In [16]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import mysql.connector
```

In [3]:
```
db = mysql.connector.connect(
    host='127.0.0.1',
    user='root',
    password='Wildcard@097',
    database='ecommerce'
)
cur = db.cursor()
```

In [5]:
```
query = """
select
      distinct customer_city
from
      customers
"""

cur.execute(query)

data = cur.fetchall()

df = pd.DataFrame(data)
df.head()
```

Out[5]:

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

Count the number of orders placed in 2017.

In [7]:
```
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]
```

```
Out[7]: ('total orders placed in 2017 are', 90202)
```

Find the total sales per category.

```
In [8]: query = """
        SELECT Upper(products.product_category)      AS category,
               Round(Sum(payments.payment_value), 2) AS sales
        FROM   products
               JOIN order_items
                 ON products.product_id = order_items.product_id
               JOIN payments
                 ON payments.order_id = order_items.order_id
        GROUP  BY category
        """

        cur.execute(query)

        data = cur.fetchall()

        df = pd.DataFrame(data, columns = ["Category", "Sales"])
        df
```

Out[8]:

	Category	Sales
0	PERFUMERY	4053909.28
1	FURNITURE DECORATION	11441411.13
2	TELEPHONY	3895056.41
3	FASHION BAGS AND ACCESSORIES	1745266.24
4	BED TABLE BATH	13700429.37
...	...	...
69	CDS MUSIC DVDS	9595.44
70	LA CUISINE	23308.24
71	FASHION CHILDREN'S CLOTHING	6285.36
72	PC GAMER	17395.44
73	INSURANCE AND SERVICES	2596.08

74 rows × 2 columns

Calculate the percentage of orders that were paid in installments.

```
In [9]: query = """
        SELECT ( ( Sum(CASE
                         WHEN payment_installments >= 1 THEN 1
                         ELSE 0
                       END) ) / Count(*) ) * 100
```

```
FROM   payments
"""

cur.execute(query)

data = cur.fetchall()

"the percentage of orders that were paid in installments is", data[0][0]
```

```
Out[9]:  ('the percentage of orders that were paid in installments is',
          Decimal('99.9981'))
```

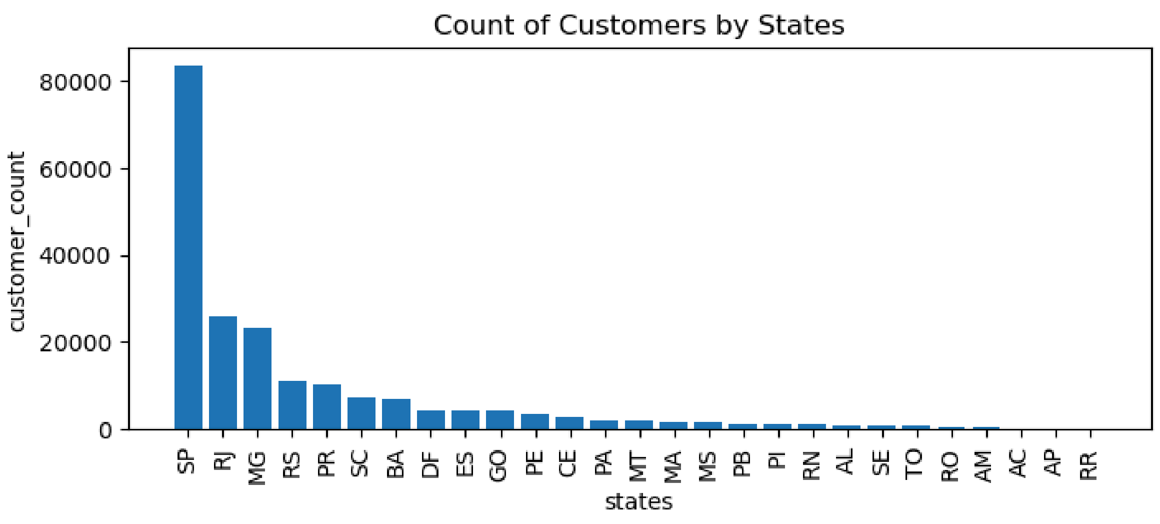
Count the number of customers from each state.

```
In [10]: 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 = (8,3))
plt.bar(df["state"], df["customer_count"])
plt.xticks(rotation = 90)
plt.xlabel("states")
plt.ylabel("customer_count")
plt.title("Count of Customers by States")
plt.show()
```



Calculate the number of orders per month in 2018.

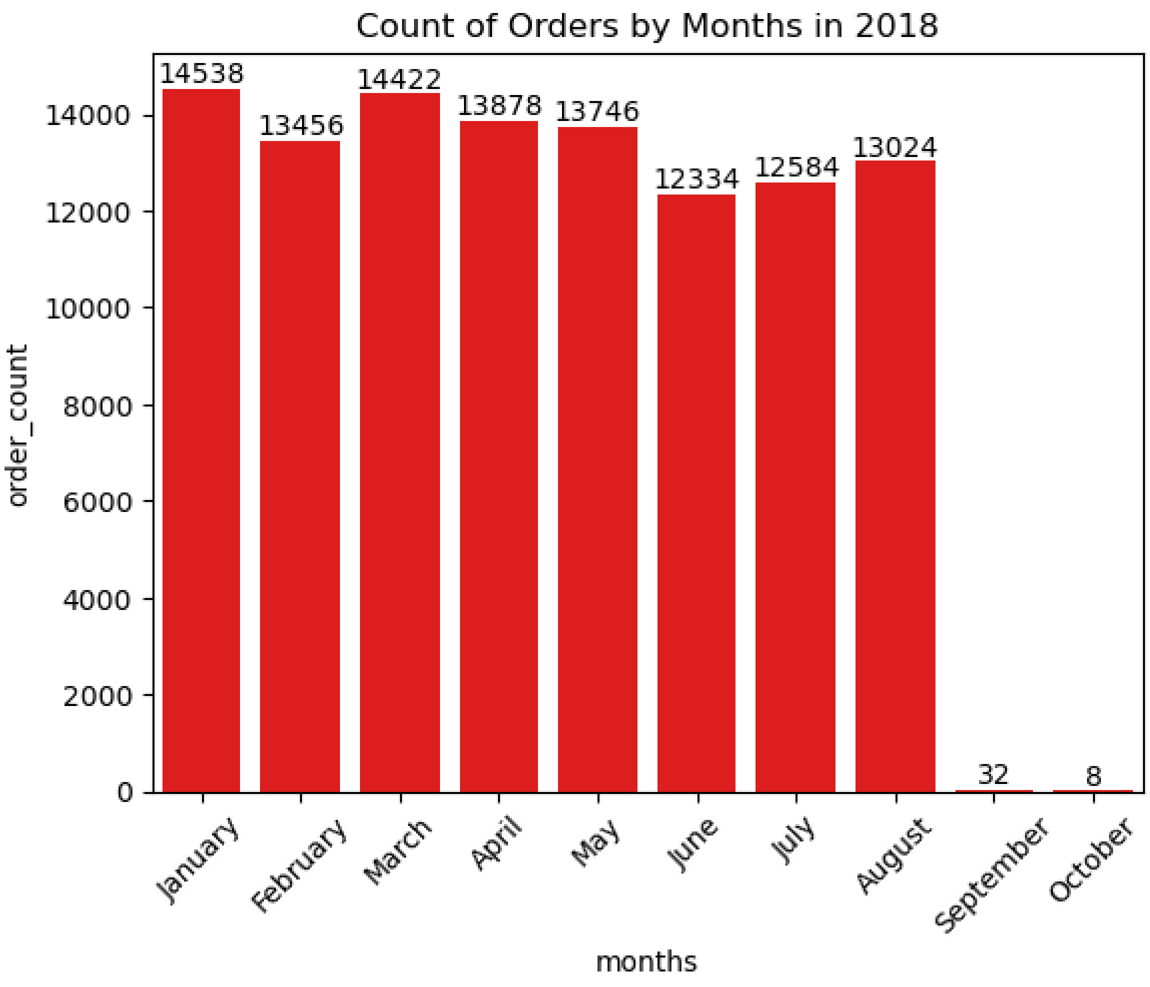
In [12]:
```
query = """
SELECT Monthname(order_purchase_timestamp) months,
       Count(order_id)                     order_count
FROM   orders
WHERE  Year(order_purchase_timestamp) = 2018
GROUP  BY months
"""

cur.execute(query)

data = cur.fetchall()
df = pd.DataFrame(data, columns = ["months", "order_count"])
o = ["January", "February","March","April","May","June","July","August","Septemb

ax = sns.barplot(x = df["months"],y =  df["order_count"], data = df, order = o,
plt.xticks(rotation = 45)
ax.bar_label(ax.containers[0])
plt.title("Count of Orders by Months in 2018")

plt.show()
```



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

In [13]:
```
query = """
WITH count_per_order
```

```
     AS (SELECT orders.order_id,
                orders.customer_id,
                Count(order_items.order_id) AS oc
         FROM   orders
                JOIN order_items
                  ON orders.order_id = order_items.order_id
         GROUP  BY orders.order_id,
                   orders.customer_id)
SELECT customers.customer_city,
       Round(Avg(count_per_order.oc), 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)

data = cur.fetchall()
df = pd.DataFrame(data,columns = ["customer city", "average products/order"])
df.head(10)
```

Out[13]:

	customer city	average products/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
5	cidelandia	16.00
6	curralinho	16.00
7	picarra	16.00
8	morro de sao paulo	16.00
9	teixeira soares	16.00

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

In [14]:
```
query = """
SELECT Upper(products.product_category) category,
       Round(( Sum(payments.payment_value) / (SELECT Sum(payment_value)
                                              FROM   payments) ) * 100, 2)
                                        sales_percentage
FROM   products
       JOIN order_items
         ON products.product_id = order_items.product_id
       JOIN payments
         ON payments.order_id = order_items.order_id
```

```
GROUP  BY category
ORDER  BY sales_percentage DESC
"""


cur.execute(query)
data = cur.fetchall()
df = pd.DataFrame(data,columns = ["Category", "percentage distribution"])
df.head()
```

Out[14]:

	Category	percentage distribution
0	BED TABLE BATH	42.79
1	HEALTH BEAUTY	41.41
2	COMPUTER ACCESSORIES	39.61
3	FURNITURE DECORATION	35.73
4	WATCHES PRESENT	35.71

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

In [17]:

```
query = """
SELECT products.product_category,
       Count(order_items.product_id),
       Round(Avg(order_items.price), 2)
FROM   products
       JOIN order_items
         ON products.product_id = order_items.product_id
GROUP  BY products.product_category
"""

cur.execute(query)
data = cur.fetchall()
df = pd.DataFrame(data,columns = ["Category", "order_count","price"])

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

a = np.corrcoef([arr1,arr2])
print("the correlation is", a[0][-1])
```

```
the correlation is -0.10631514167157562
```

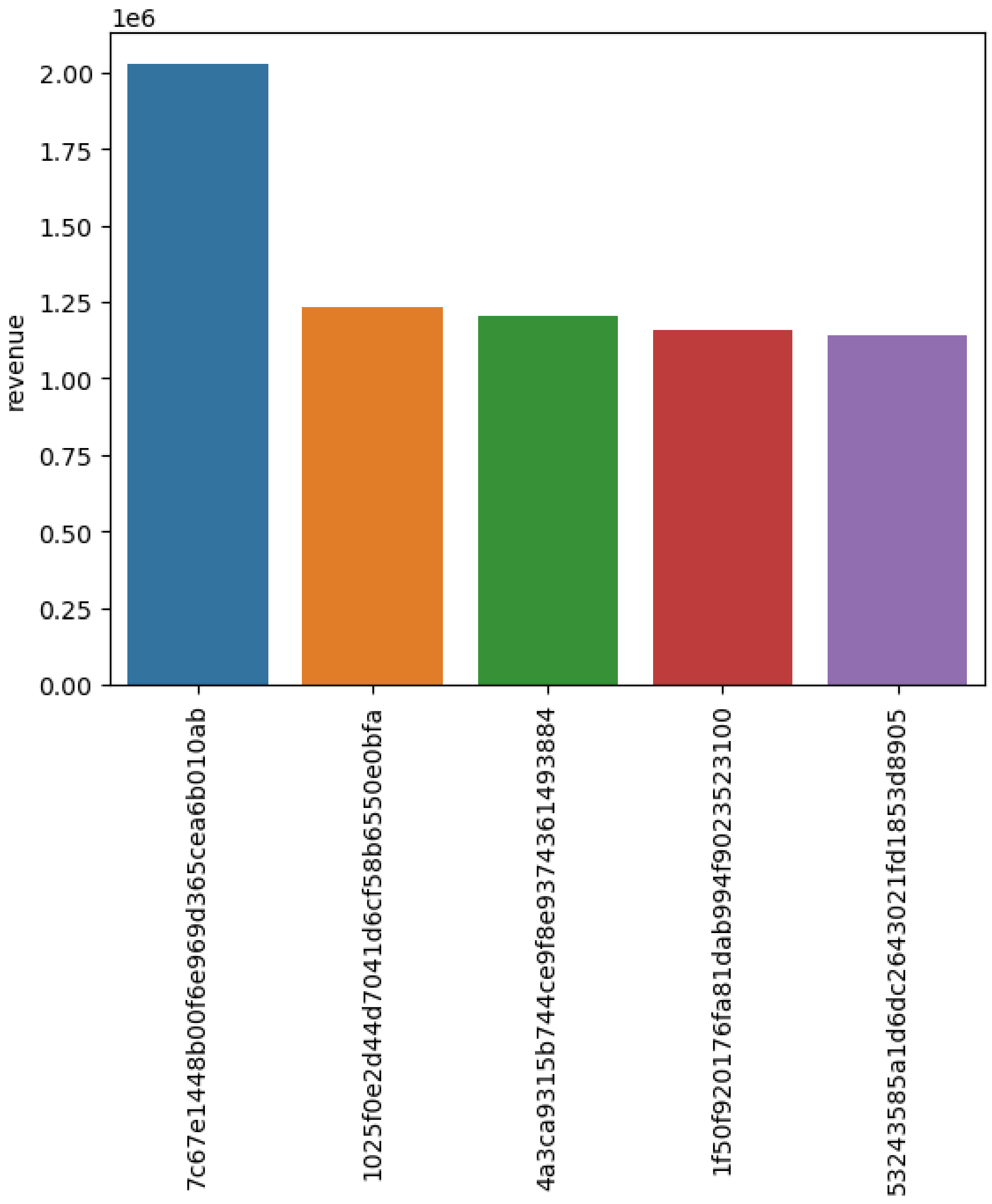
Calculate the total revenue generated by each seller, and rank them by revenue.

In [18]:

```
query = """
SELECT *,
       Dense_rank()
```

```
         OVER(
           ORDER BY revenue DESC) AS rn
FROM   (SELECT order_items.seller_id,
               Sum(payments.payment_value) revenue
        FROM   order_items
               JOIN payments
                 ON order_items.order_id = payments.order_id
        GROUP  BY order_items.seller_id) AS a
"""

cur.execute(query)
data = cur.fetchall()
df = pd.DataFrame(data, columns = ["seller_id", "revenue", "rank"])
df = df.head()
sns.barplot(x = "seller_id", y = "revenue", data = df)
plt.xticks(rotation = 90)
plt.show()
```



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

```
In [20]: 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)
data = cur.fetchall()
df = pd.DataFrame(data, columns = ["customer_id", "order_time", "purchase", "mov
df
```

Out[20]:

	customer_id	order_time	purchase	moving-average
0	00012a2ce6f8dcda20d059ce98491703	2017-11-14 16:08:26	114.74	114.739998
1	00012a2ce6f8dcda20d059ce98491703	2017-11-14 16:08:26	114.74	114.739998
2	00012a2ce6f8dcda20d059ce98491703	2017-11-14 16:08:26	114.74	114.739998
3	00012a2ce6f8dcda20d059ce98491703	2017-11-14 16:08:26	114.74	114.739998
4	000161a058600d5901f007fab4c27140	2017-07-16 09:40:32	67.41	67.410004
...	...	...	...	...
415539	ffffa3172527f765de70084a7e53aae8	2017-09-02 11:53:32	45.50	45.500000
415540	ffffe8b65bbe3087b653a978c870db99	2017-09-29 14:07:03	18.37	18.370001
415541	ffffe8b65bbe3087b653a978c870db99	2017-09-29 14:07:03	18.37	18.370001
415542	ffffe8b65bbe3087b653a978c870db99	2017-09-29 14:07:03	18.37	18.370001
415543	ffffe8b65bbe3087b653a978c870db99	2017-09-29 14:07:03	18.37	18.370001

415544 rows × 4 columns

Calculate the cumulative sales per month for each year.

In [29]:
```
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)
data = cur.fetchall()
df = pd.DataFrame(data)
df
```

Out[29]:

	0	1	2	3
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

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

In [30]:

```
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
```

Out[30]:

	years	yoy % growth
0	2016	NaN
1	2017	12112.703757
2	2018	20.000924

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

In [31]:
```
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)
data = cur.fetchall()

data
```

Out[31]:
```
[(None,)]
```

As there are no customers who have bought products within 6 months, The value is null.

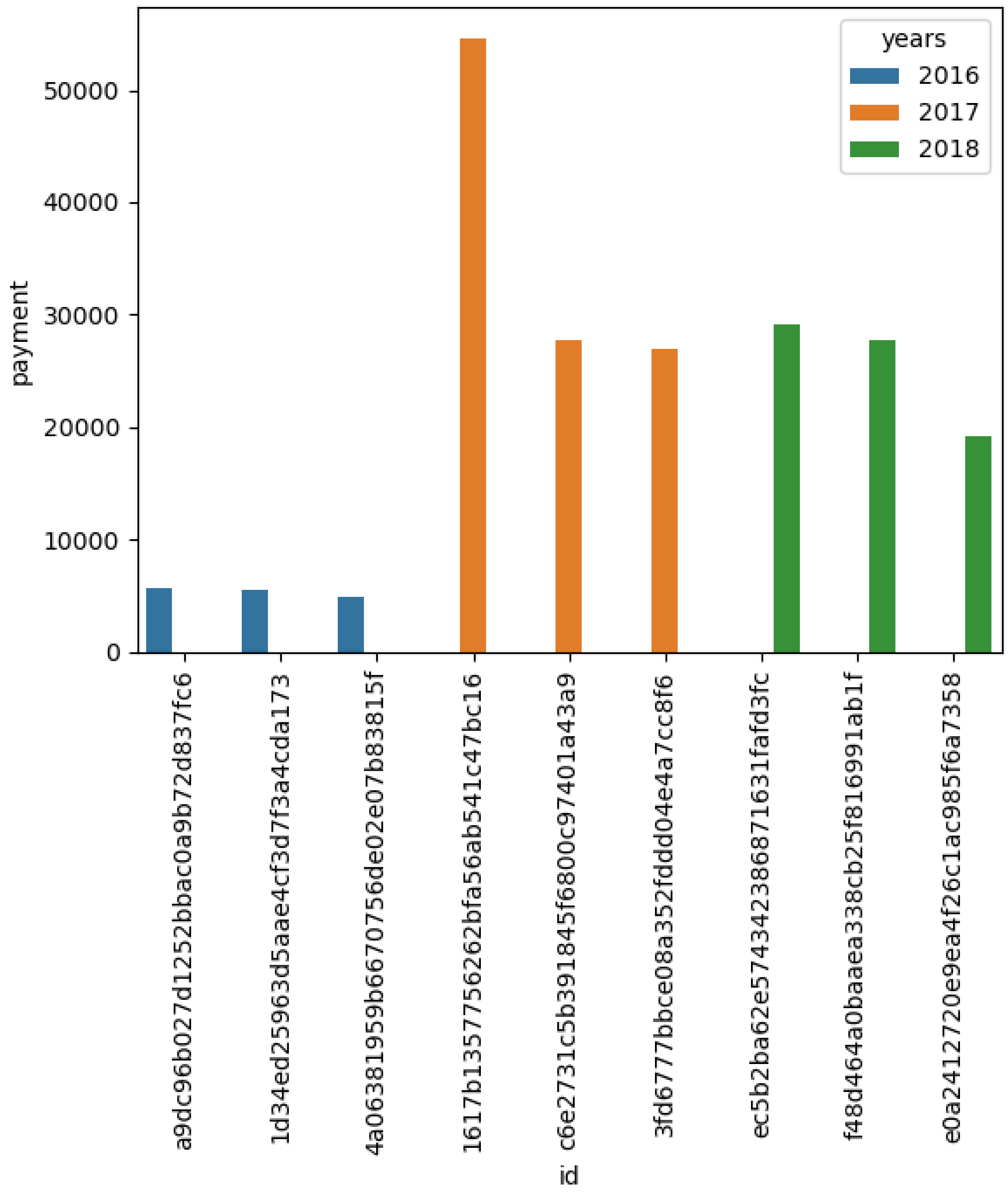
Identify the top 3 customers who spent the most money in each year.

In [33]:
```
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)
data = cur.fetchall()
df = pd.DataFrame(data, columns = ["years","id","payment","rank"])

# Convert the 'years' column to string
df['years'] = df['years'].astype(str)

sns.barplot(x = "id", y = "payment", data = df, hue = "years")
plt.xticks(rotation = 90)
plt.show()
```


years
2016
2017
2018
payment
0
10000
20000
30000
40000
50000
a9dc96b027d1252bbac0a9b72d837fc6
1d34ed25963d5aae4cf3d7f3a4cda173
4a06381959b6670756de02e07b83815f
1617b1357756262bfa56ab541c47bc16
c6e2731c5b391845f6800c97401a43a9
3fd6777bbce08a352fddd04e4a7cc8f6
ec5b2ba62e574342386871631fafd3fc
f48d464a0baaea338cb25f816991ab1f
e0a2412720e9ea4f26c1ac985f6a7358
id

```
In [ ]:
```