Shopify Summer Intern Data Science Challenge

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Question 1:

On Shopify, we have exactly 100 sneaker shops, and each of these shops sells only one model of shoe. We want to do some analysis of the average order value (AOV). When we look at orders data over a 30 day window, we naively calculate an AOV of $3145.13. Given that we know these shops are selling sneakers, a relatively affordable item, something seems wrong with our analysis.

1. **Think about what could be going wrong with our calculation. Think about a better way to evaluate this data.**
2. **What metric would you report for this dataset?**
3. **What is its value?**

In [2]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [3]:

```
df = pd.read_csv("Data_Science_Intern_Challenge.csv")
df.head()
```

Out[3]:

	order_id	shop_id	user_id	order_amount	total_items	payment_method	created_at
0	1	53	746	224	2	cash	2017-03-13 12:36:56
1	2	92	925	90	1	cash	2017-03-03 17:38:52
2	3	44	861	144	1	cash	2017-03-14 4:23:56
3	4	18	935	156	1	credit_card	2017-03-26 12:43:37
4	5	18	883	156	1	credit_card	2017-03-01 4:35:11

Basic Descriptive Stats

In [4]:

```
df.shape
```

Out[4]:

```
(5000, 7)
```

In [6]:

```
df['shop_id'].nunique()
```

Out[6]:

```
100
```

In [8]:

```
df['created_at'].describe()
```

Out[8]:

```
count                   5000
unique                  4991
top       2017-03-28 4:00:00
freq                       3
Name: created_at, dtype: object
```

In [11]:

```
df['shop_id'].value_counts()
```

Out[11]:

```
53    68
71    66
19    64
13    63
89    61
      ..
74    38
56    37
67    37
38    35
85    35
Name: shop_id, Length: 100, dtype: int64
```

In [12]:

```
min(df['created_at'])
```

Out[12]:

```
'2017-03-01 0:08:09'
```

In [13]:

```
max(df['created_at'])
```

Out[13]:

```
'2017-03-30 9:55:00'
```

In [5]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5000 entries, 0 to 4999
Data columns (total 7 columns):
 #   Column          Non-Null Count  Dtype 
---  ------          --------------  ----- 
 0   order_id        5000 non-null   int64 
 1   shop_id         5000 non-null   int64 
 2   user_id         5000 non-null   int64 
 3   order_amount    5000 non-null   int64 
 4   total_items     5000 non-null   int64 
 5   payment_method  5000 non-null   object
 6   created_at      5000 non-null   object
dtypes: int64(5), object(2)
memory usage: 273.6+ KB
```

In [6]:

```
df.describe()
```

Out[6]:

	order_id	shop_id	user_id	order_amount	total_items
count	5000.000000	5000.000000	5000.000000	5000.000000	5000.00000
mean	2500.500000	50.078800	849.092400	3145.128000	8.78720
std	1443.520003	29.006118	87.798982	41282.539349	116.32032
min	1.000000	1.000000	607.000000	90.000000	1.00000
25%	1250.750000	24.000000	775.000000	163.000000	1.00000
50%	2500.500000	50.000000	849.000000	284.000000	2.00000
75%	3750.250000	75.000000	925.000000	390.000000	3.00000
max	5000.000000	100.000000	999.000000	704000.000000	2000.00000

Clearly the error in the calculation is that the order amount column is just averaged over the 30 day period without considering the variation in the items ordered. This is misleading since if the quantity ordered is more, naturally the order_amount will be more.

Thus,
Average order value = Total Order Amount over 30 days/ Total number of items purchased over 30 days
This can be done:

1. **Overall**
2. **Shop wise**

Overall

In [14]:

```
sum(df['order_amount'])/sum(df['total_items'])
```

Out[14]:

```
357.92152221412965
```

The overall AOV is $ 357.92

Store wise

In [83]:

```
df_grouped = df.groupby('shop_id')[['order_amount', 'total_items']].sum()
df_grouped['AOV'] = df_grouped['order_amount']/df_grouped['total_items']
df_grouped.head()
```

Out[83]:

	order_amount	total_items	AOV
shop_id			
1	13588	86	158.0
2	9588	102	94.0
3	14652	99	148.0
4	13184	103	128.0
5	13064	92	142.0

In [84]:

```
print("Maximum Store wise AOV: ", max(df_grouped['AOV']))
print("Maximum Store wise AOV: ", min(df_grouped['AOV']))
```

```
Maximum Store wise AOV:  25725.0
Maximum Store wise AOV:  90.0
```

In [9]:

```
print("Maximum order amount: ", max(df['order_amount']))
print("Minimum order amount: ", min(df['order_amount']))
```

```
Maximum order amount:  704000
Minimum order amount:  90
```

In [85]:

```
df_grouped['AOV'].mean()
```

Out[85]:

```
407.99
```

In [11]:

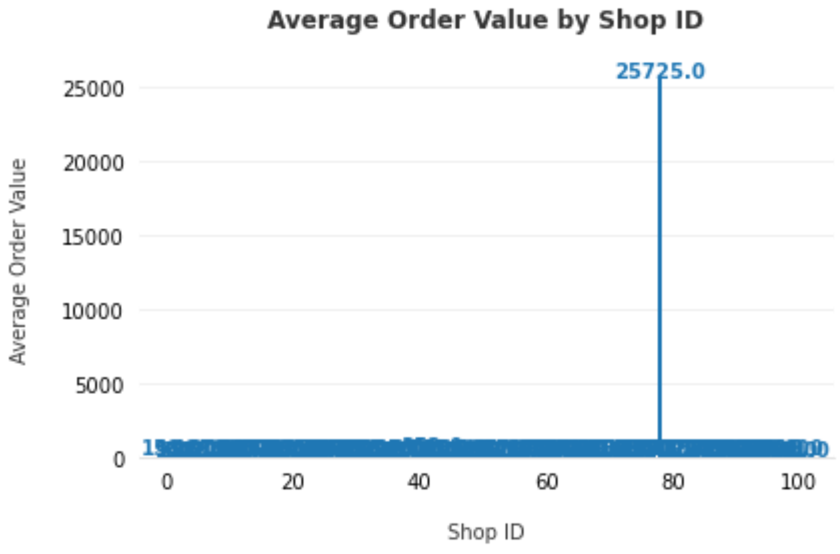
```
df_grouped.index
```

Out[11]:

```
Int64Index([  1,   2,   3,   4,   5,   6,   7,   8,   9,  10,  11,  1
2,  13,
             14,  15,  16,  17,  18,  19,  20,  21,  22,  23,  24,  2
5,  26,
             27,  28,  29,  30,  31,  32,  33,  34,  35,  36,  37,  3
8,  39,
             40,  41,  42,  43,  44,  45,  46,  47,  48,  49,  50,  5
1,  52,
             53,  54,  55,  56,  57,  58,  59,  60,  61,  62,  63,  6
4,  65,
             66,  67,  68,  69,  70,  71,  72,  73,  74,  75,  76,  7
7,  78,
             79,  80,  81,  82,  83,  84,  85,  86,  87,  88,  89,  9
0,  91,
             92,  93,  94,  95,  96,  97,  98,  99, 100],
           dtype='int64', name='shop_id')
```

In [15]:

```
fig, ax = plt.subplots()

# Save the chart so we can loop through the bars below.
bars = ax.bar(
    x=df_grouped.index,
    height=df_grouped['AOV']
)

# Axis formatting.
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)
ax.spines['left'].set_visible(False)
ax.spines['bottom'].set_color('#DDDDDD')
ax.tick_params(bottom=False, left=False)
ax.set_axisbelow(True)
ax.yaxis.grid(True, color='#EEEEEE')
ax.xaxis.grid(False)

# Add text annotations to the top of the bars.
bar_color = bars[0].get_facecolor()
for bar in bars:
  ax.text(
      bar.get_x() + bar.get_width() / 2,
      bar.get_height() + 0.3,
      round(bar.get_height(), 1),
      horizontalalignment='center',
      color=bar_color,
      weight='bold'
  )

# Add labels and a title. Note the use of `labelpad` and `pad` to add some
# extra space between the text and the tick labels.
ax.set_xlabel('Shop ID', labelpad=15, color='#333333')
ax.set_ylabel('Average Order Value', labelpad=15, color='#333333')
ax.set_title('Average Order Value by Shop ID', pad=15, color='#333333',
             weight='bold')

fig.tight_layout()
```



In [6]:

```
# Analyzing which store has such high AOV
df_grouped[df_grouped['AOV'] == max(df_grouped['AOV'])]
```

Out[6]:

	order_amount	total_items	AOV
shop_id			
78	2263800	88	25725.0

In [8]:

```
df[df['shop_id'] == 78]
```

Out[8]:

	order_id	shop_id	user_id	order_amount	total_items	payment_method	created_at
160	161	78	990	25725	1	credit_card	2017-03-12 5:56:57
490	491	78	936	51450	2	debit	2017-03-26 17:08:19
493	494	78	983	51450	2	cash	2017-03-16 21:39:35
511	512	78	967	51450	2	cash	2017-03-09 7:23:14
617	618	78	760	51450	2	cash	2017-03-18 11:18:42
691	692	78	878	154350	6	debit	2017-03-27 22:51:43
1056	1057	78	800	25725	1	debit	2017-03-15 10:16:45

Thus more data on store 78 clearly needs to be investigated for any data errors or fradulent transactions since the AOV and order amount is pretty high

Quick analysis of the rest of the stores

In [29]:

```
from matplotlib.pyplot import figure

figure(figsize=(20, 10), dpi=80)
df_grouped_cleaned = df_grouped[df_grouped['AOV'] != max(df_grouped['AOV'])]

fig, ax = plt.subplots(figsize=(15, 10))
bars = ax.bar(
    x=df_grouped_cleaned.index,
    height=df_grouped_cleaned['AOV']
)

# Axis formatting.
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)
ax.spines['left'].set_visible(False)
ax.spines['bottom'].set_color('#DDDDDD')
ax.tick_params(bottom=False, left=False)
ax.set_axisbelow(True)
ax.yaxis.grid(True, color='#EEEEEE')
ax.xaxis.grid(False)

# Add text annotations to the top of the bars.
bar_color = bars[0].get_facecolor()
for bar in bars:
  ax.text(
      bar.get_x() + bar.get_width() / 2,
      bar.get_height() + 0.3,
      round(bar.get_height(), 1),
      horizontalalignment='center',
      color=bar_color,
      weight='bold'
  )

# Add labels and a title. Note the use of `labelpad` and `pad` to add some
# extra space between the text and the tick labels.
ax.set_xlabel('Shop ID', labelpad=15, color='#333333')
ax.set_ylabel('Average Order Value', labelpad=15, color='#333333')
ax.set_title('Average Order Value by Shop ID', pad=15, color='#333333',
             weight='bold')

fig.tight_layout()
```

```
<Figure size 1600x800 with 0 Axes>
```

In [30]:

```
# Average Order Value after excluding shop 78
df_cleaned = df[df['shop_id'] != 78]
sum(df_cleaned['order_amount'])/sum(df_cleaned['total_items'])
```

Out[30]:

```
307.01149425287355
```

In [31]:

```
# AOV per shop
df_grouped_cleaned['AOV'].mean()
```

Out[31]:

```
152.26262626262627
```

A median or mode order value might be a better way to evaluate the data

a. Take the median/mode of AOV

In [39]:

```
df_grouped = df.groupby('shop_id')[['order_amount']].sum()
df_grouped['total_items'] = df.groupby('shop_id')[['total_items']].sum()
df_grouped['AOV'] = df_grouped['order_amount']/df_grouped['total_items']
```

In [41]:

```
df_grouped.head()
```

Out[41]:

	order_amount	total_items	AOV
shop_id			
1	13588	86	158.0
2	9588	102	94.0
3	14652	99	148.0
4	13184	103	128.0
5	13064	92	142.0

In [44]:

```
df_grouped['AOV'].median()
```

Out[44]:

```
153.0
```

In [46]:

```
df_grouped['AOV'].mode()
```

Out[46]:

```
0    153.0
dtype: float64
```

Thus we can report median or mode AOV value store wise to be $153 for sneakers.

2. Median Order Value: This helps us get rid of outliers from the very start

In [48]:

```
df.head()
```

Out[48]:

	order_id	shop_id	user_id	order_amount	total_items	payment_method	created_at
0	1	53	746	224	2	cash	2017-03-13 12:36:56
1	2	92	925	90	1	cash	2017-03-03 17:38:52
2	3	44	861	144	1	cash	2017-03-14 4:23:56
3	4	18	935	156	1	credit_card	2017-03-26 12:43:37
4	5	18	883	156	1	credit_card	2017-03-01 4:35:11

In [49]:

```
df['order_amount_per_item'] = df['order_amount']/df['total_items']
df.head()
```

Out[49]:

	order_id	shop_id	user_id	order_amount	total_items	payment_method	created_at	order_an
0	1	53	746	224	2	cash	2017-03-13 12:36:56	
1	2	92	925	90	1	cash	2017-03-03 17:38:52	
2	3	44	861	144	1	cash	2017-03-14 4:23:56	
3	4	18	935	156	1	credit_card	2017-03-26 12:43:37	
4	5	18	883	156	1	credit_card	2017-03-01 4:35:11	

In [50]:

```
df['order_amount_per_item'].median()
```

Out[50]:

```
153.0
```

Thus the second approach is simple and much reliable.

Better Analysis - Customer Value and Date Analysis

Average Order Value purchased by customer

In [51]:

```
print("Number of Users: ", df['user_id'].nunique())
```

```
Number of Users:  301
```

In [72]:

```
df_grouped = df.groupby('user_id')[['order_amount', 'total_items']].sum()
df_grouped['Average Order Value per Customer'] = df_grouped['order_amount']/df_group
df_grouped.sort_values(by=['Average Order Value per Customer'], ascending=False).hea
```

Out[72]:

	order_amount	total_items	Average Order Value per Customer
user_id			
878	156936	24	6539.000000
766	80076	23	3481.565217
962	80408	24	3350.333333
855	80915	27	2996.851852
775	81114	28	2896.928571

In [63]:

```
data = df_grouped['Average Order Value per Customer']
fig, ax = plt.subplots(figsize=(10,20))
ax.set_title('Notched boxes')
ax.boxplot(data, notch=True)
```

Out[63]:

```
{'whiskers': [<matplotlib.lines.Line2D at 0x7f67755a6160>,
  <matplotlib.lines.Line2D at 0x7f67755a6b80>],
 'caps': [<matplotlib.lines.Line2D at 0x7f6775159310>,
  <matplotlib.lines.Line2D at 0x7f6775159580>],
 'boxes': [<matplotlib.lines.Line2D at 0x7f67755a6400>],
 'medians': [<matplotlib.lines.Line2D at 0x7f6775159700>],
 'fliers': [<matplotlib.lines.Line2D at 0x7f6775159c70>],
 'means': []}
```

Clearly we have some outliers for Average Order Value with the customers as well

In [73]:

```
df_grouped.sort_values(by=['Average Order Value per Customer'], ascending=False).hea
```

Out[73]:

	order_amount	total_items	Average Order Value per Customer
user_id			
878	156936	24	6539.0

In [74]:

```
df[df['user_id'] == 878]
```

Out[74]:

	order_id	shop_id	user_id	order_amount	total_items	payment_method	created_at	order
691	692	78	878	154350	6	debit	2017-03-27 22:51:43	
818	819	60	878	354	2	debit	2017-03-27 12:42:01	
927	928	2	878	94	1	credit_card	2017-03-10 18:09:05	
1575	1576	47	878	290	2	cash	2017-03-07 22:06:51	
1833	1834	74	878	153	1	credit_card	2017-03-06 17:33:21	
2011	2012	87	878	298	2	cash	2017-03-04 14:14:35	
3474	3475	20	878	254	2	cash	2017-03-17 3:43:03	
3647	3648	98	878	266	2	cash	2017-03-06 1:49:57	
4106	4107	26	878	176	1	debit	2017-03-20 4:32:18	
4215	4216	80	878	435	3	debit	2017-03-05 3:07:32	
4670	4671	98	878	266	2	debit	2017-03-30 0:22:20	

Thus we observe that while other users also purchased 1-3 sneakers from store 78 in the 30 day period, user 878 purchased the maximum number (6) sneakers from store 78 resulting in a very high order amount of $154350. This transaction is definitely suspicious and needs further investigation.

Using Median

In [77]:

```
df_grouped = df.groupby('user_id')[['order_amount']].median()
df_grouped['total_items'] = df.groupby('user_id')[['total_items']].median()
df_grouped['Median Order Value'] = df_grouped['order_amount']/df_grouped['total_item
df_grouped.sort_values(by=['Median Order Value'], ascending=False).head()
```

Out[77]:

	order_amount	total_items	Median Order Value
user_id			
607	704000.0	2000.0	352.000000
946	258.0	1.0	258.000000
770	242.0	1.0	242.000000
792	218.5	1.0	218.500000
866	308.0	1.5	205.333333

In [79]:

```
df_grouped['Median Order Value'].median()
```

Out[79]:

```
149.0
```

In [80]:

```
data = df_grouped['Median Order Value']
fig, ax = plt.subplots(figsize=(10,20))
ax.set_title('Notched boxes')
ax.boxplot(data, notch=True)
```

Out[80]:

```
{'whiskers': [<matplotlib.lines.Line2D at 0x7f677539e2e0>,
  <matplotlib.lines.Line2D at 0x7f677539e370>],
 'caps': [<matplotlib.lines.Line2D at 0x7f677539efa0>,
  <matplotlib.lines.Line2D at 0x7f6774ccc460>],
 'boxes': [<matplotlib.lines.Line2D at 0x7f677539ed00>],
 'medians': [<matplotlib.lines.Line2D at 0x7f6774ccc940>],
 'fliers': [<matplotlib.lines.Line2D at 0x7f6774ef94f0>],
 'means': []}
```

The use of Median gives us another discovery of user_id 607 with the highest order amount of 70400

In [42]:

```
df[df['user_id'] == 607]
```

Out[42]:

	order_id	shop_id	user_id	order_amount	total_items	payment_method	created_at
15	16	42	607	704000	2000	credit_card	2017-03-07 4:00:00
60	61	42	607	704000	2000	credit_card	2017-03-04 4:00:00
520	521	42	607	704000	2000	credit_card	2017-03-02 4:00:00
1104	1105	42	607	704000	2000	credit_card	2017-03-24 4:00:00
1362	1363	42	607	704000	2000	credit_card	2017-03-15 4:00:00
1436	1437	42	607	704000	2000	credit_card	2017-03-11 4:00:00
1562	1563	42	607	704000	2000	credit_card	2017-03-19 4:00:00
1602	1603	42	607	704000	2000	credit_card	2017-03-17 4:00:00
2153	2154	42	607	704000	2000	credit_card	2017-03-12 4:00:00
2297	2298	42	607	704000	2000	credit_card	2017-03-07 4:00:00
2835	2836	42	607	704000	2000	credit_card	2017-03-28 4:00:00
2969	2970	42	607	704000	2000	credit_card	2017-03-28 4:00:00
3332	3333	42	607	704000	2000	credit_card	2017-03-24 4:00:00
4056	4057	42	607	704000	2000	credit_card	2017-03-28 4:00:00
4646	4647	42	607	704000	2000	credit_card	2017-03-02 4:00:00
4868	4869	42	607	704000	2000	credit_card	2017-03-22 4:00:00
4882	4883	42	607	704000	2000	credit_card	2017-03-25 4:00:00

This shop 42 and user id 607 clearly looks suspicious since they have way too many orders (2000) per order and the order amount is also the highest. There are also orders made on the same date. This might be a data error or fraudulent transaction.

Date wise analysis

In [81]:

```
df['date_time'] = pd.to_datetime(df['created_at'])
df['date'] = [d.date() for d in df["date_time"]]
```

In [82]:

```
df.head()
```

Out[82]:

	order_id	shop_id	user_id	order_amount	total_items	payment_method	created_at	order_am
0	1	53	746	224	2	cash	2017-03-13 12:36:56	
1	2	92	925	90	1	cash	2017-03-03 17:38:52	
2	3	44	861	144	1	cash	2017-03-14 4:23:56	
3	4	18	935	156	1	credit_card	2017-03-26 12:43:37	
4	5	18	883	156	1	credit_card	2017-03-01 4:35:11	

In [51]:

```
df_grouped = df.groupby('date')[['order_amount']].sum()
```

In [57]:

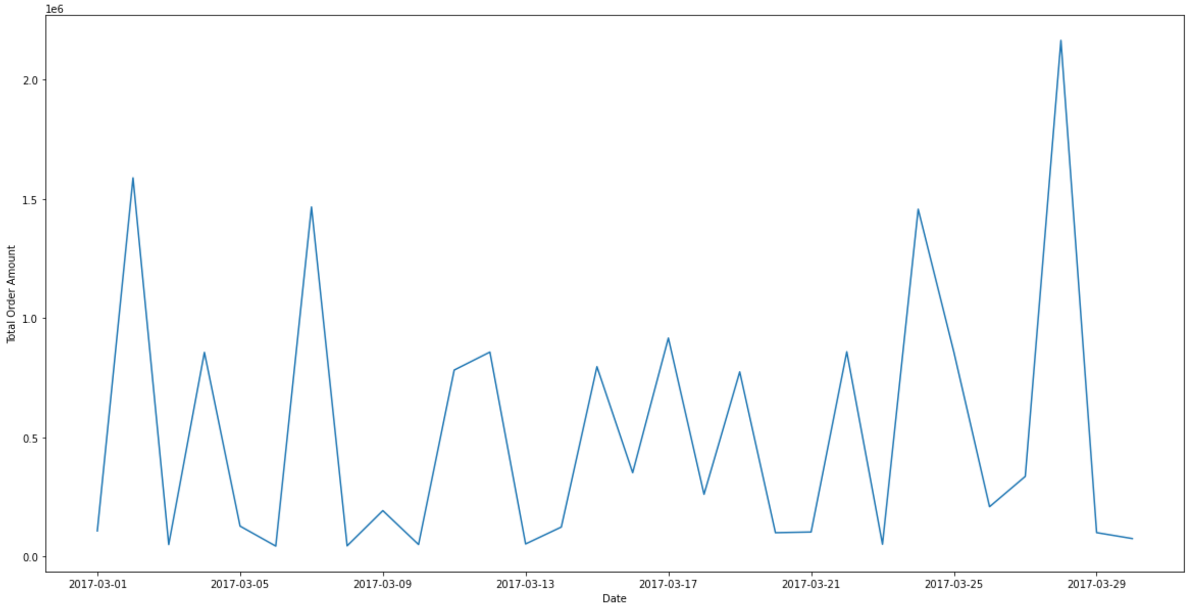
```
df_grouped.index
```

Out[57]:

```
Index([2017-03-01, 2017-03-02, 2017-03-03, 2017-03-04, 2017-03-05, 201
7-03-06,
       2017-03-07, 2017-03-08, 2017-03-09, 2017-03-10, 2017-03-11, 201
7-03-12,
       2017-03-13, 2017-03-14, 2017-03-15, 2017-03-16, 2017-03-17, 201
7-03-18,
       2017-03-19, 2017-03-20, 2017-03-21, 2017-03-22, 2017-03-23, 201
7-03-24,
       2017-03-25, 2017-03-26, 2017-03-27, 2017-03-28, 2017-03-29, 201
7-03-30],
      dtype='object', name='date')
```

In [61]:

```
import matplotlib.pyplot as plt

x = df_grouped.index
y = df_grouped['order_amount']

fig, ax = plt.subplots(figsize=(20, 10))
ax.set_xlabel('Date')
ax.set_ylabel('Total Order Amount')
plt.plot(x, y)
plt.show()
```



Since it is just a 30 day period it is hard to say about trends. More data for months need to be collected for each shop to understand patterns and comment on sneaker sales.

Conclusion

1a.

The sales for sneaker sales calculated in the question had a major error of not taking total items into account. When we considered total items and calculate the average order value it comes out to be $357.92 which is still pretty high.
So, we can dig deeper and find outliers shop and customer wise. This gives us opportunity to explore the errors in our database and analyze sales.

1b.

A better method to measure the sales would be median order value since median calculation is not affected by outliers and gives us a more realistic measure of an overall picture.

1c.

The median order value is $153.

Question 2

Please use queries to answer the following questions. Paste your queries along with your final numerical answers below.

1. **How many orders were shipped by Speedy Express in total?**
2. **What is the last name of the employee with the most orders?**
3. **What product was ordered the most by customers in Germany?**

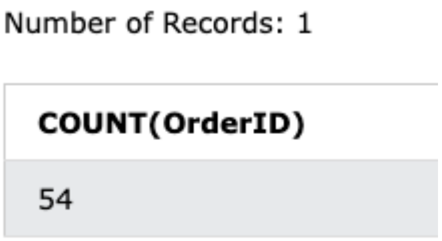
Solutions

1. How many orders were shipped by Speedy Express in total?

In [ ]:

```
# Counting Orders of the fetched ShipperID
SELECT COUNT(OrderID) FROM Orders
WHERE ShipperID IN
(
    # Getting ShipperID of Speedy Express
    SELECT ShipperID
    FROM Shippers
    WHERE ShipperName = 'Speedy Express'
);
```

Output:



Number of Records: 1

COUNT(OrderID)
54

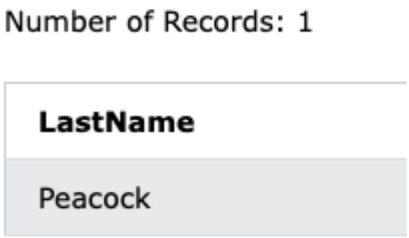
Ans: 54

2. What is the last name of the employee with the most orders?

In [ ]:

```
# Getting Last Name of the subsetted employee
SELECT LastName
FROM Employees
WHERE EmployeeID IN
(
    # Getting EmployeeID of Employee with most orders
    SELECT EmployeeID
    FROM Orders
    GROUP BY EmployeeID
    ORDER BY COUNT(OrderID) DESC
    LIMIT 1
);
```

Output



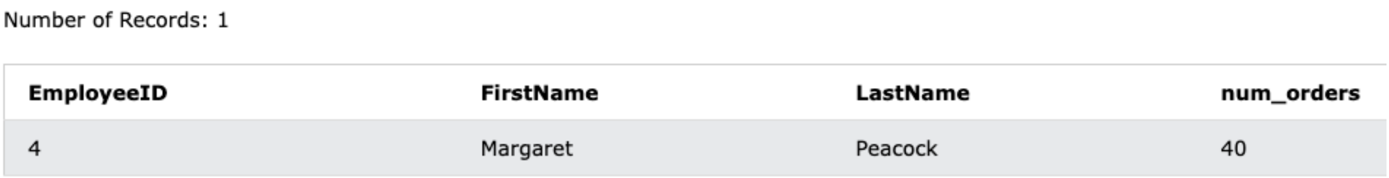
Number of Records: 1

LastName
Peacock

In [ ]:

```
## To get the num_orders of the employee with most orders with the name, we can use

# Common Table Expression for fetching Employee ID and number of orders
With temp_cte as
(
    SELECT EmployeeID, COUNT(OrderID) as num_orders
    FROM Orders
    GROUP BY EmployeeID
)
# Fetching all details from the join of CTE and Employees table for Employee having
SELECT e.EmployeeID, FirstName, LastName, num_orders
FROM Employees e LEFT JOIN temp_cte tc
ON e.EmployeeID = tc.EmployeeID
ORDER BY num_orders DESC
LIMIT 1;
```

Output



Number of Records: 1

EmployeeID	FirstName	LastName	num_orders
4	Margaret	Peacock	40

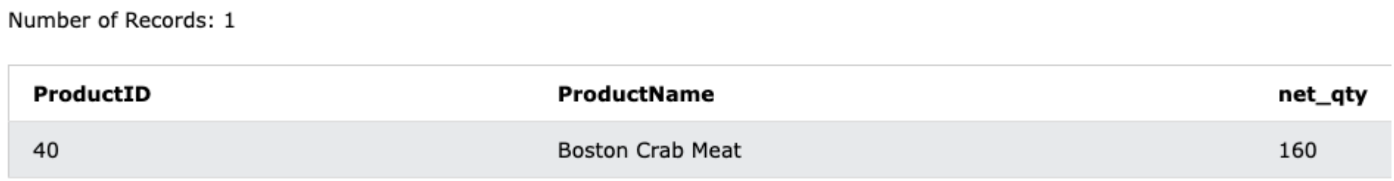
Ans: Peacock

What product was ordered the most by customers in Germany?

In [ ]:

```
# Getting Product Name and quantity by combining four tables Orders, Order Details,
# For Country Germany and for Product that was most ordered there
SELECT p.ProductID, ProductName, SUM(Quantity) AS net_qty
FROM Orders o, OrderDetails od, Customers c, Products p
WHERE Country = "Germany"
AND o.OrderID = od.OrderID
AND o.CustomerID = c.CustomerID
AND od.ProductID = p.ProductID
GROUP BY p.ProductID
ORDER BY SUM(Quantity) DESC
LIMIT 1;
```

Output:



Number of Records: 1

ProductID	ProductName	net_qty
40	Boston Crab Meat	160

Ans:
Product ID 40
Product Name: Boston Crab Meat
with net order quanity 160

END OF SUBMISSION