```python
import pandas as pd
import mysql.connector
import matplotlib.pyplot as plt
import seaborn as sns
import os
import numpy as np

conn = mysql.connector.connect(host = "localhost",
                               username = "root",
                              password = "Jaishreeram",
                              database = "ecommerce" )
cur = conn.cursor()
```

All unique cities where customers are located.

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

cur.execute(query)

dt = cur.fetchall()
df = pd.DataFrame(dt, columns = ["city"])
df
```

```
                          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]
```

Number of orders placed in 2017.

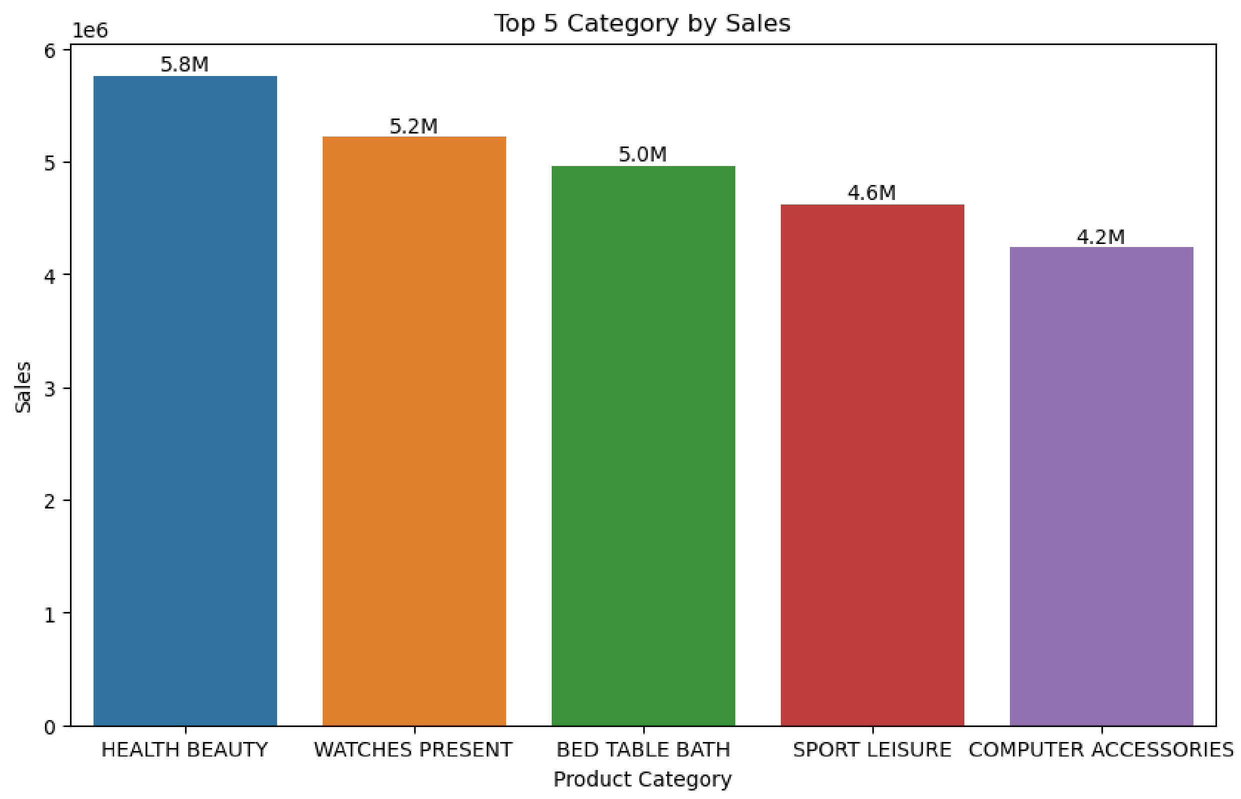
```python
query = """select count(order_id)
           from orders
           where year(order_purchase_timestamp) = 2017 """

cur.execute(query)

dt = cur.fetchall()

dt[0][0]
```

```
90202
```

Total sales per category.

```
query = """select upper(p.product_category), round(sum(oi.price +
oi.freight_value),2) as total_sales
           from order_items as oi
           join products as p
           on oi.product_id = p.product_id
           group by p.product_category
           order by total_sales desc"""

cur.execute(query)

dt = cur.fetchall()

df = pd.DataFrame(dt, columns = ["Product Category" , "Sales"])
df

              Product Category       Sales
0                HEALTH BEAUTY  5764992.28
1              WATCHES PRESENT  5222166.43
2               BED TABLE BATH  4966726.88
3                SPORT LEISURE  4626625.92
4         COMPUTER ACCESSORIES  4237089.59
..                         ...         ...
69                     FLOWERS     6395.64
70              HOUSE COMFORT 2    4682.32
71               CDS MUSIC DVDS    3819.96
72   FASHION CHILDREN'S CLOTHING     2661.44
73       INSURANCE AND SERVICES     1298.04

[74 rows x 2 columns]

# Visualization of top 5 product category

fd = df.head(5)

plt.figure(figsize = (10,6))
xa = sns.barplot(x = 'Product Category', y = 'Sales', data = fd )
plt.title("Top 5 Category by Sales")

def formated_num(number):
    if number >= 1e6:
        return f'{number / 1e6:.1f}M'
    if number >= 1e3:
        return f'{number / 1e3:.1f}k'
    else :
        return str(number)
```

```
for bars in xa.containers:
    xa.bar_label(bars, labels = [formated_num(label) for label in
bars.datavalues])
```



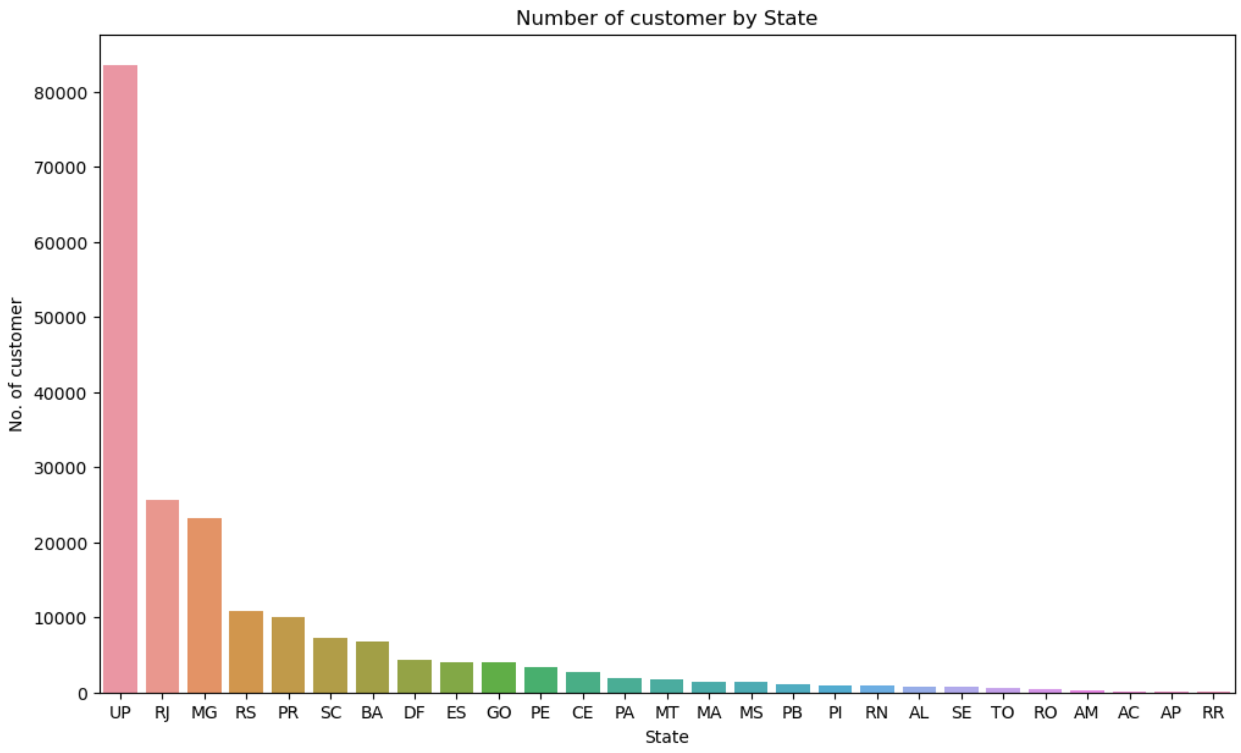
Percentage of orders that were paid in installments.

```
query = """select (select count(order_id) from payments where
payment_installments >= 1)/ count(order_id) * 100
           from payments"""

cur.execute(query)

dt = cur.fetchall()
dt

[(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)
```

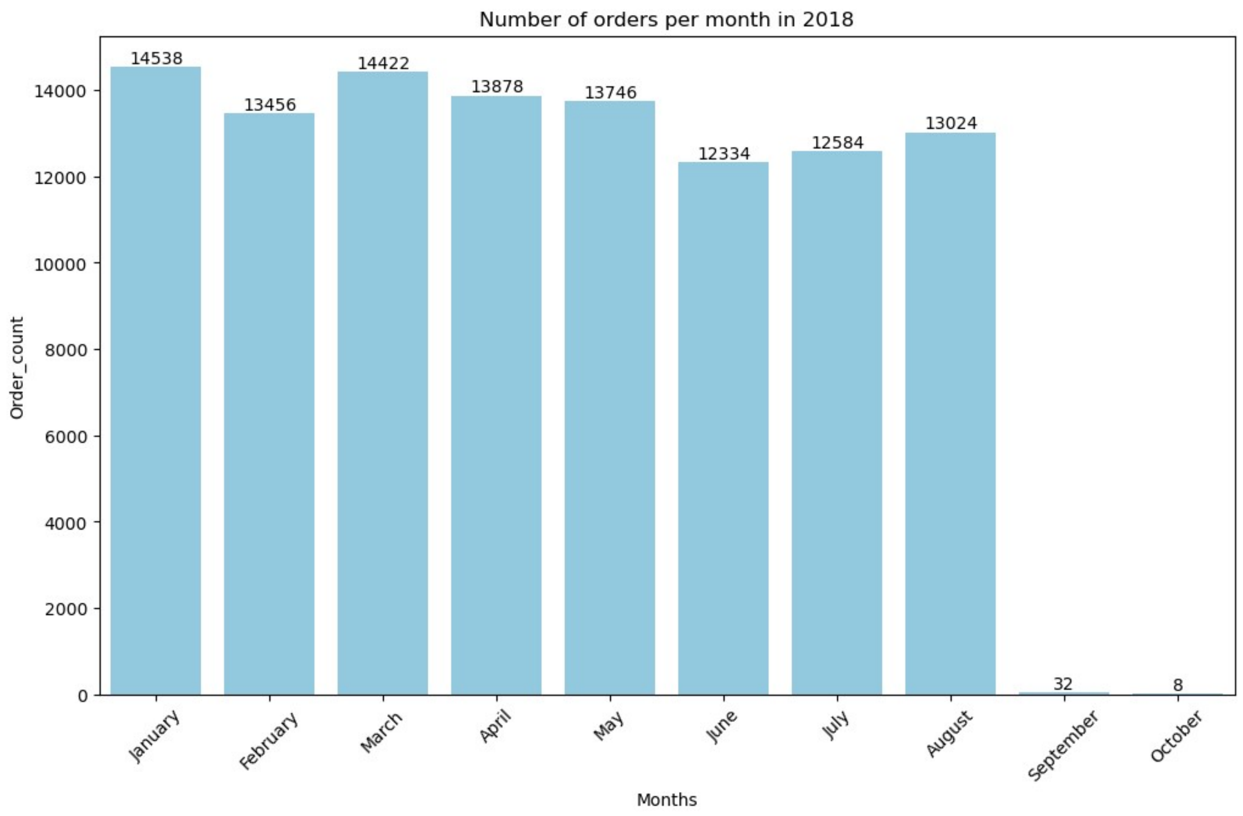
```
dt = cur.fetchall()
df = pd.DataFrame(dt, columns = ["State","No. of customer"])
df = df.sort_values(by = "No. of customer", ascending = False )

plt.figure(figsize = (12,7))
sns.barplot(x = "State", y = "No. of customer", data = df )
plt.title("Number of customer by State")

Text(0.5, 1.0, 'Number of customer by State')
```



Number of orders per month in 2018.

```
query = """select monthname(order_purchase_timestamp) as Months ,
count(order_id) as Number_of_order
from orders where year(order_purchase_timestamp) = 2018
group by Months
order by Months"""

cur.execute(query)

dt = cur.fetchall()

df = pd.DataFrame(dt, columns = ["Months","Order_count"])
df
```

```
      Months  Order_count
0      April        13878
1     August        13024
2   February        13456
3    January        14538
4       July        12584
5       June        12334
6      March        14422
7        May        13746
8    October            8
9  September           32

od = ["January", "February", "March",  "April", "May", "June", "July",
"August", "September", "October"]

plt.figure(figsize = (12,7))
ax = sns.barplot(x = "Months", y = "Order_count", data = df, order =
od, color = "skyblue")
plt.xticks(rotation = 45)
ax.bar_label(ax.containers[0])
plt.title("Number of orders per month in 2018")
plt.show()
```



Average number of products per order, grouped by customer city

```
query = """SELECT
    customers.customer_city,
    ROUND(AVG(order_count.oc), 2) AS average_od
FROM
    customers
        JOIN
    (SELECT
        orders.order_id,
            orders.customer_id,
            COUNT(order_items.order_item_id) AS oc
    FROM
        orders
    JOIN order_items ON orders.order_id = order_items.order_id
    GROUP BY orders.order_id , orders.customer_id) AS order_count ON
customers.customer_id = order_count.customer_id
GROUP BY customers.customer_city
order by average_od desc"""

cur.execute(query)

dt = cur.fetchall()
df = pd.DataFrame(dt, columns = ["City","Avg_order"])
df

                City Avg_order
0     padre carvalho     28.00
1        celso ramos     26.00
2              datas     24.00
3      candido godoi     24.00
4     matias olimpio     20.00
...              ...       ...
4105          tuiuti      4.00
4106  aurora do para      4.00
4107    nova america      4.00
4108    tibau do sul      4.00
4109  lagoa da canoa      4.00

[4110 rows x 2 columns]
```

Percentage of total revenue contributed by each product category

```
query = """select p.product_category,
round((sum(oi.price + oi.freight_value) / (select sum(price) +
sum(freight_value) from order_items)) *100,2) as
percentage_of_total_revenue
from order_items as oi
join products as p
on oi.product_id = p.product_id
group by p.product_category
```

```
order by percentage_of_total_revenue desc"""

cur.execute(query)

dt = cur.fetchall()
df = pd.DataFrame(dt, columns =
["Category","Percentage_contribution"])
df

                       Category  Percentage_contribution
0                HEALTH BEAUTY                     18.19
1              Watches present                     16.48
2               bed table bath                     15.67
3                sport leisure                     14.60
4         computer accessories                     13.37
..                          ...                      ...
69                     flowers                      0.02
70  Fashion Children's Clothing                     0.01
71              House Comfort 2                     0.01
72              cds music dvds                      0.01
73       insurance and services                     0.00

[74 rows x 2 columns]
```

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

```
query = """select pd.product_category, count(od.product_id) as
order_count,
round(avg(od.price),2) as avg_price
from products as pd join order_items as od
on pd.product_id = od.product_id
group by pd.product_category"""

cur.execute(query)

dt = cur.fetchall()
df = pd.DataFrame(dt, columns =
["Category","order_count","avg_price"])

arr1 = df["order_count"]
arr2 = df["avg_price"]

a = np.corrcoef([arr1,arr2])
print("Correlation between product price and the number of times a
product has been purchased is :",a)

Correlation between product price and the number of times a product
has been purchased is : [[ 1.         -0.10631514]
 [-0.10631514  1.        ]]
```

Total revenue generated by each seller, and rank them by revenue.

```
query = """select *, dense_rank() over(order by revenue_by_seller
desc) as Rankk from
(select oi.seller_id , sum(p.payment_value) as revenue_by_seller
from order_items as oi join payments as p
on oi.order_id = p.order_id
group by oi.seller_id) as sp;"""

cur.execute(query)

dt = cur.fetchall()
df = pd.DataFrame(dt, columns = ["seller_id","Revenue","Rank"])
print(df)
fd = df.head(5)
print(fd)
```

```
                             seller_id       Revenue  Rank
0     7c67e1448b00f6e969d365cea6b010ab  2.028668e+06     1
1     1025f0e2d44d7041d6cf58b6550e0bfa  1.232888e+06     2
2     4a3ca9315b744ce9f8e9374361493884  1.204981e+06     3
3     1f50f920176fa81dab994f9023523100  1.161014e+06     4
4     53243585a1d6dc2643021fd1853d8905  1.139612e+06     5
...                                ...           ...   ...
3090  ad14615bdd492b01b0d97922e87cb87f  7.684000e+01  3082
3091  702835e4b785b67a084280efca355756  7.424000e+01  3083
3092  4965a7002cca77301c82d3f91b82e1a9  6.544000e+01  3084
3093  77128dec4bec4878c37ab7d6169d6f26  6.088000e+01  3085
3094  cf6f6bc4df3999b9c6440f124fb2f687  4.888000e+01  3086

[3095 rows x 3 columns]
                          seller_id       Revenue  Rank
0  7c67e1448b00f6e969d365cea6b010ab  2.028668e+06     1
1  1025f0e2d44d7041d6cf58b6550e0bfa  1.232888e+06     2
2  4a3ca9315b744ce9f8e9374361493884  1.204981e+06     3
3  1f50f920176fa81dab994f9023523100  1.161014e+06     4
4  53243585a1d6dc2643021fd1853d8905  1.139612e+06     5
```

Moving average of order values for each customer over their order history.

```
query = """select *, round(avg(payments) over(partition by customer_id
order by order_purchase_timestamp
            rows between 2 preceding and current row),2) as moving_avg
from
(select od.customer_id, od.order_purchase_timestamp, p.payment_value
as Payments
from orders as od join payments as p
on od.order_id = p.order_id) as ma;"""

cur.execute(query)
```

```
dt = cur.fetchall()
df = pd.DataFrame(dt, columns =
["Customer_id","order_purchase_timestamp","payments","Moving
Average"])
df

                             Customer_id order_purchase_timestamp
payments  \
0       00012a2ce6f8dcda20d059ce98491703      2017-11-14 16:08:26
114.74
1       00012a2ce6f8dcda20d059ce98491703      2017-11-14 16:08:26
114.74
2       00012a2ce6f8dcda20d059ce98491703      2017-11-14 16:08:26
114.74
3       00012a2ce6f8dcda20d059ce98491703      2017-11-14 16:08:26
114.74
4       000161a058600d5901f007fab4c27140      2017-07-16 09:40:32
67.41
...                                  ...                      ...
...
415539  ffffa3172527f765de70084a7e53aae8      2017-09-02 11:53:32
45.50
415540  ffffe8b65bbe3087b653a978c870db99      2017-09-29 14:07:03
18.37
415541  ffffe8b65bbe3087b653a978c870db99      2017-09-29 14:07:03
18.37
415542  ffffe8b65bbe3087b653a978c870db99      2017-09-29 14:07:03
18.37
415543  ffffe8b65bbe3087b653a978c870db99      2017-09-29 14:07:03
18.37

        Moving Average
0               114.74
1               114.74
2               114.74
3               114.74
4                67.41
...                ...
415539           45.50
415540           18.37
415541           18.37
415542           18.37
415543           18.37

[415544 rows x 4 columns]
```

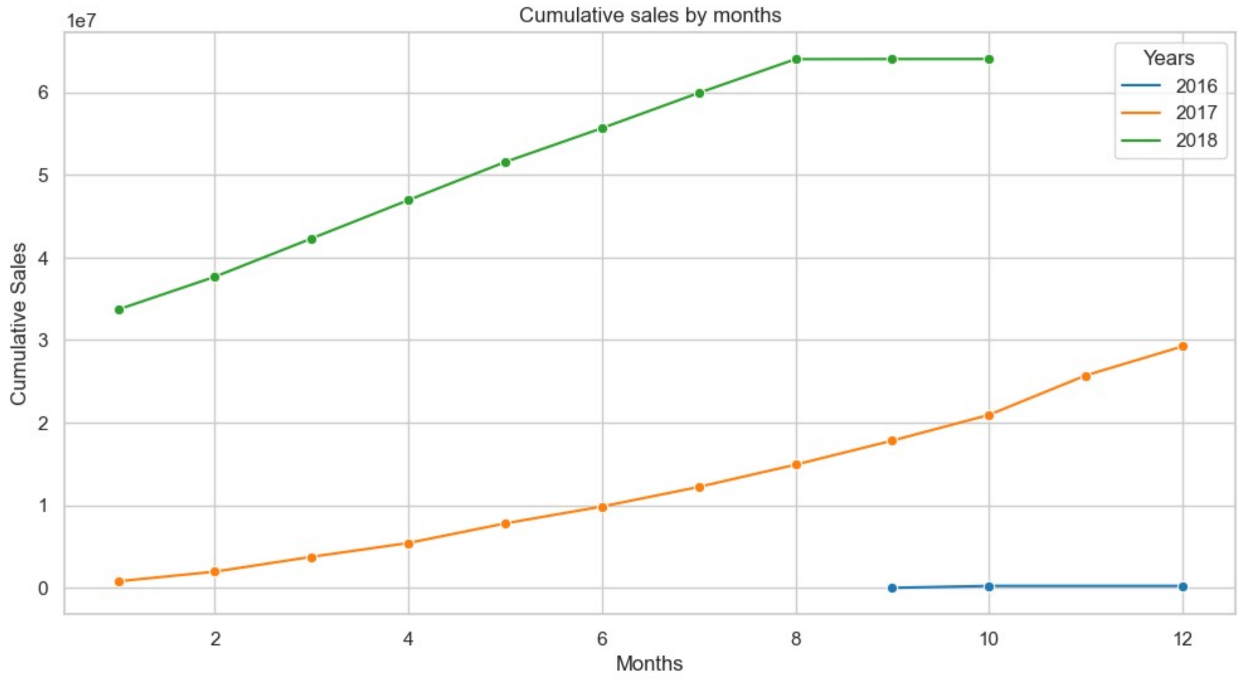
Cumulative sales per month for each year.

```
query = """select Years, Months, Sales,
round(sum(Sales) over(order by Years, Months),2) as Cumulative_sales
from
(select year(od.order_purchase_timestamp) as Years,
month(od.order_purchase_timestamp) as Months,
round(sum(p.payment_value),2) as Sales
from orders as od join payments as p
on od.order_id = p.order_id
group by Years,Months
order by Years,Months) as cu;"""

cur.execute(query)

dt = cur.fetchall()
df = pd.DataFrame(dt, columns = ["Years","Months","Sales","Cumulative
Sales"])
df
```

```
    Years  Months       Sales  Cumulative Sales
0    2016       9     1008.96           1008.96
1    2016      10   236361.92         237370.88
2    2016      12       78.48         237449.36
3    2017       1   553952.16         791401.52
4    2017       2  1167632.04        1959033.56
5    2017       3  1799454.40        3758487.96
6    2017       4  1671152.12        5429640.08
7    2017       5  2371675.28        7801315.36
8    2017       6  2045105.52        9846420.88
9    2017       7  2369531.68       12215952.56
10   2017       8  2697585.28       14913537.84
11   2017       9  2911049.80       17824587.64
12   2017      10  3118711.52       20943299.16
13   2017      11  4779531.20       25722830.36
14   2017      12  3513605.92       29236436.28
15   2018       1  4460016.72       33696453.00
16   2018       2  3969853.36       37666306.36
17   2018       3  4638608.48       42304914.84
18   2018       4  4643141.92       46948056.76
19   2018       5  4615928.60       51563985.36
20   2018       6  4095522.00       55659507.36
21   2018       7  4266163.00       59925670.36
22   2018       8  4089701.29       64015371.65
23   2018       9    17758.16       64033129.81
24   2018      10     2358.68       64035488.49
```

```
plt.figure(figsize = (12,6))
sns.set(style = 'whitegrid')
sns.lineplot(x = 'Months', y = 'Cumulative Sales', hue = 'Years', data
= df, marker = "o", palette = "tab10", legend = "full")
```

```
plt.title("Cumulative sales by months")
plt.show()
```



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

```
query = """with year_sales as (select
year(od.order_purchase_timestamp) as Years,
round(sum(p.payment_value),2) as Sales
from orders as od join payments as p
on od.order_id = p.order_id
group by Years
order by Years)

select years, Sales, lag(Sales, 1) over(order by Years) as
previous_year_sales,
round((Sales - lag(Sales, 1) over(order by Years))/lag(Sales, 1)
over(order by Years) * 100,2) as yoy_growth_Percent
from year_sales"""

cur.execute(query)
dt = cur.fetchall()
df = pd.DataFrame(dt, columns = ["Year","Sales","Previous year
sale","yoy Growth %"])
df

   Year        Sales  Previous year sale  yoy Growth %
0  2016    237449.36                 NaN           NaN
```

```
1  2017  28998986.91           237449.36       12112.7
2  2018  34799052.21         28998986.91          20.0
```

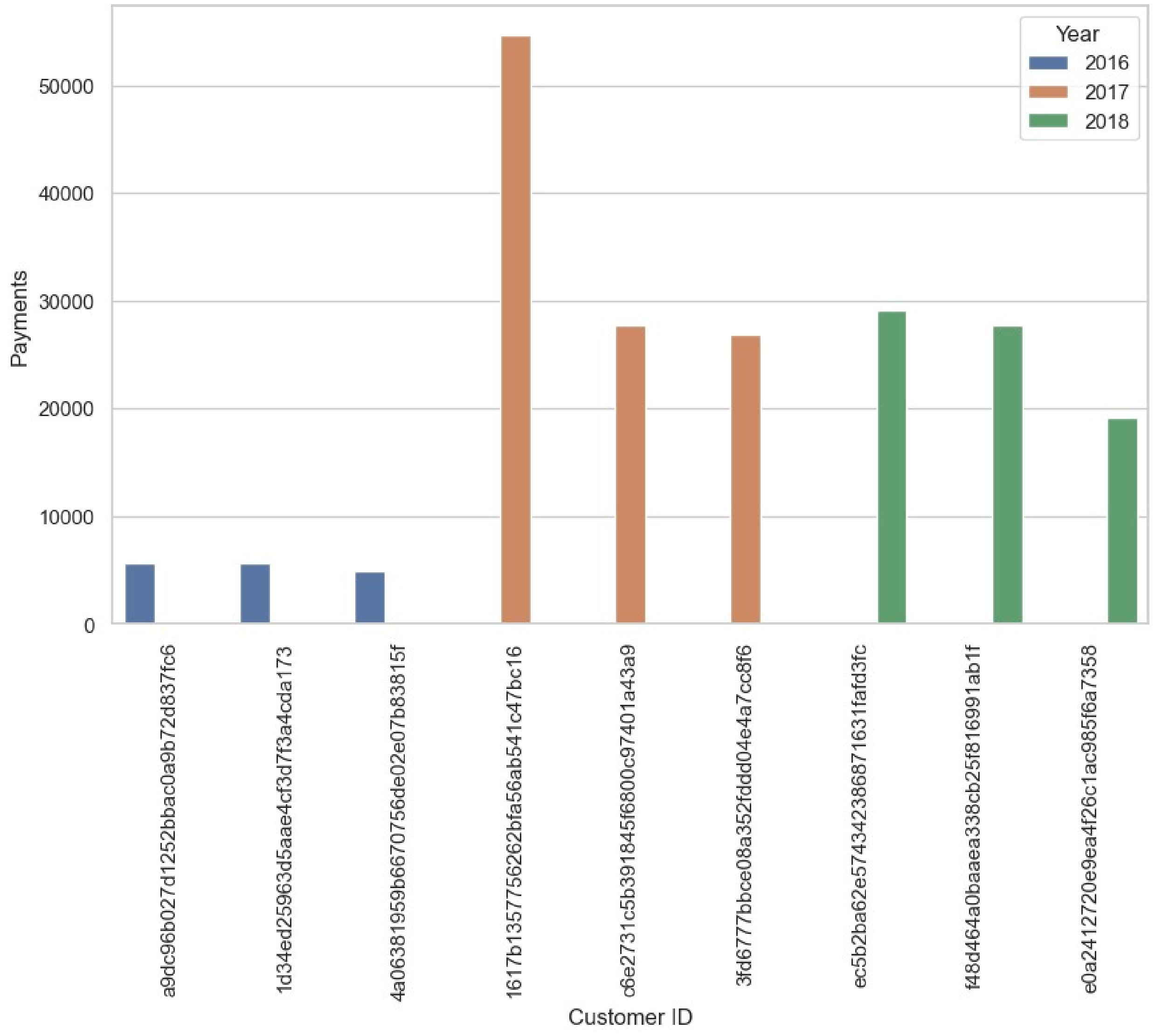
Calculate the retention rate of customers, defined as the percentage of customers who make another purchase within 6 months of their first purchase.

```
query = """with fo as (select customer_id,
min(order_purchase_timestamp) as first_order
from orders
group by customer_id),
co as (select fo.customer_id,
count(distinct(od.order_purchase_timestamp)) as count_of_order
from fo join orders as od
on fo.customer_id = od.customer_id
and od.order_purchase_timestamp > first_order
and od.order_purchase_timestamp < date_add(first_order, interval 6
month)
group by fo.customer_id)

select (count(co.customer_id) / count(fo.customer_id))*100 as
Retentaion_rate
from fo join co
on fo.customer_id = co.customer_id"""

cur.execute(query)
dt = cur.fetchall()
df = pd.DataFrame(dt, columns = ["Retention_rate"])
df

# Since none of our customers buys again with us in 6 months so we
have no Retention rate

  Retention_rate
0           None
```

Top 3 customers who spent the most money in each year.

```
query = """select * from
(select year(od.order_purchase_timestamp) as Years, od.customer_id,
sum(p.payment_value) as payment,
dense_rank() over(partition by year(od.order_purchase_timestamp) order
by sum(p.payment_value) desc) as Rankk
from orders as od join payments as p
on od.order_id = p.order_id
group by year(od.order_purchase_timestamp), od.customer_id) as rn
where Rankk <= 3"""

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

```
df = pd.DataFrame(dt, columns = ["Year","Customer
ID","Payments","Rank"])
plt.figure(figsize = (10,6))
sns.barplot(x = "Customer ID", y = "Payments",hue = "Year",data = df )
plt.xticks(rotation = 90)
plt.show()
```


Year
Payments
a9dc96b027d1252bbac0a9b72d837fc6
1d34ed25963d5aae4cf3d7f3a4cda173
4a06381959b6670756de02e07b83815f
1617b1357756262bfa56ab541c47bc16
c6e2731c5b391845f6800c97401a43a9
3fd6777bbce08a352fddd04e4a7cc8f6
ec5b2ba62e574342386871631fafd3fc
f48d464a0baaea338cb25f816991ab1f
e0a2412720e9ea4f26c1ac985f6a7358
Customer ID