TASK 9

September 15, 2025

[1]:
```python
import pandas as pd
from glob import glob
```

[4]:
```python
import os
print(os.getcwd())
```

```
/home/01e8c0d6-55b3-4404-abea-629433cfc2c8
```

[7]:
```python
%pip install pandas numpy matplotlib seaborn scikit-learn plotly missingno --quiet

import os, glob
print("Working directory:", os.getcwd())
print("CSV files found here:")
for f in sorted(glob.glob("*.csv")):
    print("  ", f)
```

```
Note: you may need to restart the kernel to use updated packages.
Working directory: /home/01e8c0d6-55b3-4404-abea-629433cfc2c8
CSV files found here:
   gender.csv
   olist_customers_dataset.csv
   olist_geolocation_dataset.csv
   olist_order_items_dataset.csv
   olist_order_payments_dataset.csv
   olist_order_reviews_dataset.csv
   olist_orders_dataset.csv
   olist_products_dataset.csv
   olist_sellers_dataset.csv
   onlineretail.csv
   product_category_name_translation.csv
   test.csv
   train.csv
```

[30]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import glob, os


sns.set_style("whitegrid")
pd.set_option('display.max_columns', 80)
pd.set_option('display.width', 120)
```

[9]:

```
orders = pd.read_csv("olist_orders_dataset.csv", low_memory=False)
order_items = pd.read_csv("olist_order_items_dataset.csv", low_memory=False)
products = pd.read_csv("olist_products_dataset.csv", low_memory=False)
customers = pd.read_csv("olist_customers_dataset.csv", low_memory=False)
sellers = pd.read_csv("olist_sellers_dataset.csv", low_memory=False)
payments = pd.read_csv("olist_order_payments_dataset.csv", low_memory=False)
reviews = pd.read_csv("olist_order_reviews_dataset.csv", low_memory=False)


if os.path.exists("olist_geolocation_dataset.csv"):
    geolocation = pd.read_csv("olist_geolocation_dataset.csv", low_memory=False)
if os.path.exists("product_category_name_translation.csv"):
    category_translation = pd.read_csv("product_category_name_translation.csv",␣
 ↪low_memory=False)

print("orders:", orders.shape, "order_items:", order_items.shape, "products:",␣
 ↪products.shape)
orders.head(2)
```

```
orders: (99441, 8) order_items: (112650, 7) products: (32951, 9)
```

[9]:

```
                           order_id                       customer_id
order_status order_purchase_timestamp  \
0  e481f51cbdc54678b7cc49136f2d6af7  9ef432eb6251297304e76186b10a928d
delivered      2017-10-02 10:56:33
1  53cdb2fc8bc7dce0b6741e2150273451  b0830fb4747a6c6d20dea0b8c802d7ef
delivered      2018-07-24 20:41:37

     order_approved_at order_delivered_carrier_date
order_delivered_customer_date order_estimated_delivery_date
0  2017-10-02 11:07:15          2017-10-04 19:55:00           2017-10-10
21:25:13           2017-10-18 00:00:00
1  2018-07-26 03:24:27          2018-07-26 14:31:00           2018-08-07
15:27:45           2018-08-13 00:00:00
```

[10]:

```
print(orders.info())
print(order_items.info())
print(products.columns.tolist())
```

```
date_cols =␣
 ↪["order_purchase_timestamp","order_approved_at","order_delivered_carrier_date",
             "order_delivered_customer_date","order_estimated_delivery_date"]
for c in date_cols:
    if c in orders.columns:
        orders[c] = pd.to_datetime(orders[c], errors="coerce")

if 'order_status' in orders.columns:
    print(orders['order_status'].value_counts())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 99441 entries, 0 to 99440
Data columns (total 8 columns):
 #   Column                         Non-Null Count  Dtype
---  ------                         --------------  -----
 0   order_id                       99441 non-null  object
 1   customer_id                    99441 non-null  object
 2   order_status                   99441 non-null  object
 3   order_purchase_timestamp       99441 non-null  object
 4   order_approved_at              99281 non-null  object
 5   order_delivered_carrier_date   97658 non-null  object
 6   order_delivered_customer_date  96476 non-null  object
 7   order_estimated_delivery_date  99441 non-null  object
dtypes: object(8)
memory usage: 6.1+ MB
None
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 112650 entries, 0 to 112649
Data columns (total 7 columns):
 #   Column               Non-Null Count   Dtype
---  ------               --------------   -----
 0   order_id             112650 non-null  object
 1   order_item_id        112650 non-null  int64
 2   product_id           112650 non-null  object
 3   seller_id            112650 non-null  object
 4   shipping_limit_date  112650 non-null  object
 5   price                112650 non-null  float64
 6   freight_value        112650 non-null  float64
dtypes: float64(2), int64(1), object(4)
memory usage: 6.0+ MB
None
['product_id', 'product_category_name', 'product_name_lenght',
'product_description_lenght', 'product_photos_qty', 'product_weight_g',
'product_length_cm', 'product_height_cm', 'product_width_cm']
order_status
delivered      96478
shipped         1107
```

```
canceled         625
unavailable      609
invoiced         314
processing       301
created            5
approved           2
Name: count, dtype: int64
```

[11]:
```
orders.columns = orders.columns.str.strip().str.lower()
order_items.columns = order_items.columns.str.strip().str.lower()
products.columns = products.columns.str.strip().str.lower()
customers.columns = customers.columns.str.strip().str.lower()
payments.columns = payments.columns.str.strip().str.lower()
reviews.columns = reviews.columns.str.strip().str.lower()
sellers.columns = sellers.columns.str.strip().str.lower()


orders = orders.drop_duplicates()
order_items = order_items.drop_duplicates()


print("Missing in orders:\n", orders.isnull().sum().
 ↪sort_values(ascending=False).head(8))
```

```
Missing in orders:
 order_delivered_customer_date    2965
order_delivered_carrier_date     1783
order_approved_at                 160
order_id                            0
order_purchase_timestamp            0
order_status                        0
customer_id                         0
order_estimated_delivery_date       0
dtype: int64
```

[12]:
```
order_totals = order_items.groupby("order_id").agg(
    n_items = ("order_item_id","count"),
    items_value = ("price","sum"),
    freight_value = ("freight_value","sum")
).reset_index()
order_totals["order_revenue"] = order_totals["items_value"] +␣
 ↪order_totals["freight_value"]


payments_by_order = payments.groupby("order_id").agg(
    payment_count = ("payment_type","count"),
    payment_value_sum = ("payment_value","sum"),
    payment_types = ("payment_type", lambda x: ", ".join(x.unique()))
).reset_index()

reviews_by_order = reviews.groupby("order_id").agg(
    review_score = ("review_score","mean"),
    review_count = ("review_comment_message","count")
).reset_index()


df = orders.merge(order_totals, on="order_id", how="left")
df = df.merge(customers, on="customer_id", how="left")
df = df.merge(payments_by_order, on="order_id", how="left")
df = df.merge(reviews_by_order, on="order_id", how="left")


df[['order_id','order_purchase_timestamp','order_status','order_revenue','payment_value_sum','
  ↪head()
```

[12]:

```
                           order_id order_purchase_timestamp order_status
order_revenue  payment_value_sum  \
0  e481f51cbdc54678b7cc49136f2d6af7      2017-10-02 10:56:33    delivered
38.71              38.71
1  53cdb2fc8bc7dce0b6741e2150273451      2018-07-24 20:41:37    delivered
141.46             141.46
2  47770eb9100c2d0c44946d9cf07ec65d      2018-08-08 08:38:49    delivered
179.12             179.12
3  949d5b44dbf5de918fe9c16f97b45f8a      2017-11-18 19:28:06    delivered
72.20              72.20
4  ad21c59c0840e6cb83a9ceb5573f8159      2018-02-13 21:18:39    delivered
28.62              28.62

   review_score
0           4.0
1           4.0
2           5.0
3           5.0
4           5.0
```

[13]:

```
if 'order_delivered_customer_date' in df.columns and 'order_purchase_timestamp'␣
  ↪in df.columns:
    df['delivery_time_days'] = (df['order_delivered_customer_date'] -␣
  ↪df['order_purchase_timestamp']).dt.days


if 'order_approved_at' in df.columns:
    df['days_to_approve'] = (df['order_approved_at'] -␣
  ↪df['order_purchase_timestamp']).dt.days
```

```python
if 'order_status' in df.columns and 'delivered' in df['order_status'].unique():
    df_sales = df[df['order_status'] == 'delivered'].copy()
else:
    df_sales = df.copy()

df_sales['order_month'] = df_sales['order_purchase_timestamp'].dt.to_period('M')
df_sales.head(2)
```

[13]:

```
                           order_id                       customer_id
order_status order_purchase_timestamp  \
0  e481f51cbdc54678b7cc49136f2d6af7  9ef432eb6251297304e76186b10a928d
delivered      2017-10-02 10:56:33
1  53cdb2fc8bc7dce0b6741e2150273451  b0830fb4747a6c6d20dea0b8c802d7ef
delivered      2018-07-24 20:41:37

    order_approved_at order_delivered_carrier_date order_delivered_customer_date
order_estimated_delivery_date  \
0 2017-10-02 11:07:15          2017-10-04 19:55:00           2017-10-10 21:25:13
2017-10-18
1 2018-07-26 03:24:27          2018-07-26 14:31:00           2018-08-07 15:27:45
2018-08-13

   n_items  items_value  freight_value  order_revenue
customer_unique_id  customer_zip_code_prefix  \
0      1.0        29.99           8.72          38.71
7c396fd4830fd04220f754e42b4e5bff                      3149
1      1.0       118.70          22.76         141.46
af07308b275d755c9edb36a90c618231                     47813

  customer_city customer_state  payment_count  payment_value_sum
payment_types  review_score  review_count  \
0      sao paulo             SP            3.0              38.71  credit_card,
voucher           4.0           1.0
1      barreiras             BA            1.0             141.46
boleto           4.0           1.0

   delivery_time_days  days_to_approve order_month
0                 8.0              0.0     2017-10
1                13.0              1.0     2018-07
```

[14]:

```python
oi = order_items.merge(products[['product_id','product_category_name']],␣
 ↪on='product_id', how='left')
top_products = oi.groupby("product_id").agg(revenue=("price","sum"),␣
 ↪n_orders=("order_id","nunique")).reset_index()
top_products = top_products.sort_values("revenue", ascending=False).head(10)
```

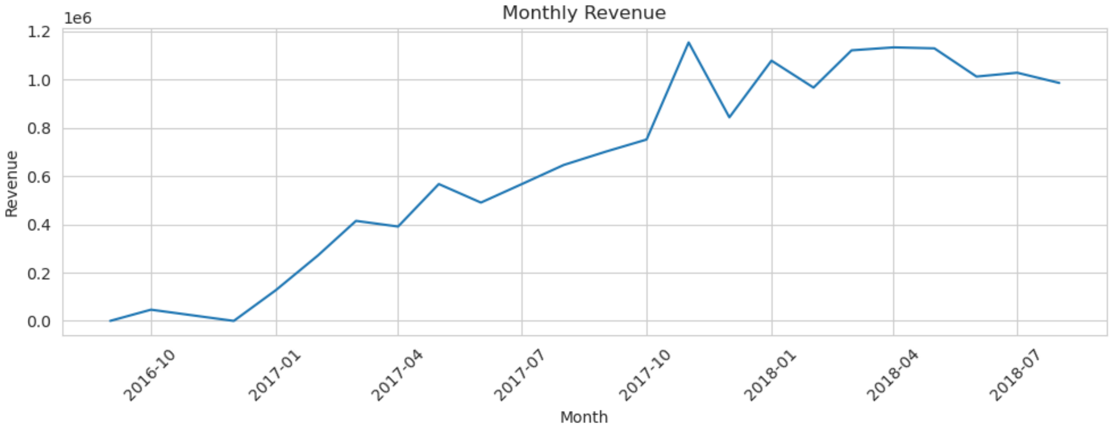
```
top_products
```

[14]:

```
                                   product_id   revenue  n_orders
24086  bb50f2e236e5eea0100680137654686c  63885.00       187
14068  6cdd53843498f92890544667809f1595  54730.20       151
27613  d6160fb7873f184099d9bc95e30376af  48899.34        35
27039  d1c427060a0f73f6b889a5c7c61f2ac4  47214.51       323
19742  99a4788cb24856965c36a24e339b6058  43025.56       467
8051   3dd2a17168ec895c781a9191c1e95ad7  41082.60       255
4996   25c38557cf793876c5abdd5931f922db  38907.32        38
12351  5f504b3a1c75b73d6151be81eb05bdc9  37733.90        63
10867  53b36df67ebb7c41585e8d54d6772e08  37683.42       306
22112  aca2eb7d00ea1a7b8ebd4e68314663af  37608.90       431
```

[15]:

```
monthly = df_sales.groupby(df_sales['order_purchase_timestamp'].dt.
 ↪to_period('M')).agg(month_revenue=("order_revenue","sum")).reset_index()
monthly['order_purchase_timestamp'] = monthly['order_purchase_timestamp'].dt.
 ↪to_timestamp()
plt.figure(figsize=(10,4))
plt.plot(monthly['order_purchase_timestamp'], monthly['month_revenue'])
plt.title("Monthly Revenue")
plt.ylabel("Revenue")
plt.xlabel("Month")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



[16]:

```
cust_orders = df_sales.groupby("customer_id").agg(
    n_orders=("order_id","nunique"),
    lifetime_value=("order_revenue","sum")
).reset_index()
```

```
repeat_rate = (cust_orders['n_orders'] > 1).mean()
print(f"Repeat purchase rate: {repeat_rate:.2%}")
print("Average Order Value (AOV):", df_sales['order_revenue'].mean())
```

```
Repeat purchase rate: 0.00%
Average Order Value (AOV): 159.82683876116837
```

[17]:

```
seller_revenue = order_items.
 ↪merge(products[['product_id','product_category_name']], on='product_id',␣
 ↪how='left')
seller_revenue = seller_revenue.groupby("seller_id").
 ↪agg(revenue=("price","sum")).reset_index().sort_values("revenue",␣
 ↪ascending=False).head(10)
seller_revenue
```

[17]:

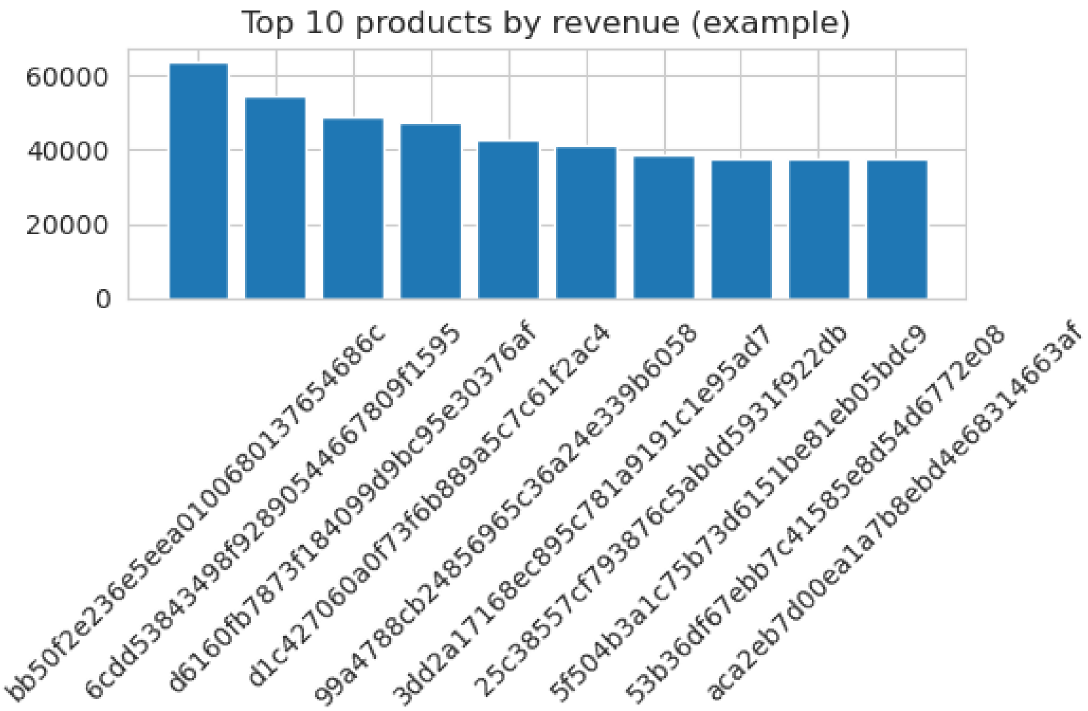
```
                             seller_id    revenue
857   4869f7a5dfa277a7dca6462dcf3b52b2  229472.63
1013  53243585a1d6dc2643021fd1853d8905  222776.05
881   4a3ca9315b744ce9f8e9374361493884  200472.92
3024  fa1c13f2614d7b5c4749cbc52fecda94  194042.03
1535  7c67e1448b00f6e969d365cea6b010ab  187923.89
1560  7e93a43ef30c4f03f38b393420bc753a  176431.87
2643  da8622b14eb17ae2831f4ac5b9dab84a  160236.57
1505  7a67c85e85bb2ce8582c35f2203ad736  141745.53
192   1025f0e2d44d7041d6cf58b6550e0bfa  138968.55
1824  955fee9216a65b617aa5c0531780ce60  135171.70
```

[20]:

```
snapshot_date = df_sales['order_purchase_timestamp'].max() + pd.
 ↪Timedelta(days=1)

rfm = df_sales.groupby("customer_id").agg(
    recency_days = ("order_purchase_timestamp", lambda x: (snapshot_date - x.
 ↪max()).days),
    frequency = ("order_id", "nunique"),
    monetary = ("order_revenue", "sum")
).reset_index()


rfm['r_quartile'] = pd.qcut(rfm['recency_days'], 4, labels=[4,3,2,1]).
 ↪astype(int)   # smaller recency -> higher score
rfm['f_quartile'] = pd.qcut(rfm['frequency'].rank(method='first'), 4,␣
 ↪labels=[1,2,3,4]).astype(int)
rfm['m_quartile'] = pd.qcut(rfm['monetary'], 4, labels=[1,2,3,4]).astype(int)
rfm['rfm_score'] = rfm['r_quartile'].astype(str) + rfm['f_quartile'].
 ↪astype(str) + rfm['m_quartile'].astype(str)
rfm.head()
```

```
[20]:                         customer_id  recency_days  frequency  monetary  \
      r_quartile  f_quartile  m_quartile rfm_score
      0  00012a2ce6f8dcda20d059ce98491703           288          1    114.74
      2           1           3       213
      1  000161a058600d5901f007fab4c27140           410          1     67.41
      1           1           2       112
      2  0001fd6190edaaf884bcaf3d49edf079           548          1    195.42
      1           1           4       114
      3  0002414f95344307404f0ace7a26f1d5           379          1    179.35
      1           1           4       114
      4  000379cdec625522490c315e70c7a9fb           150          1    107.01
      3           1           3       313
```

```
[22]: df_sales.to_csv("olist_cleaned_orders.csv", index=False)
      rfm.to_csv("olist_customer_rfm.csv", index=False)



      plt.figure(figsize=(6,4))
      plt.bar(top_products['product_id'].astype(str).head(10),␣
       ↪top_products['revenue'].head(10))
      plt.title("Top 10 products by revenue (example)")
      plt.xticks(rotation=45)
      plt.tight_layout()
      plt.savefig("plots_top_products.png")
      plt.show()
```



[24]:

```
import numpy as np

snapshot_date = df_sales['order_purchase_timestamp'].max() + pd.
 ↪Timedelta(days=1)
start_12m = snapshot_date - pd.DateOffset(months=12)
last_12m = df_sales[df_sales['order_purchase_timestamp'] >= start_12m].copy()


last_12m['order_revenue'] = last_12m['order_revenue'].fillna(0)

total_revenue_12m = last_12m['order_revenue'].sum()
aov = last_12m['order_revenue'].mean() if len(last_12m) else 0
repeat_rate = (last_12m.groupby('customer_id')['order_id'].nunique() > 1).
 ↪mean() if 'customer_id' in last_12m.columns else np.nan


monthly = last_12m.set_index('order_purchase_timestamp').resample('M').
 ↪agg(month_revenue=('order_revenue','sum')).reset_index()


if 'order_delivered_customer_date' in last_12m.columns:
    last_12m['delivery_time_days'] = (pd.
 ↪to_datetime(last_12m['order_delivered_customer_date']) - pd.
 ↪to_datetime(last_12m['order_purchase_timestamp'])).dt.days
    median_delivery_days = int(last_12m['delivery_time_days'].median())
    avg_review_all = last_12m['review_score'].mean() if 'review_score' in␣
 ↪last_12m.columns else None
    avg_review_long = last_12m.loc[last_12m['delivery_time_days'] >␣
 ↪median_delivery_days, 'review_score'].mean() if 'review_score' in last_12m.
 ↪columns else None
else:
    median_delivery_days = None
    avg_review_all = None
    avg_review_long = None


top_categories = []
top_products = []
top_sellers = []
if 'order_items' in globals():
    oi = order_items.copy()
    if 'products' in globals():
        oi = oi.merge(products[['product_id','product_category_name']],␣
 ↪on='product_id', how='left')
```

```
        top_categories = (oi.groupby('product_category_name').agg(revenue=('price','sum')).sort_values('revenue', ascending=False).head(5).reset_index())
    top_products = (oi.groupby('product_id').agg(revenue=('price','sum')).sort_values('revenue', ascending=False).head(5).reset_index())
    if 'seller_id' in oi.columns:
        top_sellers = (oi.groupby('seller_id').agg(revenue=('price','sum')).sort_values('revenue', ascending=False).head(5).reset_index())


payment_summary = None
if 'payments' in globals():
    payment_summary = payments.groupby('payment_type').agg(count=('payment_type','count'), amount=('payment_value','sum'))
    payment_summary['pct_orders'] = payment_summary['count'] / payment_summary['count'].sum()


print("Snapshot date:", snapshot_date.date())
print(f"Total revenue (last 12m): ${total_revenue_12m:,.2f}")
print(f"AOV (last 12m): ${aov:,.2f}")
print(f"Repeat purchase rate (last 12m): {repeat_rate:.2%}")
print("Median delivery time (days):", median_delivery_days)
if avg_review_all is not None:
    print(f"Avg review (all): {avg_review_all:.2f} ; Avg review (orders slower than median): {avg_review_long:.2f}")
print("\nTop categories (if available):")
print(top_categories.head() if isinstance(top_categories, pd.DataFrame) else "N/A")
print("\nTop products:")
print(top_products)
print("\nTop sellers:")
print(top_sellers)
if payment_summary is not None:
    print("\nPayment summary:")
    print(payment_summary)
```

```
Snapshot date: 2018-08-30
Total revenue (last 12m): $11,937,358.55
AOV (last 12m): $160.37
Repeat purchase rate (last 12m): 0.00%
Median delivery time (days): 10
Avg review (all): 4.13 ; Avg review (orders slower than median): 3.85

Top categories (if available):
    product_category_name     revenue
0            beleza_saude  1258681.34
```

```
1      relogios_presentes  1205005.68
2         cama_mesa_banho  1036988.68
3           esporte_lazer   988048.97
4  informatica_acessorios   911954.32

Top products:
                         product_id   revenue
0  bb50f2e236e5eea0100680137654686c  63885.00
1  6cdd53843498f92890544667809f1595  54730.20
2  d6160fb7873f184099d9bc95e30376af  48899.34
3  d1c427060a0f73f6b889a5c7c61f2ac4  47214.51
4  99a4788cb24856965c36a24e339b6058  43025.56

Top sellers:
                          seller_id    revenue
0  4869f7a5dfa277a7dca6462dcf3b52b2  229472.63
1  53243585a1d6dc2643021fd1853d8905  222776.05
2  4a3ca9315b744ce9f8e9374361493884  200472.92
3  fa1c13f2614d7b5c4749cbc52fecda94  194042.03
4  7c67e1448b00f6e969d365cea6b010ab  187923.89

Payment summary:
              count       amount  pct_orders
payment_type
boleto        19784   2869361.27    0.190440
credit_card   76795  12542084.19    0.739224
debit_card     1529    217989.79    0.014718
not_defined       3         0.00    0.000029
voucher        5775    379436.87    0.055590
```

[ ]: