In [14]:
```python
import pandas as pd
import mysql.connector
import os

# List of CSV files and their corresponding table names
csv_files = [
    ('customers.csv', 'customers'),
    ('orders.csv', 'orders'),
    ('sellers.csv', 'sellers'),
    ('products.csv', 'products'),
    ('geolocation.csv', 'delivery'),
    ('payments.csv', 'payments'),
    ('order_items.csv', 'order_items')
]

# Connect to MySQL (without specifying a database initially)
conn = mysql.connector.connect(
    host='localhost',
    user='root',
    password='root'
)
cursor = conn.cursor()

# 🔷 **Check if 'ecommerce' database exists**
cursor.execute("SHOW DATABASES")
databases = [db[0] for db in cursor.fetchall()]

if 'ecommerce' in databases:
    print("Database 'ecommerce' exists. Dropping it...")
    cursor.execute("DROP DATABASE ecommerce")

# 🔷 **Create a fresh 'ecommerce' database**
cursor.execute("CREATE DATABASE ecommerce")
print("Database 'ecommerce' created successfully!")

# Close and reconnect to the newly created database
conn.close()
conn = mysql.connector.connect(
    host='localhost',
    user='root',
    password='root',
    database='ecommerce'
)
cursor = conn.cursor()

# Folder containing the CSV files
folder_path = r'D:\Projects\Data Analysis\Project 2\archive'

def get_sql_type(dtype):
    if pd.api.types.is_integer_dtype(dtype):
        return 'INT'
    elif pd.api.types.is_float_dtype(dtype):
        return 'FLOAT'
    elif pd.api.types.is_bool_dtype(dtype):
        return 'BOOLEAN'
    elif pd.api.types.is_datetime64_any_dtype(dtype):
        return 'DATETIME'
    else:
        return 'TEXT'

for csv_file, table_name in csv_files:
    file_path = os.path.join(folder_path, csv_file)

    # Read the CSV file into a pandas DataFrame
    df = pd.read_csv(file_path)

    # Replace NaN with None to handle SQL NULL
    df = df.where(pd.notnull(df), None)

    # Debugging: Check for NaN values
    print(f"Processing {csv_file}")
    print(f"NaN values before replacement:\n{df.isnull().sum()}\n")

    # Clean column names
    df.columns = [col.replace(' ', '_').replace('-', '_').replace('.', '_') for

    # Generate the CREATE TABLE statement with appropriate data types
    columns = ', '.join([f'`{col}` {get_sql_type(df[col].dtype)}' for col in df.
    create_table_query = f'CREATE TABLE IF NOT EXISTS `{table_name}` ({columns})
    cursor.execute(create_table_query)

    # Insert DataFrame data into the MySQL table
    for _, row in df.iterrows():
        # Convert row to tuple and handle NaN/None explicitly
        values = tuple(None if pd.isna(x) else x for x in row)
        sql = f"INSERT INTO `{table_name}` ({', '.join(['`' + col + '`' for col
        cursor.execute(sql, values)

    # Commit the transaction for the current CSV file
    conn.commit()

# Close the connection
conn.close()
```

```
Processing customers.csv
NaN values before replacement:
customer_id                 0
customer_unique_id          0
customer_zip_code_prefix    0
customer_city               0
customer_state              0
dtype: int64

Processing orders.csv
NaN values before replacement:
order_id                            0
customer_id                         0
order_status                        0
order_purchase_timestamp            0
order_approved_at                 160
order_delivered_carrier_date     1783
order_delivered_customer_date    2965
order_estimated_delivery_date       0
dtype: int64

Processing sellers.csv
NaN values before replacement:
seller_id                 0
seller_zip_code_prefix    0
seller_city               0
seller_state              0
dtype: int64

Processing products.csv
NaN values before replacement:
product_id                      0
product category              610
product_name_length           610
product_description_length    610
product_photos_qty            610
product_weight_g                2
product_length_cm               2
product_height_cm               2
product_width_cm                2
dtype: int64

Processing geolocation.csv
NaN values before replacement:
geolocation_zip_code_prefix    0
geolocation_lat                0
geolocation_lng                0
geolocation_city               0
geolocation_state              0
dtype: int64

Processing payments.csv
NaN values before replacement:
order_id                0
payment_sequential      0
payment_type            0
payment_installments    0
payment_value           0
dtype: int64
```

```
Processing order_items.csv
NaN values before replacement:
order_id               0
order_item_id          0
product_id             0
seller_id              0
shipping_limit_date    0
price                  0
freight_value          0
dtype: int64
```

In [9]:
```
import matplotlib.pyplot as plt
import mysql.connector
import pandas as pd
import os
import seaborn as sns
```

In [10]:
```
conn = mysql.connector.connect(
    host='localhost',
    user='root',
    password='root',
    database='ecommerce'
)
cursor = conn.cursor()
```

1. List all unique cities where customers are located.

In [14]:
```
querry = """ select distinct customer_city from customers """
cursor.execute(querry)
data = cursor.fetchall()
data[:10]
```

Out[14]:
```
[('franca',),
 ('sao bernardo do campo',),
 ('sao paulo',),
 ('mogi das cruzes',),
 ('campinas',),
 ('jaragua do sul',),
 ('timoteo',),
 ('curitiba',),
 ('belo horizonte',),
 ('montes claros',)]
```

2. Count the number of orders placed in 2017.

In [26]:
```
querry = """ select count(order_id) from orders where year(order_purchase_timest
cursor.execute(querry)
data = cursor.fetchall()
'Total orders placed in 2017 is', data[0][0]
```

```
Out[26]: ('Total orders placed in 2017 is', 45101)
```

3. Find the total sales per category.

```
In [16]: querry = """ select products.product_category category, round(sum(payments.payme
         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 """
         cursor.execute(querry)
         data = cursor.fetchall()
         data
```

```
Out[16]: [('perfumery', 506738.66),
          ('Furniture Decoration', 1430176.39),
          ('telephony', 486882.05),
          ('bed table bath', 1712553.67),
          ('automotive', 852294.33),
          ('computer accessories', 1585330.45),
          ('housewares', 1094758.13),
          ('babies', 539845.66),
          ('toys', 619037.69),
          ('Furniture office', 646826.49),
          ('Cool Stuff', 779698.0),
          ('HEALTH BEAUTY', 1657373.12),
          ('pet Shop', 311268.97),
          ('General Interest Books', 64694.76),
          ('stationary store', 317440.07),
          ('Watches present', 1429216.68),
          ('PCs', 279121.55),
          ('climatization', 91170.66),
          ('Construction Tools Construction', 241475.63),
          ('sport leisure', 1392127.56),
          ('Bags Accessories', 187151.29),
          ('electronics', 259857.1),
          ('Casa Construcao', 136645.29),
          ('Games consoles', 195480.38),
          ('Fashion Bags and Accessories', 218158.28),
          ('home appliances', 95532.27),
          ('Garden tools', 838280.75),
          ('Agro Industria e Comercio', 118730.61),
          (None, 252801.71),
          ('audio', 60324.62),
          ('technical books', 24915.44),
          ('Construction Tools Garden', 42394.41),
          ('Market Place', 45335.92),
          ('musical instruments', 233074.12),
          ('Drink foods', 27289.73),
          ('SIGNALIZATION AND SAFETY', 68488.05),
          ('Furniture Kitchen Service Area Dinner and Garden', 74660.98),
          ('song', 6901.43),
          ('HOUSE PASTALS OVEN AND CAFE', 51229.32),
          ('fixed telephony', 207010.26),
          ('Room Furniture', 136138.77),
          ('Construction Tools Tools', 21069.07),
          ('House comfort', 84329.06),
          ('Industry Commerce and Business', 56745.76),
          ('Construction Tools Illumination', 72712.48),
          ('ELECTRICES 2', 124563.46),
          ('Fashion Calcados', 32422.74),
          ('Fashion Underwear and Beach Fashion', 12714.54),
          ('electrostile', 225584.38),
          ('foods', 46428.67),
          ('IMAGE IMPORT TABLETS', 10042.93),
          ('Art', 30992.93),
          ('drinks', 71429.65),
          ('Arts and Crafts', 2326.17),
          ("Fashion Women's Clothing", 5109.62),
          ('flowers', 2213.01),
          ("Fashion Men's Clothing", 17290.98),
          ('Fashion Sport', 3645.92),
          ('CONSTRUCTION SECURITY TOOLS', 65691.03),
          ('Christmas articles', 18994.77),
          ('Furniture', 31598.94),
          ('Imported books', 6701.89),
          ('cine photo', 9530.32),
          ('Blu Ray DVDs', 7935.28),
          ('party articles', 5966.31),
          ('Hygiene diapers', 4221.25),
          ('House Comfort 2', 1710.54),
          ('CITTE AND UPHACK FURNITURE', 5998.54),
          ('Kitchen portable and food coach', 4335.65),
          ('cds music dvds', 1199.43),
          ('La Cuisine', 2913.53),
          ("Fashion Children's Clothing", 785.67),
          ('PC Gamer', 2174.43),
          ('insurance and services', 324.51)]
```

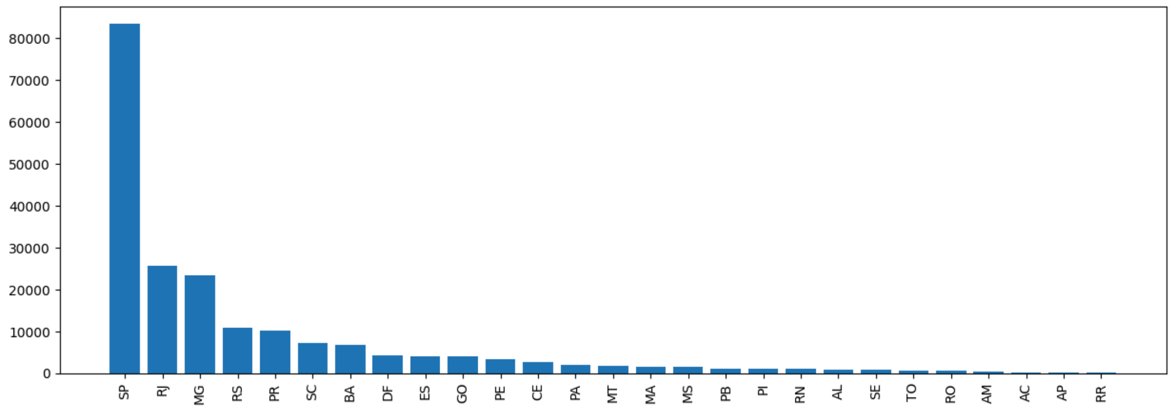
4. Calculate the percentage of orders that were paid in installments.

In [3]:
```
querry = """ select (sum(case when payment_installments >= 1 then 1
else 0 end))*100/count(*)
from payments"""
cursor.execute(querry)
data = cursor.fetchall()
'Percentage of orders that were pain in installments is ', data[0][0]
```

Out[3]:
```
('Percentage of orders that were pain in installments is ', Decimal('99.9981'))
```

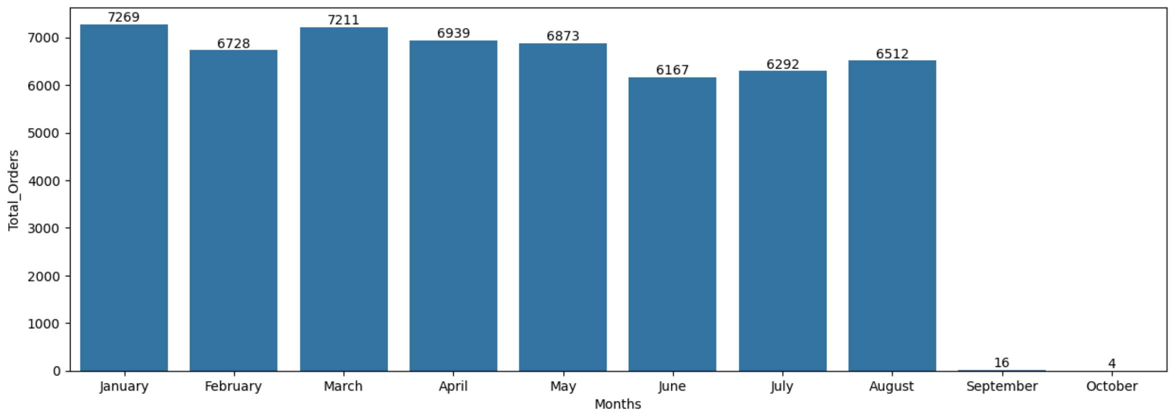
5. Count the number of customers from each state.

In [13]:
```
querry = """ select customer_state state, count(customer_id) from customers grou
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns= ['States','Number of Customers'])
df = df.sort_values(by= 'Number of Customers', ascending= False)

plt.figure(figsize= (15,5))
plt.bar(df['States'], df['Number of Customers'])
plt.xticks(rotation = 90)
plt.show()
```



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

```
In [16]: querry = """ select monthname(order_purchase_timestamp) Months, count(order_id)
from orders
where year(order_purchase_timestamp) = 2018
GROUP BY MONTH(order_purchase_timestamp), MONTHNAME(order_purchase_timestamp)
ORDER BY MONTH(order_purchase_timestamp)"""
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns=["Months", "Total_Orders"])

plt.figure(figsize=(15,5))
ax = sns.barplot(x="Months", y="Total_Orders", data=df)
ax.bar_label(ax.containers[0])
plt.show()
```



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

```
In [19]: querry = """ 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, avg(count_per_order.oc)
from customers join count_per_order
on customers.customer_id = count_per_order.customer_id
group by customers.customer_city
"""
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns=('City', 'Average Order per Customer'))
df
```

Out[19]:

	City	Average Order per Customer
0	sao paulo	1.1562
1	sao jose dos campos	1.1385
2	porto alegre	1.1749
3	indaial	1.1154
4	treze tilias	1.2727
...	...	...
4105	japaratuba	1.0000
4106	sebastiao leal	1.0000
4107	buriti	3.0000
4108	morro agudo de goias	1.0000
4109	padre paraiso	1.0000

4110 rows × 2 columns

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

In [24]:

```
querry = """ select products.product_category category, round(sum(payments.payme
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_per desc """
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns= ['Category','Percentage of Revenue'])
df
```

Out[24]:

	Category	Percentage of Revenue
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 × 2 columns

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

In [30]:
```
querry = """ select products.product_category, count(order_items.product_id), ro
from products join order_items
on products.product_id = order_items.product_id
group by products.product_category """
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns= ['Category','Order Count', 'Price'])
df

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

import numpy as np

a = np.corrcoef([arr1,arr2])

print("The correlation between price and number of times product has been purcha
```

```
The correlation between price and number of times product has been purchased is -
0.10631514167157557
```

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

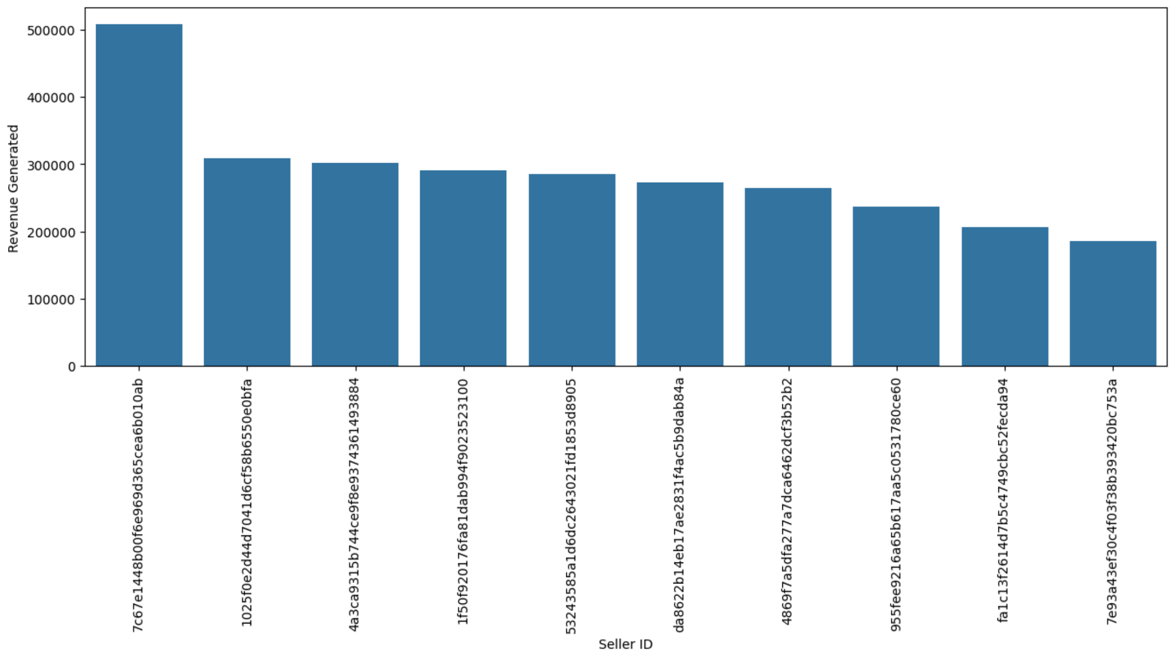
In [76]:
```
querry = """ select *, dense_rank() over(order by revenue desc) as ranking from
(select sellers.seller_id, sum(payments.payment_value) revenue
from sellers join order_items on sellers.seller_id = order_items.seller_id
join payments on order_items.order_id = payments.order_id
group by sellers.seller_id) as a """
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns= ['Seller ID','Revenue Generated', 'Ranking'])
df
```

Out[76]:

	Seller ID	Revenue Generated	Ranking
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 × 3 columns

In [77]:
```
df = df.head(10)
plt.figure(figsize=(15, 5))
sns.barplot(x = 'Seller ID', y = 'Revenue Generated', data = df)
plt.xticks(rotation = 90)
plt.show()
```



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

In [ ]:
```
#Calculating moving average based on last 2 orders
querry = """
select customer_id, order_purchase_timestamp, payment, avg(payment) over(partiti
rows between 2 preceding and current row) as mov_avg
from
(select orders.customer_id, orders.order_purchase_timestamp, payments.payment_va
from payments join orders
on payments.order_id = orders.order_id) as a
"""
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns= ['Customer ID','Time Stamp', 'Payments' ,'Movin
df
```

Out[ ]:

	Customer ID	Time Stamp	Payments	Moving Average
0	00012a2ce6f8dcda20d059ce98491703	2017-11-14 16:08:26	114.74	114.739998
1	000161a058600d5901f007fab4c27140	2017-07-16 09:40:32	67.41	67.410004
2	0001fd6190edaaf884bcaf3d49edf079	2017-02-28 11:06:43	195.42	195.419998
3	0002414f95344307404f0ace7a26f1d5	2017-08-16 13:09:20	179.35	179.350006
4	000379cdec625522490c315e70c7a9fb	2018-04-02 13:42:17	107.01	107.010002
...	...	...	...	...
103881	fffecc9f79fd8c764f843e9951b11341	2018-03-29 16:59:26	71.23	27.120001
103882	fffeda5b6d849fbd39689bb92087f431	2018-05-22 13:36:02	63.13	63.130001
103883	ffff42319e9b2d713724ae527742af25	2018-06-13 16:57:05	214.13	214.130005
103884	ffffa3172527f765de70084a7e53aae8	2017-09-02 11:53:32	45.50	45.500000
103885	ffffe8b65bbe3087b653a978c870db99	2017-09-29 14:07:03	18.37	18.370001

103886 rows × 4 columns

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

In [61]:
```
querry = """
SELECT
    years,
    months,
    payment,
    SUM(payment) OVER (ORDER BY years, month_num) AS cumulative_sales
FROM (
    SELECT
        YEAR(orders.order_purchase_timestamp) AS years,
        MONTHNAME(orders.order_purchase_timestamp) AS months,
        MONTH(orders.order_purchase_timestamp) AS month_num,
        ROUND(SUM(payments.payment_value), 2) AS payment
    FROM orders
    JOIN payments ON orders.order_id = payments.order_id
    GROUP BY years, months, month_num
) AS a
ORDER BY years, month_num
"""
```

```
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns= ['Year','Month', 'Payments' ,'Cumulative Sales'
df
```

Out[61]:

	Year	Month	Payments	Cumulative Sales
0	2016	September	252.24	252.24
1	2016	October	59090.48	59342.72
2	2016	December	19.62	59362.34
3	2017	January	138488.04	197850.38
4	2017	February	291908.01	489758.39
5	2017	March	449863.60	939621.99
6	2017	April	417788.03	1357410.02
7	2017	May	592918.82	1950328.84
8	2017	June	511276.38	2461605.22
9	2017	July	592382.92	3053988.14
10	2017	August	674396.32	3728384.46
11	2017	September	727762.45	4456146.91
12	2017	October	779677.88	5235824.79
13	2017	November	1194882.80	6430707.59
14	2017	December	878401.48	7309109.07
15	2018	January	1115004.18	8424113.25
16	2018	February	992463.34	9416576.59
17	2018	March	1159652.12	10576228.71
18	2018	April	1160785.48	11737014.19
19	2018	May	1153982.15	12890996.34
20	2018	June	1023880.50	13914876.84
21	2018	July	1066540.75	14981417.59
22	2018	August	1022425.32	16003842.91
23	2018	September	4439.54	16008282.45
24	2018	October	589.67	16008872.12

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

In [62]:

```
querry = """
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,
    ((payment - lag(payment, 1) over (order by years))/lag(payment, 1) over (ord
from a
"""
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns= ['Year', 'Total Sales', 'Year over Year growth
df
```

Out[62]:

	Year	Total Sales	Year over Year growth %
0	2016	59362.34	NaN
1	2017	7249746.73	12112.703761
2	2018	8699763.05	20.000924

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

In [63]:

```
querry = """
with a as (
        select
                customers.customer_id,
                min(orders.order_purchase_timestamp) as 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)
        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 m
        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
"""
```

```
cursor.execute(querry)
data = cursor.fetchall()
data
```

Out[63]:

```
[(None,)]
```

There were no customers who made a second purchase within 6 months on first purchase

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

In [64]:

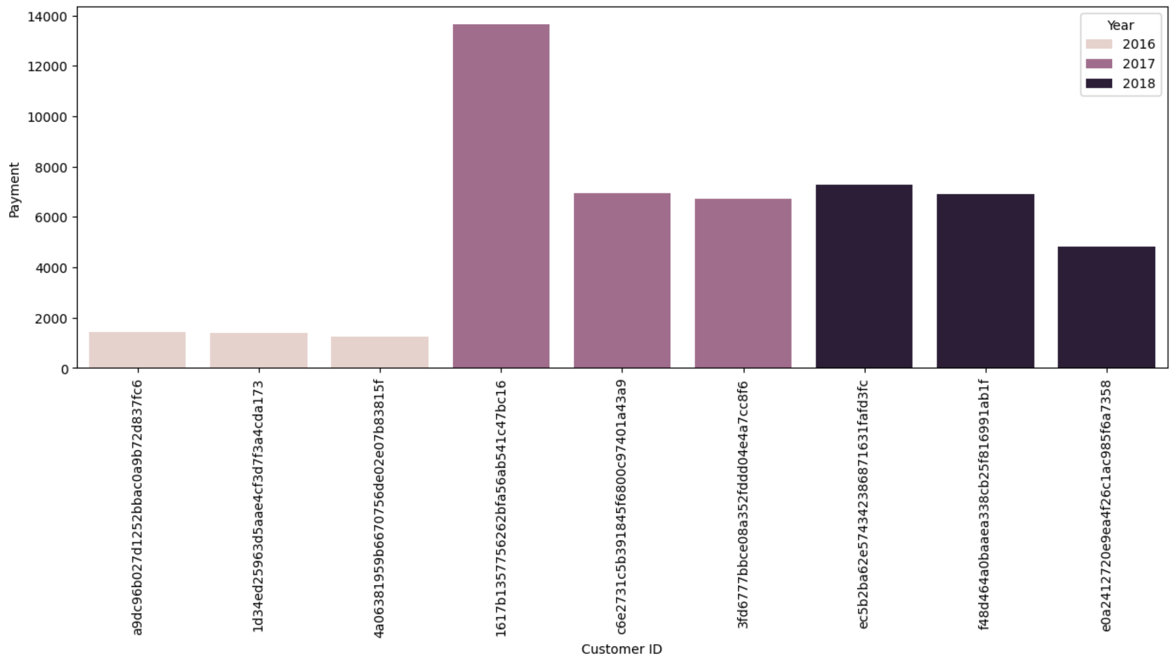
```
querry = """
select
        years,
        customer_id,
    round(payment,2),
    ranking
from
(select
        year(orders.order_purchase_timestamp) as years ,
    orders.customer_id,
    sum(payments.payment_value) as payment,
    dense_rank() over (partition by year(orders.order_purchase_timestamp)
        order by sum(payments.payment_value) desc) ranking
from orders join payments
on orders.order_id = payments.order_id
group by years, orders.customer_id
) as a
where ranking <= 3
"""
cursor.execute(querry)
data = cursor.fetchall()
df = pd.DataFrame(data, columns= ['Year', 'Customer ID', 'Payment', 'Rank'])
df
```

Out[64]:

	Year	Customer ID	Payment	Rank
0	2016	a9dc96b027d1252bbac0a9b72d837fc6	1423.55	1
1	2016	1d34ed25963d5aae4cf3d7f3a4cda173	1400.74	2
2	2016	4a06381959b6670756de02e07b83815f	1227.78	3
3	2017	1617b1357756262bfa56ab541c47bc16	13664.08	1
4	2017	c6e2731c5b391845f6800c97401a43a9	6929.31	2
5	2017	3fd6777bbce08a352fddd04e4a7cc8f6	6726.66	3
6	2018	ec5b2ba62e574342386871631fafd3fc	7274.88	1
7	2018	f48d464a0baaea338cb25f816991ab1f	6922.21	2
8	2018	e0a2412720e9ea4f26c1ac985f6a7358	4809.44	3

In [74]:
```
plt.figure(figsize=(15, 5))
sns.barplot(x = 'Customer ID', y = 'Payment', data = df, hue = 'Year')
plt.xticks(rotation = 90)
```

Out[74]:
```
([0, 1, 2, 3, 4, 5, 6, 7, 8],
 [Text(0, 0, 'a9dc96b027d1252bbac0a9b72d837fc6'),
  Text(1, 0, '1d34ed25963d5aae4cf3d7f3a4cda173'),
  Text(2, 0, '4a06381959b6670756de02e07b83815f'),
  Text(3, 0, '1617b1357756262bfa56ab541c47bc16'),
  Text(4, 0, 'c6e2731c5b391845f6800c97401a43a9'),
  Text(5, 0, '3fd6777bbce08a352fddd04e4a7cc8f6'),
  Text(6, 0, 'ec5b2ba62e574342386871631fafd3fc'),
  Text(7, 0, 'f48d464a0baaea338cb25f816991ab1f'),
  Text(8, 0, 'e0a2412720e9ea4f26c1ac985f6a7358')])
```



In [ ]: