e-commerce-marketing-analysis

July 10, 2023

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
pd.options.display.float_format = "{:.2f}".format
import datetime as dt
import seaborn as sns


sns.set_context('talk')
import scipy.stats as stats


# set seaborn graphs to a better style
sns.set(style="ticks")

# for better visualization
plt.style.use('ggplot')


#Remove warnings
import warnings
warnings.filterwarnings('ignore')
```

[4]:
```
sellers=pd.read_csv('SELLERS.csv')
product = pd.read_csv('PRODUCTS.csv')
geo_location =pd.read_csv('GEO_LOCATION.csv')
order_payments = pd.read_csv('ORDER_PAYMENTS.csv')
reviews_rating =pd.read_csv('ORDER_REVIEW_RATINGS.csv')
orders = pd.read_csv('ORDERS.csv')
order_items = pd.read_csv('ORDER_ITEMS.csv')
customers = pd.read_csv('CUSTOMERS.csv')
```

[5]:
```
orderpayments_value=order_payments.groupby('order_id').payment_value.sum().
 ↪reset_index()
order_review_rate_avg=reviews_rating.groupby('order_id').review_score.mean().
 ↪reset_index()
data=orders.merge(orderpayments_value,on='order_id')
```

```
data=data.merge(customers,on='customer_id')
data=data.merge(order_items,how='left',on='order_id')
data=data.merge(product,how='left',on='product_id')
data=data.merge(sellers,how='left',on='seller_id')
data=data.merge(order_review_rate_avg,how='left',on='order_id')
data.head(3)
```

[5]:

```
                          order_id                       customer_id  \
0  e481f51cbdc54678b7cc49136f2d6af7  9ef432eb6251297304e76186b10a928d
1  53cdb2fc8bc7dce0b6741e2150273451  b0830fb4747a6c6d20dea0b8c802d7ef
2  47770eb9100c2d0c44946d9cf07ec65d  41ce2a54c0b03bf3443c3d931a367089

  order_status order_purchase_timestamp order_approved_at  \
0    delivered          10/2/2017 10:56   10/2/2017 11:07
1    delivered          7/24/2018 20:41    7/26/2018 3:24
2    delivered            8/8/2018 8:38     8/8/2018 8:55

  order_delivered_carrier_date order_delivered_customer_date  \
0              10/4/2017 19:55              10/10/2017 21:25
1              7/26/2018 14:31                8/7/2018 15:27
2               8/8/2018 13:50               8/17/2018 18:06

  order_estimated_delivery_date  payment_value  \
0               10/18/2017 0:00          38.71
1                8/13/2018 0:00         141.46
2                 9/4/2018 0:00         179.12

                 customer_unique_id  …  product_description_lenght  \
0  7c396fd4830fd04220f754e42b4e5bff  …                      268.00
1  af07308b275d755c9edb36a90c618231  …                      178.00
2  3a653a41f6f9fc3d2a113cf8398680e8  …                      232.00

  product_photos_qty product_weight_g  product_length_cm product_height_cm  \
0               4.00          500.00              19.00              8.00
1               1.00          400.00              19.00             13.00
2               1.00          420.00              24.00             19.00

  product_width_cm seller_zip_code_prefix   seller_city    seller_state  \
0            13.00                9350.00   Chhuikhadan    Chhattisgarh
1            19.00               31570.00     Anantapur  Andhra Pradesh
2            21.00               14840.00  Freelandgunj         Gujarat

  review_score
0         4.00
1         4.00
2         5.00
```

[3 rows x 31 columns]

[6]:
```
data=data.
 ↪drop(columns=['order_approved_at','order_delivered_carrier_date','order_estimated_delivery_
data.head()
```

[6]:

	order_id	customer_id	order_status	order_purchase_timestamp	payment_value
0	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	delivered	10/2/2017 10:56	38.71
1	53cdb2fc8bc7dce0b6741e2150273451	b0830fb4747a6c6d20dea0b8c802d7ef	delivered	7/24/2018 20:41	141.46
2	47770eb9100c2d0c44946d9cf07ec65d	41ce2a54c0b03bf3443c3d931a367089	delivered	8/8/2018 8:38	179.12
3	949d5b44dbf5de918fe9c16f97b45f8a	f88197465ea7920adcdbec7375364d82	delivered	11/18/2017 19:28	72.20
4	ad21c59c0840e6cb83a9ceb5573f8159	8ab97904e6daea8866dbdbc4fb7aad2c	delivered	2/13/2018 21:18	28.62

	customer_unique_id	customer_zip_code_prefix	customer_city	customer_state
0	7c396fd4830fd04220f754e42b4e5bff	3149	Akkarampalle	Andhra Pradesh
1	af07308b275d755c9edb36a90c618231	47813	Pandariya	Chhattisgarh
2	3a653a41f6f9fc3d2a113cf8398680e8	75265	Dhamdha	Chhattisgarh
3	7c142cf63193a1473d2e66489a9ae977	59296	Kartarpur	Punjab
4	72632f0f9dd73dfee390c9b22eb56dd6	9195	Bheemavaram	Andhra Pradesh

	order_item_id	product_id	seller_id	price	freight_value
0	1.00	87285b34884572647811a353c7ac498a	3504c0cb71d7fa48d967e0e4c94d59d9	29.99	8.72
1	1.00	595fac2a385ac33a80bd5114aec74eb8	289cdb325fb7e7f891c38608bf9e0962	118.70	22.76
2	1.00	aa4383b373c6aca5d8797843e5594415	4869f7a5dfa277a7dca6462dcf3b52b2	159.90	19.22
3	1.00	d0b61bfb1de832b15ba9d266ca96e5b0	66922902710d126a0e7d26b0e3805106	45.00	27.20
4	1.00	65266b2da20d04dbe00c5c2d3bb7859e	2c9e548be18521d1c43cde1c582c6de8	19.90	8.72

	product_category_name	review_score
0	Housewares	4.00
1	Perfumery	4.00
2	Auto	5.00
3	Pet_Shop	5.00
4	Stationery	5.00

[7]:
```
data.order_purchase_timestamp=pd.to_datetime(data.order_purchase_timestamp)
data['year']=data.order_purchase_timestamp.dt.year
data['month']=data.order_purchase_timestamp.dt.month_name()
data['week']=data.order_purchase_timestamp.dt.weekofyear
data['time']=data.order_purchase_timestamp.dt.time
data['day']=data.order_purchase_timestamp.dt.date
data['month_year']=data.order_purchase_timestamp.dt.date.astype(str).str[0:7]
data['price_to_pay']=data['price']+data['freight_value']
data.duplicated(['order_id','product_id','order_item_id']).sum()
```

[7]:
```
0
```

0.1 1. Perform Detailed exploratory analysis

0.2 a. Define & calculate high level metrics like (Total Revenue, Total quantity, Total products, Total categories, Total sellers, Total locations, Total channels, Total payment methods etc…)

[8]:
```
#TOTAL CATEGORIES
product['product_category_name'].nunique()
```

[8]:
```
71
```

[9]:
```
#TOTAL PRODUCTS
product['product_id'].nunique()
```

[9]:
```
32951
```

[ ]:
```
#TOTAL REVENUE : UNITS SOLD * PRICE OF PRODUCT
```

[10]:
```
order_items['price_to_pay']=order_items['price']+order_items['freight_value']
order_items.head(3)
```

[10]:

	order_id	order_item_id	product_id	seller_id	shipping_limit_date	price	freight_value	price_to_pay
0	00010242fe8c5a6d1ba2dd792cb16214	1	4244733e06e7ecb4970a6e2683c13e61	48436dade18ac8b2bce089ec2a041202	9/19/2017 9:45	58.90	13.29	72.19
1	00018f77f2f0320c557190d7a144bdd3	1	e5f2d52b802189ee658865ca93d83a8f	dd7ddc04e1b6c2c614352b383efe2d36	5/3/2017 11:05	239.90	19.93	259.83
2	000229ec398224ef6ca0657da4fc703e	1	c777355d18b72b67abbeef9df44fd0fd	5b51032eddd242adc84c38acab88f23d	1/18/2018 14:48	199.00	17.87	216.87

[11]:
```
order_items.price_to_pay.sum()
```

[11]:
```
15843553.24
```

[ ]:
```
# Total quantity
```

[12]:
```
order_items.order_item_id.count()
```

[12]:
```
112650
```

[13]:
```
#TOTAL GEO LOCATIONS
customers['customer_zip_code_prefix'].nunique()
```

[13]:
```
14994
```

[14]:
```
#TOTAL SELLERS
sellers['seller_id'].count()
```

[14]:
```
3095
```

[15]:
```
#TOTAL PAYMENTS METHOD
order_payments['payment_type'].value_counts()
```

[15]:
```
credit_card    76795
UPI            19784
voucher         5775
debit_card      1529
not_defined        3
Name: payment_type, dtype: int64
```

[16]:
```
len(order_payments['payment_type'].value_counts())
```

[16]:
```
5
```

0.3 b . Understanding how many new customers acquired every month

[17]:
```
# sort data by customer level
b=data.groupby(['order_id','customer_id']).last().reset_index()
customer_count_per_month=b.groupby(['month_year',b.customer_id.
 ↪rename('customer')]).customer_id.count().reset_index()
customer_firstpurchase=b.groupby('customer_id').month_year.min().reset_index().
 ↪rename(columns={'customer_id':'customer','month_year':
 ↪'first_purchase_month'})
bfinal=customer_count_per_month.merge(customer_firstpurchase,on='customer')
bfinal.customer_id=np.where(bfinal.month_year==bfinal.
 ↪first_purchase_month,'New','Old')
bfinal.head()
```

[17]:

	month_year	customer	customer_id	\
0	2016-09	08c5351a6aca1c1589a38f244edeee9d	New	
1	2016-09	622e13439d6b5a0b486c435618b2679e	New	
2	2016-09	683c54fc24d40ee9f8a6fc179fd9856c	New	
3	2016-10	00474d2582fd72663036795b7ab8cfc1	New	
4	2016-10	01415cfeb907d8ce0e17075b4c097fe9	New	

	first_purchase_month
0	2016-09
1	2016-09
2	2016-09
3	2016-10
4	2016-10

[18]:
```
bfinal.query('customer_id=="New"').groupby('month_year').customer_id.count()
```

[18]:
```
month_year
2016-09       3
2016-10     324
2016-12       1
2017-01     800
2017-02    1780
2017-03    2682
2017-04    2404
2017-05    3700
2017-06    3245
2017-07    4026
2017-08    4331
2017-09    4285
2017-10    4631
2017-11    7544
2017-12    5673
2018-01    7269
2018-02    6728
2018-03    7211
```

```
2018-04    6939
2018-05    6873
2018-06    6167
2018-07    6292
2018-08    6512
2018-09      16
2018-10       4
Name: customer_id, dtype: int64
```

0.4 c. Understand the retention of customers on month on month basis

[19]:
```
bfinal.customer_id.value_counts()
```

[19]:
```
New    99440
Name: customer_id, dtype: int64
```

[20]:
```
data.customer_id.nunique()
```

[20]:
```
99440
```

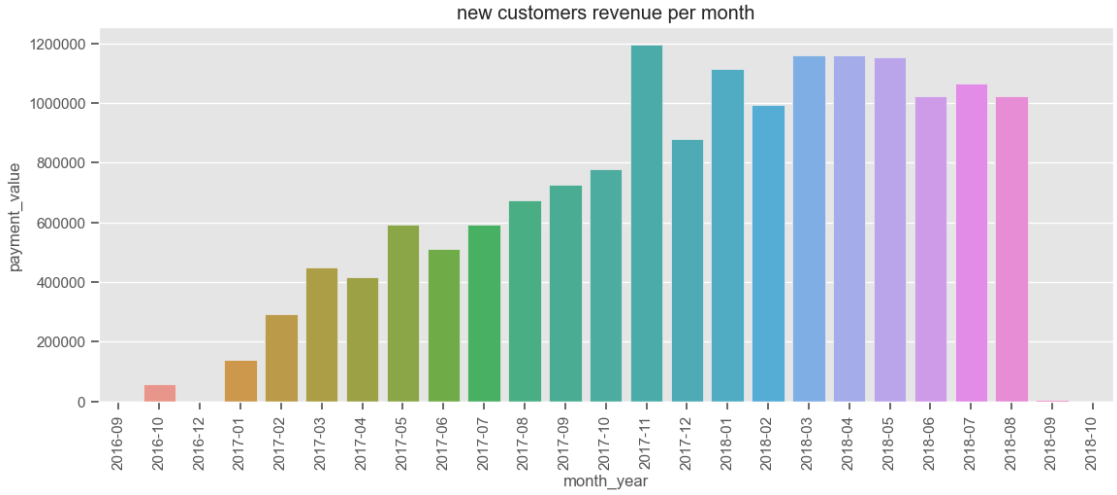
[21]:
```
data.order_id.nunique()
```

[21]:
```
99440
```

0.5 d.how the revenues from existing/new customers on month on month basis

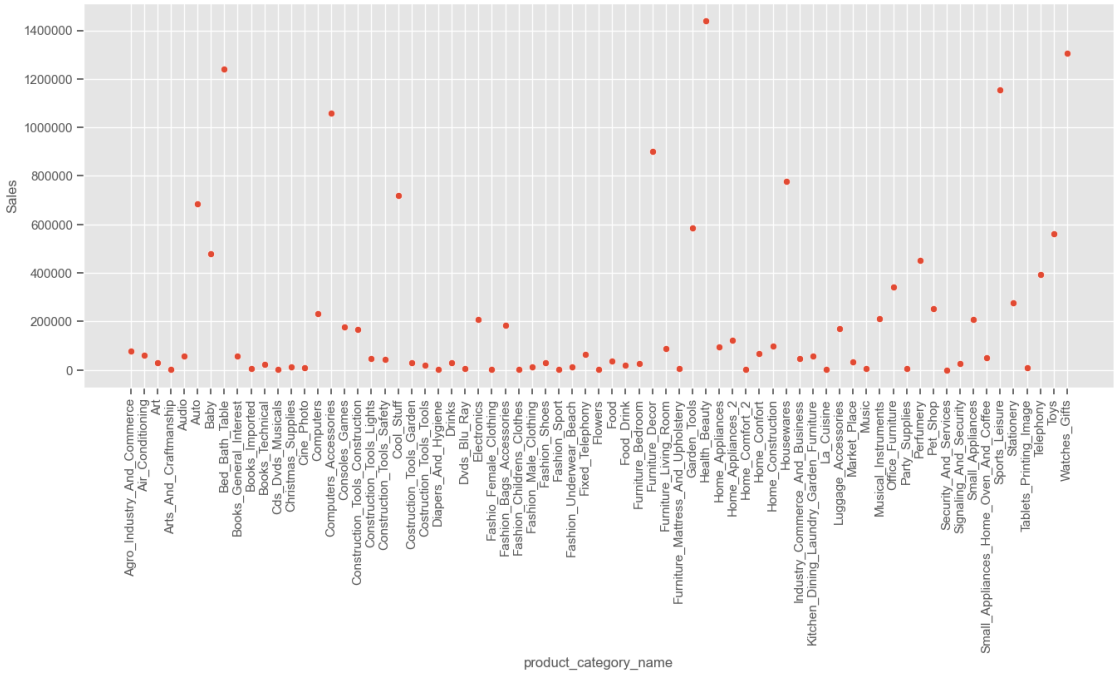
[22]:
```
d = data.drop_duplicates('customer_id')
```

[23]:
```
D=d.groupby('month_year').payment_value.sum().reset_index()
plt.figure(figsize=(13.5,5))
sns.barplot(D.month_year,D.payment_value)
plt.xticks(rotation=90)
plt.ticklabel_format(style='plain',axis='y')
plt.title('new customers revenue per month')
plt.show()
```

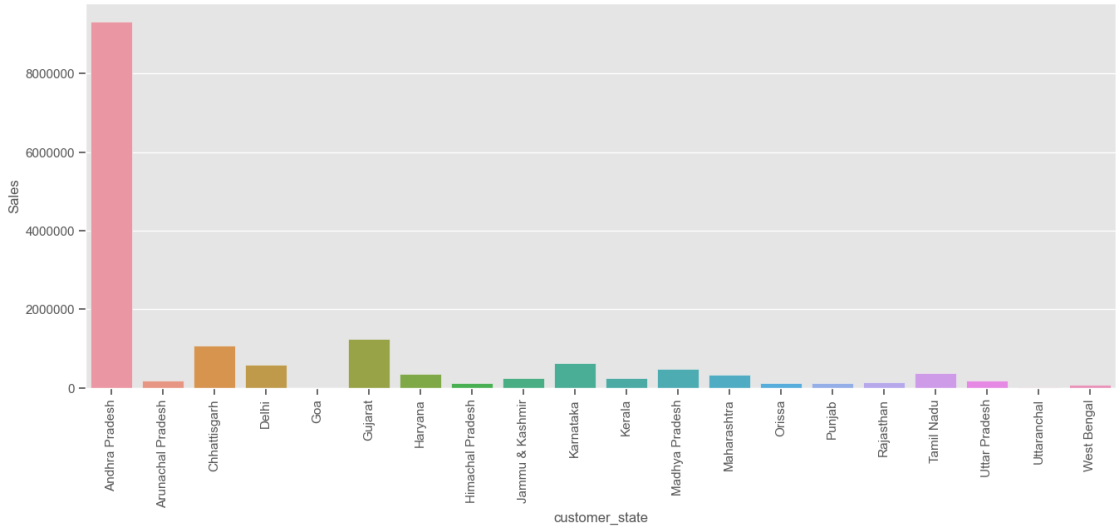


0.6 e. Understand the trends/seasonality of sales, quantity by category, location, month, week, day, time, channel, payment method etc...

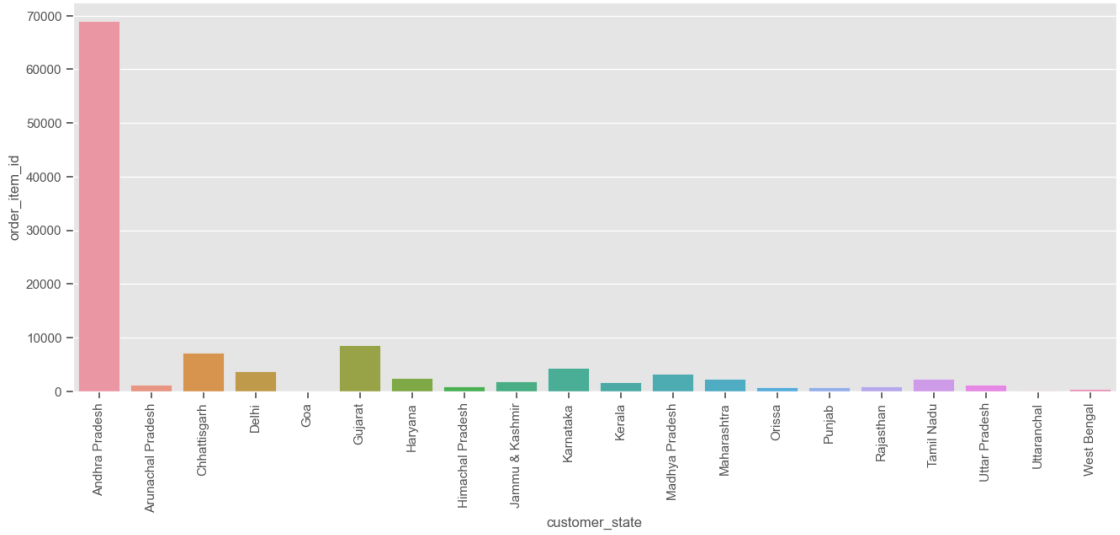
[24]:
```
e1=data.groupby('product_category_name').price_to_pay.sum().reset_index()
plt.figure(figsize=(16,6))
sns.scatterplot(x='product_category_name',y='price_to_pay',data=e1)
plt.ylabel('Sales')
plt.ticklabel_format(style='plain',axis='y')
plt.xticks(rotation=90)
plt.show()
```



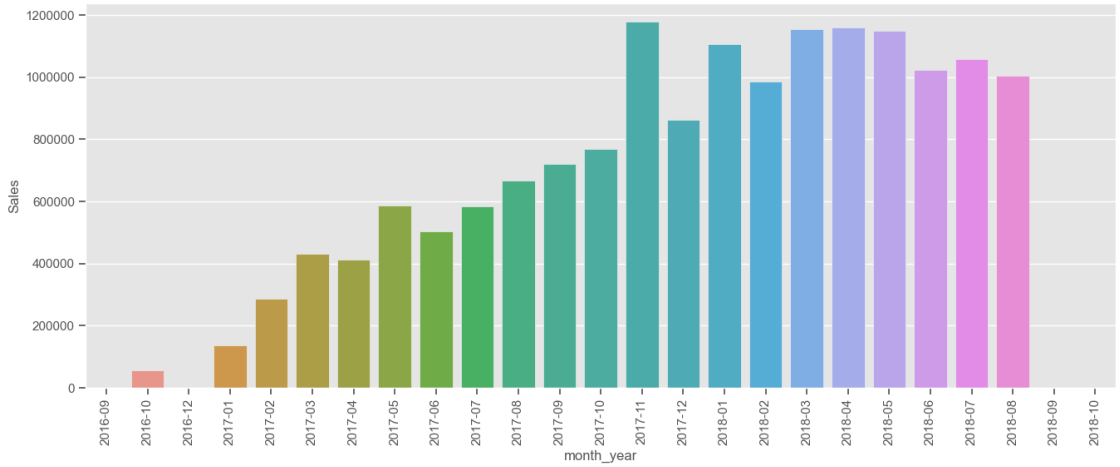
[25]:
```
e3=data.groupby('customer_state').price_to_pay.sum().reset_index()
plt.figure(figsize=(16,6))
sns.barplot(e3.customer_state,e3.price_to_pay)
plt.ticklabel_format(style='plain',axis='y')
plt.ylabel('Sales')
plt.xticks(rotation=90)
plt.show()
```



[26]:
```
e4=data.groupby('customer_state').order_item_id.count().reset_index()
plt.figure(figsize=(16,6))
sns.barplot(e4.customer_state,e4.order_item_id)
plt.ticklabel_format(style='plain',axis='y')
plt.xticks(rotation=90)
plt.show()
```

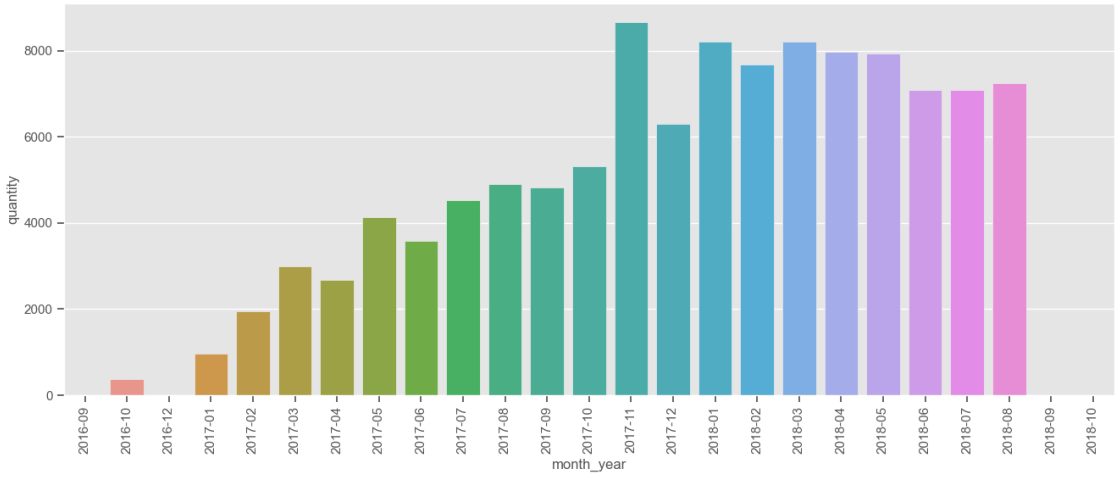


[27]:
```
e5=data.groupby('month_year').price_to_pay.sum().reset_index()
plt.figure(figsize=(16,6))
sns.barplot(e5.month_year,e5.price_to_pay)
plt.ticklabel_format(style='plain',axis='y')
plt.ylabel('Sales')
plt.xticks(rotation=90)
plt.show()
```

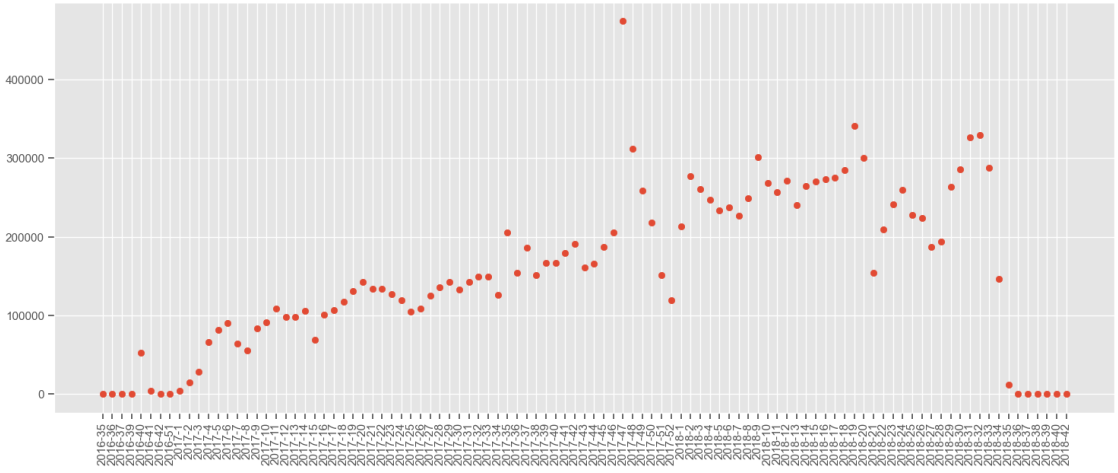


[28]:
```
e6=data.groupby('month_year').order_item_id.count().reset_index()
plt.figure(figsize=(16,6))
sns.barplot(e6.month_year,e6.order_item_id)
plt.ticklabel_format(style='plain',axis='y')
plt.ylabel('quantity')
```

```
plt.xticks(rotation=90)
plt.show()
```

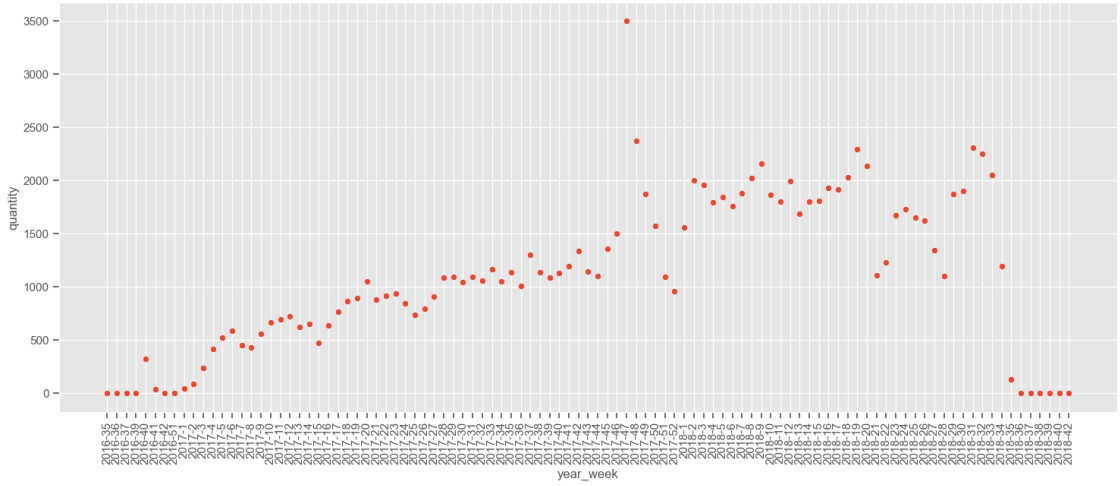


[29]:
```
e7=data.groupby(['year','week']).price_to_pay.sum().reset_index()
e7['year_week']=e7.year.astype(str)+'-'+e7.week.astype(str)
plt.figure(figsize=(18,7))
plt.scatter(e7.year_week,e7.price_to_pay)
plt.ticklabel_format(style='plain',axis='y')
plt.xticks(rotation=90)
plt.show()
```

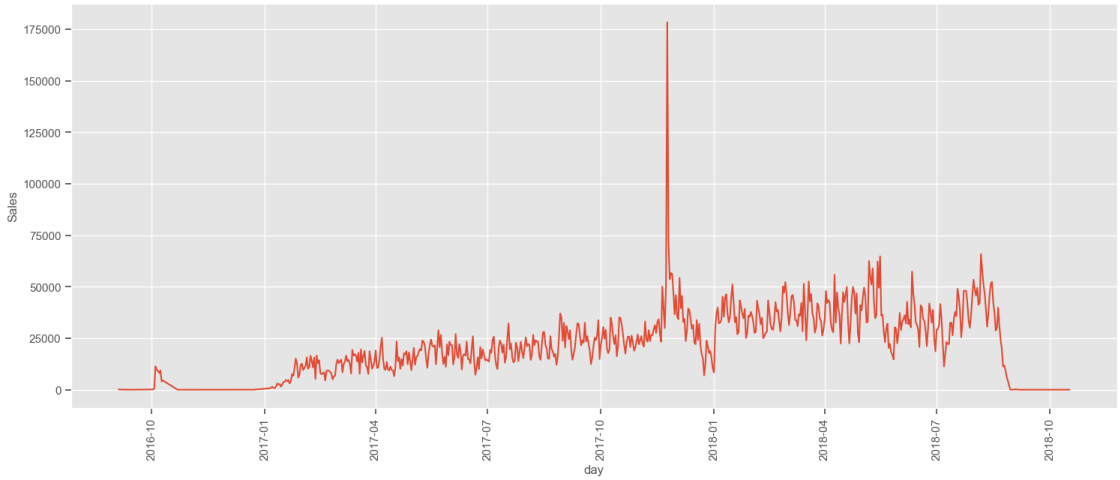


[30]:
```
e8=data.groupby(['year','week']).order_item_id.count().reset_index()
e8['year_week']=e8.year.astype(str)+'-'+e8.week.astype(str)
plt.figure(figsize=(18,7))
```

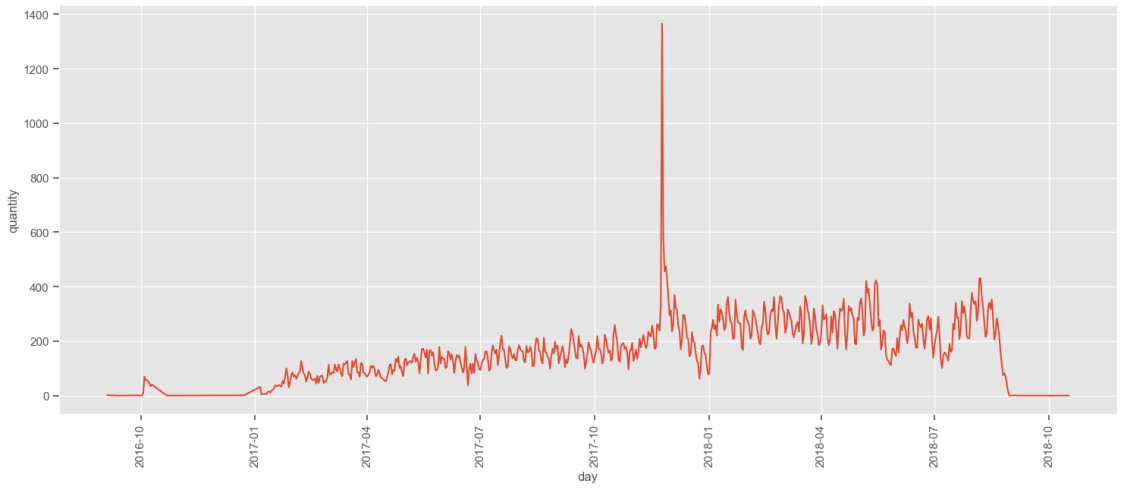
```
sns.scatterplot(e8.year_week,e8.order_item_id)
plt.ticklabel_format(style='plain',axis='y')
plt.ylabel('quantity')
plt.xticks(rotation=90)
plt.show()
```



[31]:
```
e9=data.groupby('day').price_to_pay.sum().reset_index()
plt.figure(figsize=(18,7))
sns.lineplot(x='day',y='price_to_pay',data=e9)
plt.ticklabel_format(style='plain',axis='y')
plt.ylabel('Sales')
plt.xticks(rotation=90)
plt.show()
```



[32]:
```
e10=data.groupby('day').order_item_id.count().reset_index()
plt.figure(figsize=(18,7))
sns.lineplot(x='day',y='order_item_id',data=e10)
plt.ticklabel_format(style='plain',axis='y')
plt.ylabel('quantity')
plt.xticks(rotation=90)
plt.show()
```



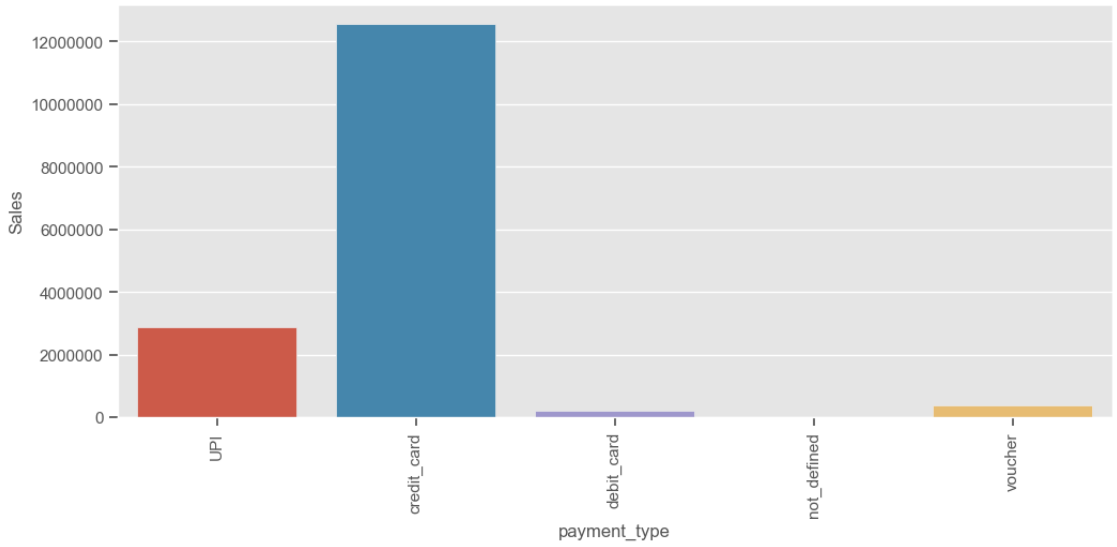
[33]:
```
order_payments.payment_type.nunique()
```

[33]:
```
5
```

[34]:
```
order_payments.groupby('payment_type').payment_value.sum()
```

[34]:
```
payment_type
UPI             2869361.27
credit_card    12542084.19
debit_card       217989.79
not_defined           0.00
voucher          379436.87
Name: payment_value, dtype: float64
```

[35]:
```
e11=order_payments.groupby('payment_type').payment_value.sum().reset_index()
plt.figure(figsize=(12,5))
sns.barplot(e11.payment_type,e11.payment_value)
plt.ticklabel_format(style='plain',axis='y')
plt.ylabel('Sales')
plt.xticks(rotation=90)
plt.show()
```



0.7 f. Popular Products by month, seller, state, category.

[36]:
```
f1=data.groupby(['month_year',data.product_id.rename('product')]).product_id.
  ↪count().reset_index().
  ↪sort_values(by=['month_year','product_id'],ascending=[True,False])
f1=f1.groupby('month_year').head(5).reset_index(drop=True)
f1[['month_year','product']]
```

[36]:

	month_year	product
0	2016-09	c1488892604e4ba5cff5b4eb4d595400
1	2016-09	f293394c72c9b5fafd7023301fc21fc2
2	2016-09	f3c2d01a84c947b078e32bbef0718962
3	2016-10	eba7488e1c67729f045ab43fac426f2e
4	2016-10	d9894482fba41f536a273ba2276d951f
..	…	…
105	2018-08	73326828aa5efe1ba096223de496f596
106	2018-08	19c91ef95d509ea33eda93495c4d3481
107	2018-08	3fbc0ef745950c7932d5f2a446189725
108	2018-08	a92930c327948861c015c919a0bcb4a8
109	2018-09	b98992ea80b467987a7fbb88e7f2076a

[110 rows x 2 columns]

[37]:
```
f2=data.groupby(['seller_id',data.product_id.rename('product')]).product_id.
  ↪count().reset_index().
  ↪sort_values(by=['seller_id','product_id'],ascending=[True,False])
f2=f2.groupby('seller_id').head(5).reset_index(drop=True)
f2[['seller_id','product']]
```

[37]:
```
                              seller_id                           product
0      0015a82c2db000af6aaaf3ae2ecb0532  a2ff5a97bf95719e38ea2e3b4105bce8
1      001cca7ae9ae17fb1caed9dfb1094831  08574b074924071f4e201e151b152b4e
2      001cca7ae9ae17fb1caed9dfb1094831  e251ebd2858be1aa7d9b2087a6992580
3      001cca7ae9ae17fb1caed9dfb1094831  98a8c2fa16d7239c606640f5555768e4
4      001cca7ae9ae17fb1caed9dfb1094831  0da9ffd92214425d880de3f94e74ce39
…                                   …                               …
10367  ffff564a4f9085cd26170f4732393726  8f7a3322e1abfed89ac080b0f7364779
10368  ffff564a4f9085cd26170f4732393726  96aca2f53bcaed6f466449f7fb18ae75
10369  ffff564a4f9085cd26170f4732393726  c4b925e40f11289063a854c47aaef129
10370  ffff564a4f9085cd26170f4732393726  c5897f6f2d995196dbb40542439da9b9
10371  ffff564a4f9085cd26170f4732393726  dbd024d4182504993ad1e3cd2ee9d9e9

[10372 rows x 2 columns]
```

[38]:
```
f3=data.groupby(['customer_state',data.product_id.rename('product')]).
 ↪product_id.count().reset_index().
 ↪sort_values(by=['customer_state','product_id'],ascending=[True,False])
f3=f3.groupby('customer_state').head(5).reset_index(drop=True)
f3[['customer_state','product']]
```

[38]:
```
    customer_state                           product
0   Andhra Pradesh  aca2eb7d00ea1a7b8ebd4e68314663af
1   Andhra Pradesh  99a4788cb24856965c36a24e339b6058
2   Andhra Pradesh  422879e10f46682990de24d770e7f83d
3   Andhra Pradesh  53b36df67ebb7c41585e8d54d6772e08
4   Andhra Pradesh  389d119b48cf3043d311335e499d9c6b
..             …                                …
95     West Bengal  99a4788cb24856965c36a24e339b6058
96     West Bengal  30ac6df06dc59ad72cf2f158fc2d904c
97     West Bengal  389d119b48cf3043d311335e499d9c6b
98     West Bengal  ffaf0af7eebb57c7f262b51ebb05dfd6
99     West Bengal  1ba4e3fe92f16fd5a8942f7b7d804b52

[100 rows x 2 columns]
```

[39]:
```
f4=data.groupby(['product_category_name',data.product_id.rename('product')]).
 ↪product_id.count().reset_index().
 ↪sort_values(by=['product_category_name','product_id'],ascending=[True,False])
f4=f4.groupby('product_category_name').head(5).reset_index(drop=True)
f4[['product_category_name','product']]
```

[39]:
```
          product_category_name                           product
0    Agro_Industry_And_Commerce  11250b0d4b709fee92441c5f34122aed
1    Agro_Industry_And_Commerce  423a6644f0aa529e8828ff1f91003690
2    Agro_Industry_And_Commerce  672e757f331900b9deea127a2a7b79fd
3    Agro_Industry_And_Commerce  3bebad3cf2c8d1a8d3ce97174643e054
```

```
4    Agro_Industry_And_Commerce  a0fe1efb855f3e786f0650268cd77f44
..                          …                               …
343              Watches_Gifts  53b36df67ebb7c41585e8d54d6772e08
344              Watches_Gifts  a62e25e09e05e6faf31d90c6ec1aa3d1
345              Watches_Gifts  e0d64dcfaa3b6db5c54ca298ae101d05
346              Watches_Gifts  a92930c327948861c015c919a0bcb4a8
347              Watches_Gifts  461f43be3bdf8844e65b62d9ac2c7a5a

[348 rows x 2 columns]
```

0.8 g. Popular categories by state, month

[40]:
```
g1=data.groupby(['customer_state',data.product_category_name.
  ↪rename('category')]).product_category_name.count().reset_index().
  ↪sort_values(by=['customer_state','product_category_name'],ascending=[True,False])
g1=g1.groupby('customer_state').head(5).reset_index(drop=True)
g1[['customer_state','category']]
```

[40]:
```
    customer_state              category
0   Andhra Pradesh         Bed_Bath_Table
1   Andhra Pradesh          Health_Beauty
2   Andhra Pradesh         Sports_Leisure
3   Andhra Pradesh        Furniture_Decor
4   Andhra Pradesh  Computers_Accessories
..             …                       …
95     West Bengal          Health_Beauty
96     West Bengal              Telephony
97     West Bengal  Computers_Accessories
98     West Bengal         Bed_Bath_Table
99     West Bengal         Sports_Leisure

[100 rows x 2 columns]
```

[41]:
```
g1=data.groupby(['month_year',data.product_category_name.rename('category')]).
  ↪product_category_name.count().reset_index().
  ↪sort_values(by=['month_year','product_category_name'],ascending=[True,False])
g1=g1.groupby('month_year').head(5).reset_index(drop=True)
g1[['month_year','category']]
```

[41]:
```
    month_year                          category
0      2016-09                  Furniture_Decor
1      2016-09                        Telephony
2      2016-10                  Furniture_Decor
3      2016-10                    Health_Beauty
4      2016-10                        Perfumery
..         …                                …
```

```
104    2018-08                              Bed_Bath_Table
105    2018-08                                  Housewares
106    2018-08                              Sports_Leisure
107    2018-08                             Furniture_Decor
108    2018-09  Kitchen_Dining_Laundry_Garden_Furniture

[109 rows x 2 columns]
```

0.9 h. List top 10 most expensive products sorted by price¶

[43]:
```
expensive = data.groupby(['product_id'])['price'].mean()
expensive.sort_values(ascending = False).head(10).reset_index().product_id
```

[43]:
```
0    489ae2aa008f021502940f251d4cce7f
1    69c590f7ffc7bf8db97190b6cb6ed62e
2    1bdf5e6731585cf01aa8169c7028d6ad
3    a6492cc69376c469ab6f61d8f44de961
4    c3ed642d592594bb648ff4a04cee2747
5    259037a6a41845e455183f89c5035f18
6    a1beef8f3992dbd4cd8726796aa69c53
7    6cdf8fc1d741c76586d8b6b15e9eef30
8    6902c1962dd19d540807d0ab8fade5c6
9    4ca7b91a31637bd24fb8e559d5e015e4
Name: product_id, dtype: object
```

0.10 2. Performing Customers/sellers Segmentation :

a. Divide the customers into groups based on the revenue generated

b. Divide the sellers into groups based on the revenue generated

[44]:
```
a2=data.groupby('customer_id').price_to_pay.sum().reset_index()
a2['Group_number']=pd.qcut(a2['price_to_pay'],10,labels=False)
a2[['customer_id','Group_number']]
```

[44]:
```
                        customer_id  Group_number
0      00012a2ce6f8dcda20d059ce98491703             5
1      000161a058600d5901f007fab4c27140             2
2      0001fd6190edaaf884bcaf3d49edf079             7
3      0002414f95344307404f0ace7a26f1d5             7
4      000379cdec625522490c315e70c7a9fb             5
…                                    …           …
99435  fffecc9f79fd8c764f843e9951b11341             3
99436  fffeda5b6d849fbd39689bb92087f431             2
99437  ffff42319e9b2d713724ae527742af25             8
99438  ffffa3172527f765de70084a7e53aae8             1
99439  ffffe8b65bbe3087b653a978c870db99             0
```

```
[99440 rows x 2 columns]
```

[45]:
```
b2=data.groupby('seller_id').price_to_pay.sum().reset_index()
b2['Group_number']=pd.qcut(b2['price_to_pay'],10,labels=False)
b2[['seller_id','Group_number']]
```

[45]:
```
                            seller_id  Group_number
0     0015a82c2db000af6aaaf3ae2ecb0532             6
1     001cca7ae9ae17fb1caed9dfb1094831             9
2     001e6ad469a905060d959994f1b41e4f             2
3     002100f778ceb8431b7a1020ff7ab48f             6
4     003554e2dce176b5555353e4f3555ac8             1
…                                  …            …
3090  ffcfefa19b08742c5d315f2791395ee5             0
3091  ffdd9f82b9a447f6f8d4b91554cc7dd3             6
3092  ffeee66ac5d5a62fe688b9d26f83f534             6
3093  fffd5413c0700ac820c7069d66d98c89             9
3094  ffff564a4f9085cd26170f4732393726             6

[3095 rows x 2 columns]
```

[46]:
```
data.product_id.nunique()
```

[46]:
```
32951
```

0.11 3. Cross-Selling (Which products are selling together)

Hint: We need to find which of the top 10 combinations of products are selling together in each transaction. (combination of 2 or 3 buying together)

[47]:
```
cs=data.groupby(['order_id','product_id']).order_item_id.count().reset_index()
cs=pd.crosstab(data.order_id,data.product_category_name)
function=lambda x: True if x>0 else False
for i in cs.columns:
    cs[i]=cs[i].apply(function)
cs.head()
```

[47]:
```
product_category_name            Agro_Industry_And_Commerce  \
order_id
00010242fe8c5a6d1ba2dd792cb16214                       False
00018f77f2f0320c557190d7a144bdd3                       False
000229ec398224ef6ca0657da4fc703e                       False
00024acbcdf0a6daa1e931b038114c75                       False
00042b26cf59d7ce69dfabb4e55b4fd9                       False

product_category_name            Air_Conditioning    Art  \
```

```
order_id
00010242fe8c5a6d1ba2dd792cb16214            False  False
00018f77f2f0320c557190d7a144bdd3            False  False
000229ec398224ef6ca0657da4fc703e            False  False
00024acbcdf0a6daa1e931b038114c75            False  False
00042b26cf59d7ce69dfabb4e55b4fd9            False  False

product_category_name            Arts_And_Craftmanship  Audio   Auto   Baby  \
order_id
00010242fe8c5a6d1ba2dd792cb16214                 False  False  False  False
00018f77f2f0320c557190d7a144bdd3                 False  False  False  False
000229ec398224ef6ca0657da4fc703e                 False  False  False  False
00024acbcdf0a6daa1e931b038114c75                 False  False  False  False
00042b26cf59d7ce69dfabb4e55b4fd9                 False  False  False  False

product_category_name            Bed_Bath_Table  Books_General_Interest  \
order_id
00010242fe8c5a6d1ba2dd792cb16214          False                   False
00018f77f2f0320c557190d7a144bdd3          False                   False
000229ec398224ef6ca0657da4fc703e          False                   False
00024acbcdf0a6daa1e931b038114c75          False                   False
00042b26cf59d7ce69dfabb4e55b4fd9          False                   False

product_category_name            Books_Imported  …  Security_And_Services  \
order_id                                         …
00010242fe8c5a6d1ba2dd792cb16214          False  …                  False
00018f77f2f0320c557190d7a144bdd3          False  …                  False
000229ec398224ef6ca0657da4fc703e          False  …                  False
00024acbcdf0a6daa1e931b038114c75          False  …                  False
00042b26cf59d7ce69dfabb4e55b4fd9          False  …                  False

product_category_name            Signaling_And_Security  Small_Appliances  \
order_id
00010242fe8c5a6d1ba2dd792cb16214                  False             False
00018f77f2f0320c557190d7a144bdd3                  False             False
000229ec398224ef6ca0657da4fc703e                  False             False
00024acbcdf0a6daa1e931b038114c75                  False             False
00042b26cf59d7ce69dfabb4e55b4fd9                  False             False

product_category_name            Small_Appliances_Home_Oven_And_Coffee  \
order_id
00010242fe8c5a6d1ba2dd792cb16214                                  False
00018f77f2f0320c557190d7a144bdd3                                  False
000229ec398224ef6ca0657da4fc703e                                  False
00024acbcdf0a6daa1e931b038114c75                                  False
00042b26cf59d7ce69dfabb4e55b4fd9                                  False
```

```
product_category_name             Sports_Leisure  Stationery  \
order_id
00010242fe8c5a6d1ba2dd792cb16214           False       False
00018f77f2f0320c557190d7a144bdd3           False       False
000229ec398224ef6ca0657da4fc703e           False       False
00024acbcdf0a6daa1e931b038114c75           False       False
00042b26cf59d7ce69dfabb4e55b4fd9           False       False

product_category_name             Tablets_Printing_Image  Telephony   Toys  \
order_id
00010242fe8c5a6d1ba2dd792cb16214                   False      False  False
00018f77f2f0320c557190d7a144bdd3                   False      False  False
000229ec398224ef6ca0657da4fc703e                   False      False  False
00024acbcdf0a6daa1e931b038114c75                   False      False  False
00042b26cf59d7ce69dfabb4e55b4fd9                   False      False  False

product_category_name             Watches_Gifts
order_id
00010242fe8c5a6d1ba2dd792cb16214         False
00018f77f2f0320c557190d7a144bdd3         False
000229ec398224ef6ca0657da4fc703e         False
00024acbcdf0a6daa1e931b038114c75         False
00042b26cf59d7ce69dfabb4e55b4fd9         False

[5 rows x 71 columns]
```

0.12 4. Payment Behaviour

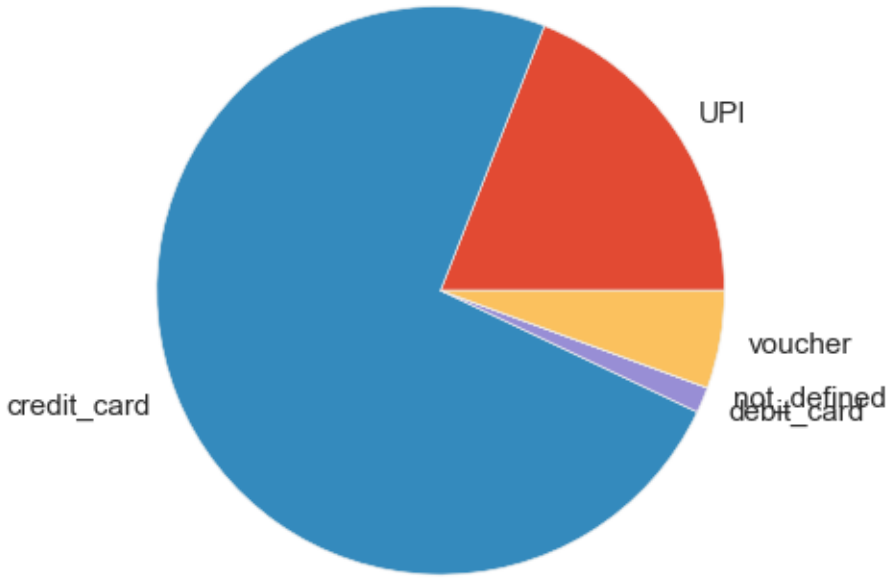
a. How customers are paying?

b. Which payment channels are used by most customers?

[48]:
```
#A. how customers are paying
order_payments['payment_type'].value_counts()
```

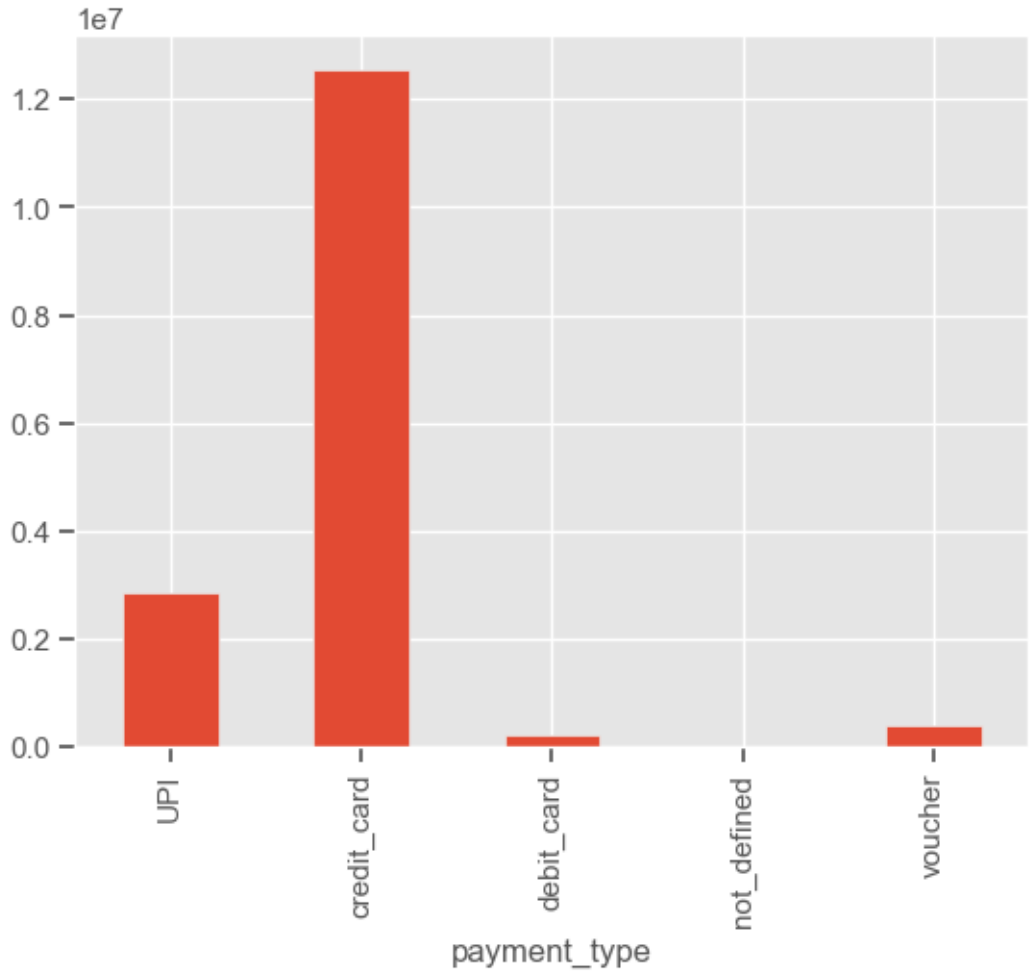
[48]:
```
credit_card    76795
UPI            19784
voucher         5775
debit_card      1529
not_defined        3
Name: payment_type, dtype: int64
```

[49]:
```
payment_behaviour=order_payments.merge(orders,on='order_id')
a4=payment_behaviour.groupby('payment_type').customer_id.count().reset_index()
plt.pie(a4.customer_id,labels=a4.payment_type)
plt.show()
```



[50]:
```
#b
payment_behaviour.groupby('payment_type').payment_value.sum().plot.bar()
```

[50]: <AxesSubplot:xlabel='payment_type'>



0.13 5. Customer satisfaction towards category & product

a. Which categories (top 10) are maximum rated & minimum rated?

b. Which products (top10) are maximum rated & minimum rated?

c. Average rating by location, seller, product, category, month etc.

d. Which categories (top 10) are maximum rated & minimum rated?

[54]:
```
category_ratings=data.groupby('product_category_name').review_score.mean().
↪reset_index().sort_values(by='review_score')
#  top 10 min rated
category_ratings.head(10)
```

[54]:

	product_category_name	review_score
61	Security_And_Services	2.50
23	Diapers_And_Hygiene	3.26

46	Home_Comfort_2	3.37
57	Office_Furniture	3.48
30	Fashion_Male_Clothing	3.62
34	Fixed_Telephony	3.67
58	Party_Supplies	3.77
27	Fashio_Female_Clothing	3.78
52	La_Cuisine	3.79
4	Audio	3.81

[55]:
```
#  top 10 max rated
category_ratings.tail(10)
```

[55]:

	product_category_name	review_score
32	Fashion_Sport	4.23
37	Food_Drink	4.30
64	Small_Appliances_Home_Oven_And_Coffee	4.30
53	Luggage_Accessories	4.31
10	Books_Technical	4.33
22	Costruction_Tools_Tools	4.36
9	Books_Imported	4.40
8	Books_General_Interest	4.44
29	Fashion_Childrens_Clothes	4.50
11	Cds_Dvds_Musicals	4.64

0.14 c. Average rating by location, seller, product, category, month etc

[58]:
```
# data at customer level
c1=data.groupby(['order_id','customer_id']).last().reset_index()
c1.groupby('customer_state').review_score.mean().reset_index()
```

[58]:

	customer_state	review_score
0	Andhra Pradesh	4.05
1	Arunachal Pradesh	4.11
2	Chhattisgarh	4.09
3	Delhi	4.06
4	Goa	4.80
5	Gujarat	4.08
6	Haryana	4.15
7	Himachal Pradesh	4.02
8	Jammu & Kashmir	4.08
9	Karnataka	4.07
10	Kerala	4.14
11	Madhya Pradesh	4.09
12	Maharashtra	4.13
13	Orissa	4.14
14	Punjab	4.20
15	Rajasthan	4.19

```
16          Tamil Nadu          4.16
17       Uttar Pradesh          4.16
18         Uttaranchal          3.92
19         West Bengal          4.05
```

[59]:
```
# getting data at product and seller level:
c2=data.groupby(['order_id','product_id','seller_id']).last().reset_index()
c2.groupby('seller_id').review_score.mean().reset_index()
```

[59]:
```
                              seller_id  review_score
0     0015a82c2db000af6aaaf3ae2ecb0532          3.67
1     001cca7ae9ae17fb1caed9dfb1094831          3.94
2     001e6ad469a905060d959994f1b41e4f          1.00
3     002100f778ceb8431b7a1020ff7ab48f          3.98
4     003554e2dce176b5555353e4f3555ac8          5.00
…                                  …           …
3090  ffcfefa19b08742c5d315f2791395ee5          1.00
3091  ffdd9f82b9a447f6f8d4b91554cc7dd3          4.33
3092  ffeee66ac5d5a62fe688b9d26f83f534          4.21
3093  fffd5413c0700ac820c7069d66d98c89          3.87
3094  ffff564a4f9085cd26170f4732393726          2.10

[3095 rows x 2 columns]
```

[60]:
```
# getting data at product  level:
c3=data.groupby(['order_id','product_id']).last().reset_index()
c3.groupby('product_id').review_score.mean().reset_index()
```

[60]:
```
                              product_id  review_score
0      00066f42aeeb9f3007548bb9d3f33c38          5.00
1      00088930e925c41fd95ebfe695fd2655          4.00
2      0009406fd7479715e4bef61dd91f2462          1.00
3      000b8f95fcb9e0096488278317764d19          5.00
4      000d9be29b5207b54e86aa1b1ac54872          5.00
…                                   …           …
32946  fff6177642830a9a94a0f2cba5e476d1          4.50
32947  fff81cc3158d2725c0655ab9ba0f712c          4.00
32948  fff9553ac224cec9d15d49f5a263411f          5.00
32949  fffdb2d0ec8d6a61f0a0a0db3f25b441          5.00
32950  fffe9eeff12fcbd74a2f2b007dde0c58          4.00

[32951 rows x 2 columns]
```

[61]:
```
# getting data at product  level:
c4=data.groupby(['order_id','product_id']).last().reset_index()
c4.groupby('product_category_name').review_score.mean().reset_index()
```

[61]:

	product_category_name	review_score
0	Agro_Industry_And_Commerce	4.03
1	Air_Conditioning	3.98
2	Art	4.00
3	Arts_And_Craftmanship	4.12
4	Audio	3.82
..	…	…
66	Stationery	4.22
67	Tablets_Printing_Image	4.08
68	Telephony	3.97
69	Toys	4.16
70	Watches_Gifts	4.03

[71 rows x 2 columns]

[62]:
```
# getting data at product  level:
c5=data.groupby(['order_id','product_id']).last().reset_index()
c5.groupby('month_year').review_score.mean().reset_index()
```

[62]:

	month_year	review_score
0	2016-09	1.00
1	2016-10	3.60
2	2016-12	5.00
3	2017-01	4.06
4	2017-02	4.05
5	2017-03	4.08
6	2017-04	4.03
7	2017-05	4.14
8	2017-06	4.13
9	2017-07	4.16
10	2017-08	4.23
11	2017-09	4.17
12	2017-10	4.09
13	2017-11	3.89
14	2017-12	3.99
15	2018-01	4.00
16	2018-02	3.80
17	2018-03	3.71
18	2018-04	4.11
19	2018-05	4.16
20	2018-06	4.25
21	2018-07	4.24
22	2018-08	4.23
23	2018-09	1.00

[ ]: