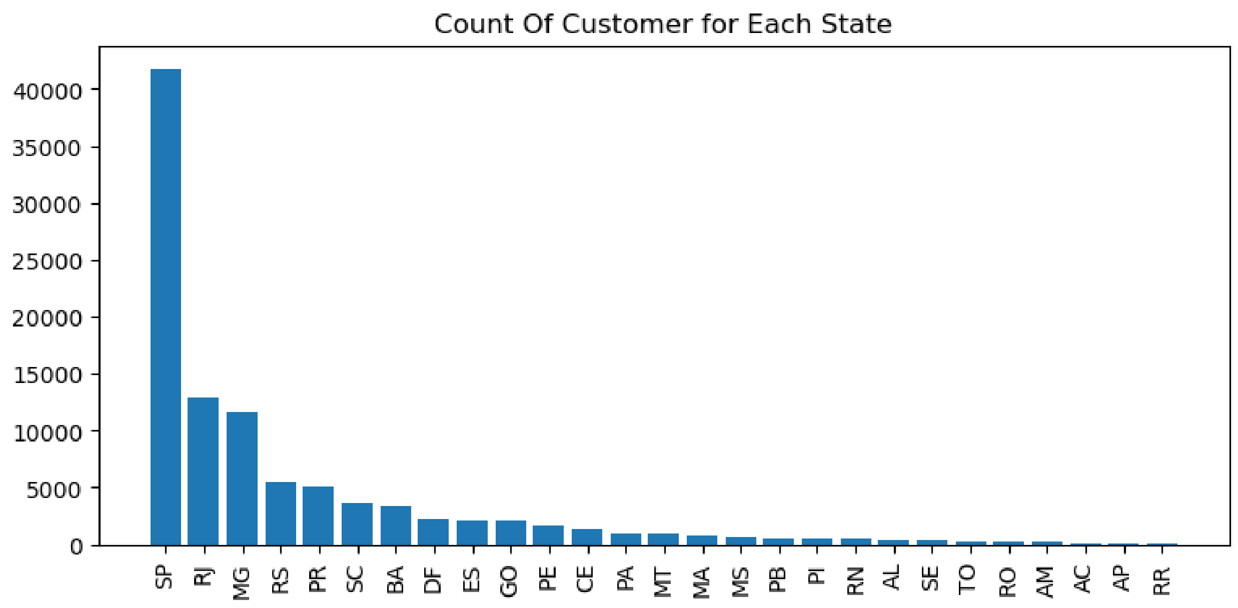
```
                        Category       Sales
0                      PERFUMERY   506738.66
1           FURNITURE DECORATION  1430176.39
2                      TELEPHONY   486882.05
3    FASHION BAGS AND ACCESSORIES  218158.28
4                  BED TABLE BATH  1712553.67
..                           ...         ...
69                 CDS MUSIC DVDS     1199.43
70                     LA CUISINE     2913.53
71    FASHION CHILDREN'S CLOTHING      785.67
72                       PC GAMER     2174.43
73          INSURANCE AND SERVICES      324.51

[74 rows x 2 columns]
```

Calculate the percentage of orders that were paid in installments.

```
query = """ select (sum(case when payment_installments >= 1 then 1
             else 0
             end))/ count(*) * 100 from payments
            """

cur.execute(query)
data4 = cur.fetchall()

data4[0][0]

Decimal('99.9981')
```

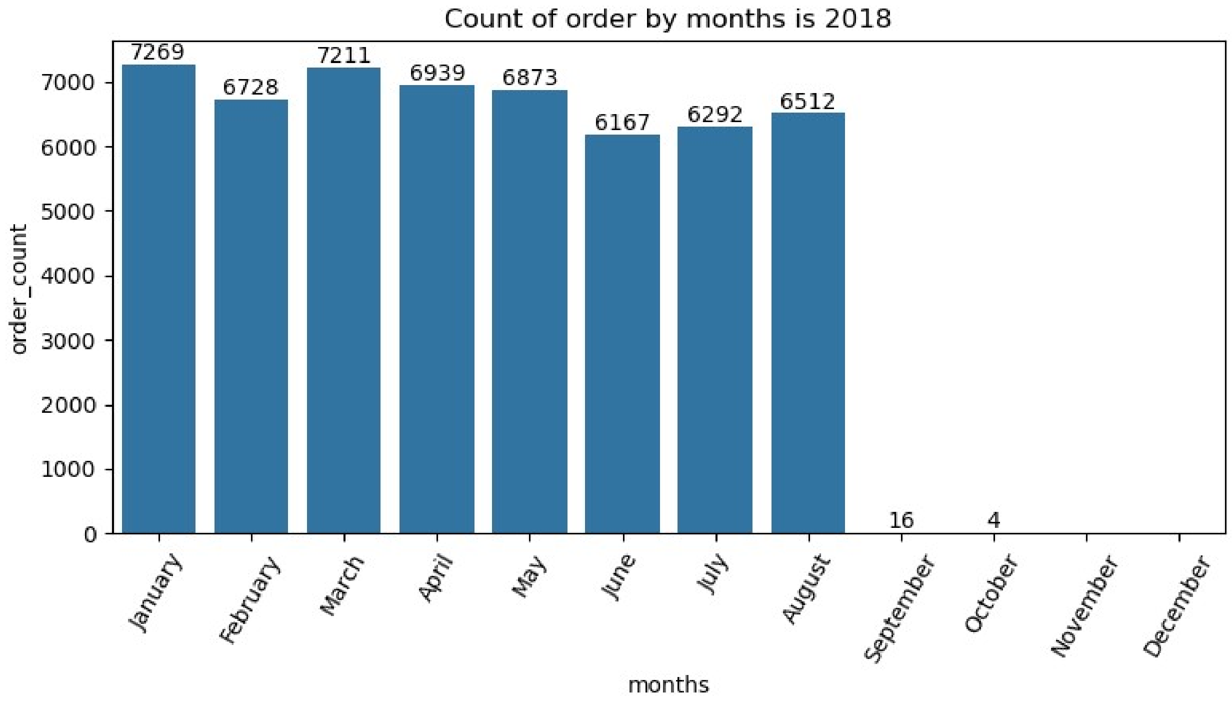
Count the number of customers from each state.

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

cur.execute(query)
data5 = cur.fetchall()
data5
df = pd.DataFrame(data5,columns =["State","Customer_Count"])
df = df.sort_values(by = "Customer_Count",ascending=False)


plt.figure(figsize = (9,4))
plt.bar(df["State"],df["Customer_Count"])
plt.xticks(rotation = 90)
plt.title('Count Of Customer for Each State')
plt.show()
```



Calculate the number of orders per month in 2018.

```
query = """
        select monthname(order_purchase_timestamp)
months,count(order_id) order_count
        from orders where year(order_purchase_timestamp) = 2018
        group by months
        """
cur.execute(query)
data6 = cur.fetchall()
df = pd.DataFrame(data6,columns=["months","order_count"])
o =
["January" ,"February","March","April","May","June","July","August","S
eptember","October","November","December"]

plt.figure(figsize=[9,4])
ax = sns.barplot(x = df["months"],y = df["order_count"],data =
df,order = o)
plt.xticks(rotation=60)
ax.bar_label(ax.containers[0])
plt.title("Count of order by months is 2018")
plt.show()
```



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

```
query = """
          with count_per_order as (
          select
orders.order_id,orders.customer_id,count(orders_items.order_id) as
order_count
          from orders join orders_items
          on orders.order_id = orders_items.order_id
          group by orders.order_id,orders.customer_id)

          select customers.customer_city,
round(avg(count_per_order.order_count),2)average_orders
          from customers join count_per_order
          on customers.customer_id = count_per_order.customer_id
          group by customers.customer_city order by average_orders desc
        """

cur.execute(query)
data7 = cur.fetchall()
df = pd.DataFrame(data7,columns=["Customer_city","Average"])
df
# plt.bar(df["Customer_city"],df["Average"])
```

```
             Customer_city Average
0           padre carvalho    7.00
1              celso ramos    6.50
```

```
2             candido godoi    6.00
3                     datas    6.00
4            matias olimpio    5.00
...                     ...     ...
4105         sebastiao leal    1.00
4106  morro agudo de goias    1.00
4107        santa filomena    1.00
4108             guamiranga    1.00
4109          padre paraiso    1.00

[4110 rows x 2 columns]
```

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

```
query = """
        select upper(products.product_category) category,
        round((sum(payments.payment_value)/(select
sum(payment_value)from payments))*100,2)as sales
        from products join orders_items
        on products.product_id = orders_items.product_id
        join payments
        on payments.order_id = orders_items.order_id
        group by category order by sales desc
"""
cur.execute(query)
data8 = cur.fetchall()
df = pd.DataFrame(data8,columns=["Category","Sales"])
df

                       Category  Sales
0                BED TABLE BATH  10.70
1                 HEALTH BEAUTY  10.35
2          COMPUTER ACCESSORIES   9.90
3          FURNITURE DECORATION   8.93
4               WATCHES PRESENT   8.93
..                          ...    ...
69               HOUSE COMFORT 2   0.01
70                CDS MUSIC DVDS   0.01
71                      PC GAMER   0.01
72  FASHION CHILDREN'S CLOTHING   0.00
73       INSURANCE AND SERVICES   0.00

[74 rows x 2 columns]
```

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

```
query = """
       select products.product_category,
       count(orders_items.product_id),
       round(avg(orders_items.price),2)
       from products join orders_items
       on products.product_id = orders_items.product_id
       group by products.product_category
       """

cur.execute(query)
data9 = cur.fetchall()
df = pd.DataFrame(data9,columns=["Category","Order_count","Price"])
df
```

```
                               Category  Order_count   Price
0                         HEALTH BEAUTY         9670  130.16
1                         sport leisure         8641  114.34
2                            Cool Stuff         3796  167.36
3                  computer accessories         7827  116.51
4                       Watches present         5991  201.14
..                                  ...          ...     ...
69                              flowers           33   33.64
70  Kitchen portable and food coach           15  264.57
71                      House Comfort 2           30   25.34
72          CITTE AND UPHACK FURNITURE           38  114.95
73                       cds music dvds           14   52.14

[74 rows x 3 columns]
```

```
query = """
        select * ,dense_rank() over (order by revenue desc) as rn from

        (select orders_items.seller_id,sum(payments.payment_value)
        revenue from orders_items join payments
        on orders_items.order_id = payments.order_id
        group by orders_items.seller_id)as a
       """

cur.execute(query)
data10 = cur.fetchall()
df = pd.DataFrame(data10,columns = ["Seller_id","Revenue","Rank"])
df
```

```
                          Seller_id        Revenue  Rank
0  7c67e1448b00f6e969d365cea6b010ab  507166.907302     1
1  1025f0e2d44d7041d6cf58b6550e0bfa  308222.039840     2
2  4a3ca9315b744ce9f8e9374361493884  301245.269765     3
3  1f50f920176fa81dab994f9023523100  290253.420128     4
```

```
4     53243585a1d6dc2643021fd1853d8905  284903.080498     5
...                                ...            ...   ...
3090  ad14615bdd492b01b0d97922e87cb87f      19.209999  3082
3091  702835e4b785b67a084280efca355756      18.559999  3083
3092  4965a7002cca77301c82d3f91b82e1a9      16.360001  3084
3093  77128dec4bec4878c37ab7d6169d6f26      15.220000  3085
3094  cf6f6bc4df3999b9c6440f124fb2f687      12.220000  3086

[3095 rows x 3 columns]
```

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

```
query = """
        select customer_id,order_purchase_timestamp,payment,
        avg(payment) over (partition by customer_id order by
order_purchase_timestamp
        rows between 2 preceding and current row)as mov_avg
        from
        (select orders.customer_id,orders.order_purchase_timestamp,
        payments.payment_value as payment
        from payments join orders
        on payments.order_id = orders.order_id)as a
        """

cur.execute(query)
data11 = cur.fetchall()
df = pd.DataFrame(data11,columns =
["Customer_id","Purchase_timestamp","Payments","Moving_avg"])
df

                             Customer_id   Purchase_timestamp
Payments  \
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
...                                  ...                  ...        ..
.
103881  fffecc9f79fd8c764f843e9951b11341  2018-03-29 16:59:26
71.23
103882  fffeda5b6d849fbd39689bb92087f431  2018-05-22 13:36:02
63.13
```

```
103883  ffff42319e9b2d713724ae527742af25  2018-06-13 16:57:05
214.13
103884  ffffa3172527f765de70084a7e53aae8  2017-09-02 11:53:32
45.50
103885  ffffe8b65bbe3087b653a978c870db99  2017-09-29 14:07:03
18.37

        Moving_avg
0       114.739998
1        67.410004
2       195.419998
3       179.350006
4       107.010002
...            ...
103881   27.120001
103882   63.130001
103883  214.130005
103884   45.500000
103885   18.370001

[103886 rows x 4 columns]
```

Calculate the cumulative sales per month for each year.

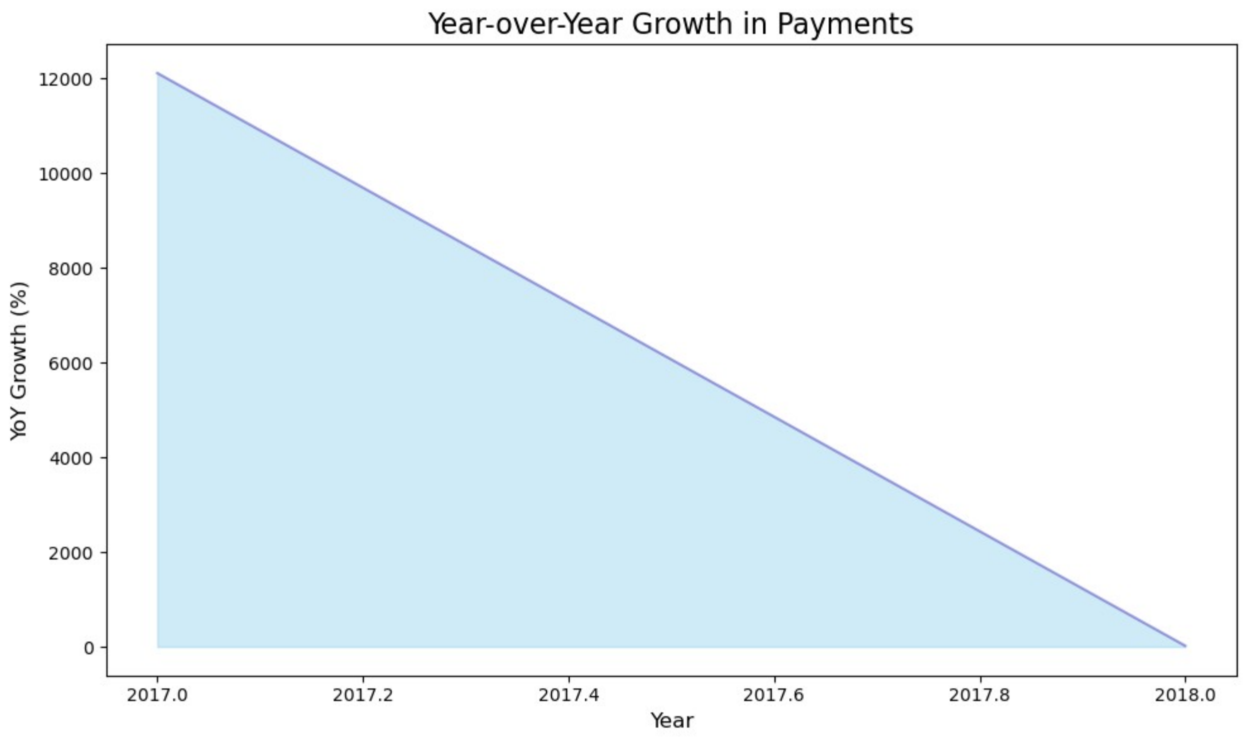
```
query ="""
        select years,months,payment,sum(payment)
        over(order by years,months) cumulative_sales from
        (select year(orders.order_purchase_timestamp)as years,
        month(orders.order_purchase_timestamp)as months,
        round(sum(payments.payment_value),2)as payment from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

cur.execute(query)
data12 = cur.fetchall()
df = pd.DataFrame(data12,columns =
["Years","Months","Payments","Cumulative_sales"])
df

    Years  Months   Payments  Cumulative_sales
0    2016       9     252.24            252.24
1    2016      10   59090.48          59342.72
2    2016      12      19.62          59362.34
3    2017       1  138488.04         197850.38
4    2017       2  291908.01         489758.39
5    2017       3  449863.60         939621.99
6    2017       4  417788.03        1357410.02
7    2017       5  592918.82        1950328.84
```

```
8    2017       6   511276.38        2461605.22
9    2017       7   592382.92        3053988.14
10   2017       8   674396.32        3728384.46
11   2017       9   727762.45        4456146.91
12   2017      10   779677.88        5235824.79
13   2017      11  1194882.80        6430707.59
14   2017      12   878401.48        7309109.07
15   2018       1  1115004.18        8424113.25
16   2018       2   992463.34        9416576.59
17   2018       3  1159652.12       10576228.71
18   2018       4  1160785.48       11737014.19
19   2018       5  1153982.15       12890996.34
20   2018       6  1023880.50       13914876.84
21   2018       7  1066540.75       14981417.59
22   2018       8  1022425.32       16003842.91
23   2018       9     4439.54       16008282.45
24   2018      10      589.67       16008872.12
```

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)
data13 = cur.fetchall()
df = pd.DataFrame(data13,columns = ["Years","Yoy%growth"])




# Create an area plot
plt.figure(figsize=(10, 6))
plt.fill_between(df['Years'], df['Yoy%growth'], color='skyblue',
alpha=0.4)
plt.plot(df['Years'], df['Yoy%growth'], color='Slateblue', alpha=0.6)

# Set title and labels
plt.title('Year-over-Year Growth in Payments', fontsize=16)
plt.xlabel('Year', fontsize=12)
plt.ylabel('YoY Growth (%)', fontsize=12)
```

```
# Show the plot
plt.tight_layout()
plt.show()
```

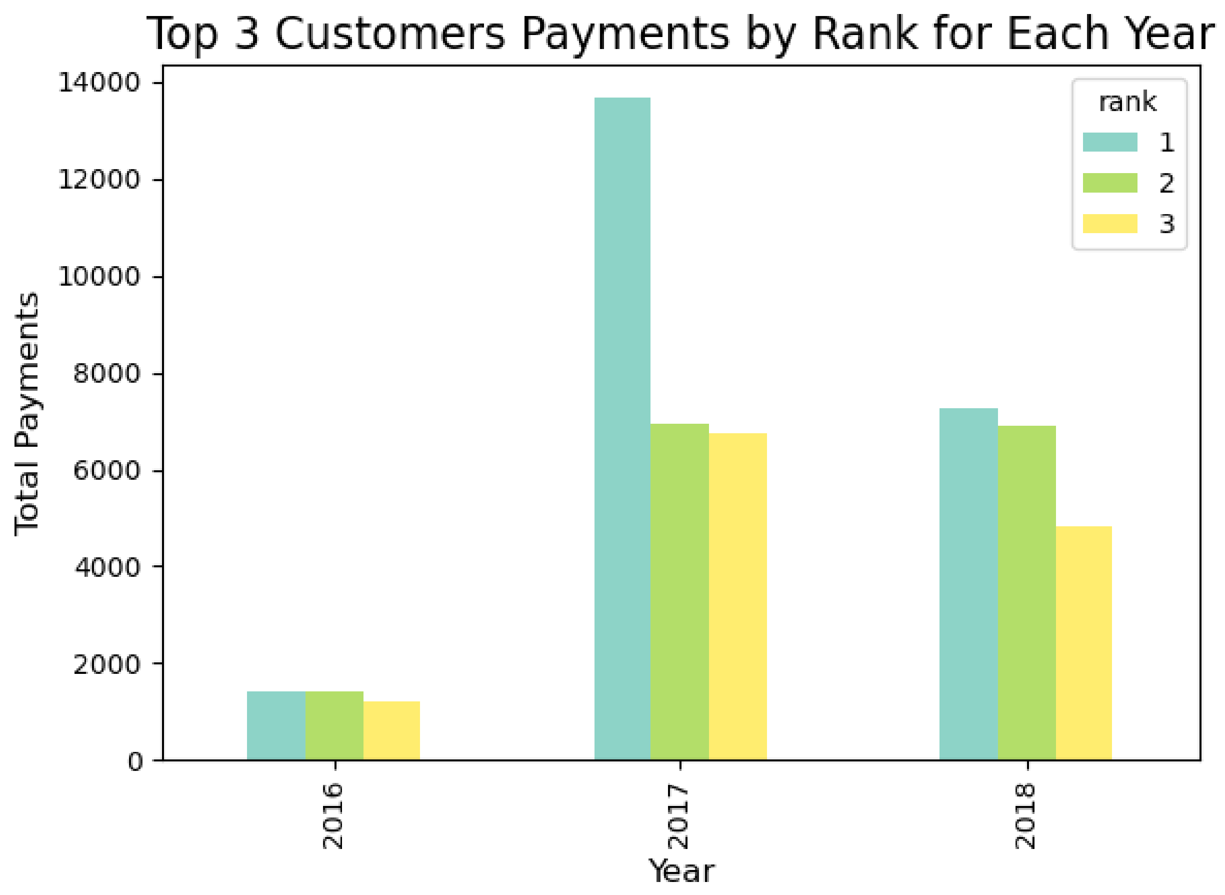


Calculate the retention rate of customers, defined as the percentage of customers who make another purchase within 6 months of their first purchase.

```
query = """
       with a as(select customers.customer_id,
       min(orders.order_purchase_timestamp)first_order
       from customers join orders
       on customers.customer_id = orders.customer_id
       group by customers.customer_id),

       b as (select a.customer_id,
       count(distinct orders.order_purchase_timestamp) next_order
       from a join orders
       on orders.customer_id = a.customer_id
       and orders.order_purchase_timestamp > first_order
       and orders.order_purchase_timestamp <
       date_add(first_order,interval 6 month)
       group by a.customer_id)

       select 100 * (count(distinct a.customer_id)/count(distinct
b.customer_id))
       from a left join b
       on a.customer_id = b.customer_id
        """

cur.execute(query)
data14 = cur.fetchall()
data14

[(None,)]
```

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

```
query = """
        select years,customer_id,payment,d_rank
        from
        (select year(orders.order_purchase_timestamp) years,
        orders.customer_id,
        sum(payments.payment_value) payment,
        dense_rank() over (partition by
year(orders.order_purchase_timestamp)
        order by sum(payments.payment_value)desc)d_rank
        from orders join payments
        on payments.order_id = orders.order_id
        group by year(orders.order_purchase_timestamp),
        orders.customer_id) as a
        where d_rank <= 3
        """

cur.execute(query)
data15 = cur.fetchall()
df = pd.DataFrame(data15,columns=["Years","Id","Payments","rank"])


df_pivot = df.pivot_table(index='Years', columns='rank',
values='Payments', aggfunc='sum')

# Create a grouped bar plot
plt.figure(figsize=(12, 6))
df_pivot.plot(kind='bar', stacked=False, colormap='Set3')

# Set title and labels
plt.title('Top 3 Customers Payments by Rank for Each Year',
fontsize=16)
plt.xlabel('Year', fontsize=12)
plt.ylabel('Total Payments', fontsize=12)

# Show the plot
plt.tight_layout()
plt.show()


<Figure size 1200x600 with 0 Axes>
```


Top 3 Customers Payments by Rank for Each Year
Total Payments
14000
12000
10000
8000
6000
4000
2000
0
2016
2017
2018
Year
rank
1
2
3