Time,Date & Timezone Analysis

Dataset : https://github.com/Asif520/Time-Date-Timezone-Analysis-Project-with-Python/blob/main/Sales-products-tz-mod.csv

Main Task:

-Obtain information about the product sales of the various retailer types in UTC offset. Display the average amount of sales that occurred in each time zone

Solution map:

- **Step 1:** Store the date and time values in a single column called "MOS", denoting "Moment of Sale". Verify that the time zone values stored in "sales_data" are valid and can be manipulated with the pytz module. *(Data Preparation)*
- **Step 2:** Estimate the offset of the values of "MOS" to UTC. Store them in a column called "OffsetUTC". *(Data Manipulation)*
- **Step 3:** Order all sales according to a reconciled UTC-equivalent of the moment of sale and analyze the data. *(Data Analysis)*
- **Step 4:** Obtain statistics and visualizations that will respond to the Main Task and further improve the analysis of your data. *(Data Visualization)*

In [1]:

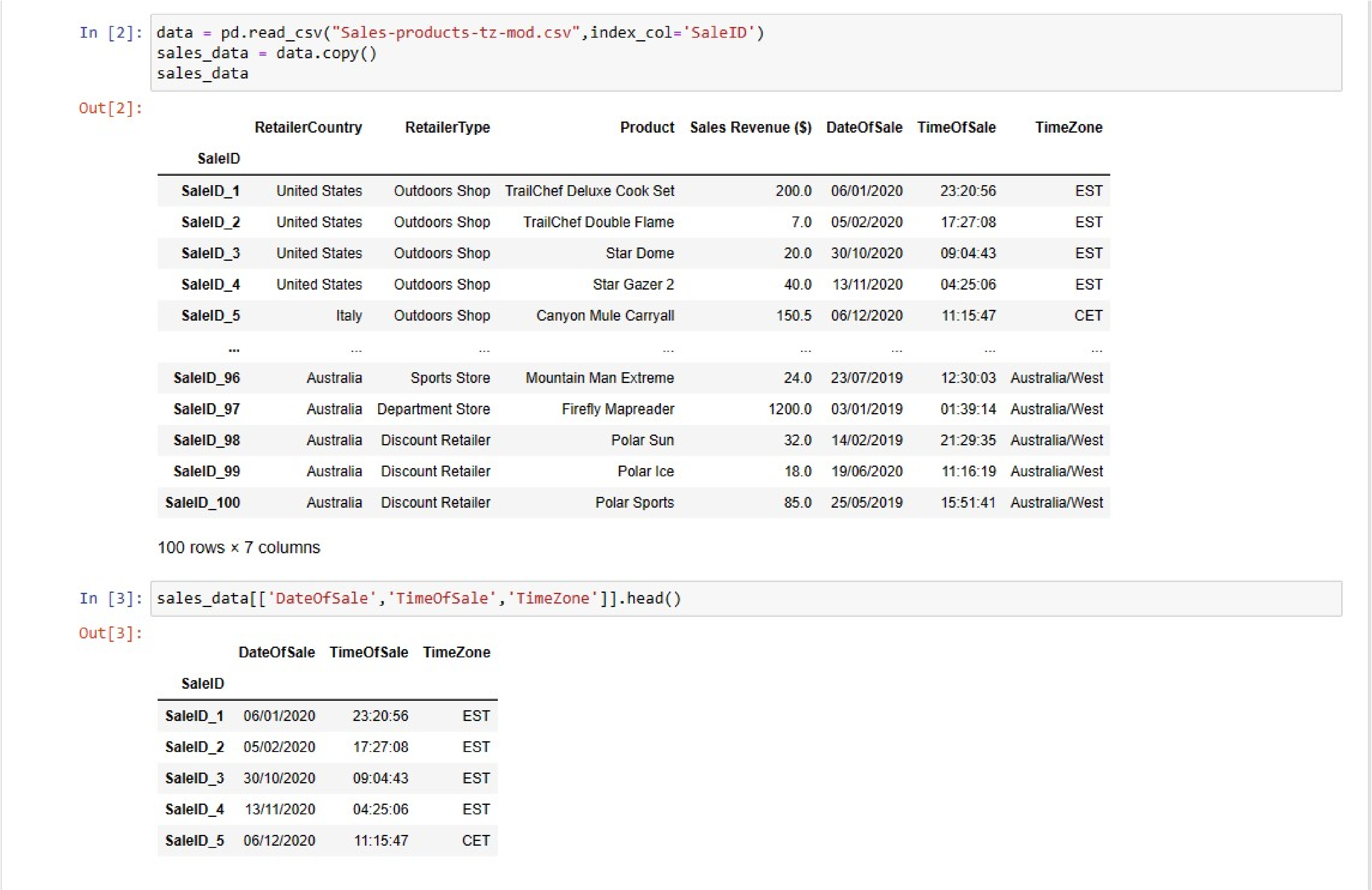
```python
import pandas as pd
import pytz
from datetime import datetime
from matplotlib import pyplot as plt
import warnings
warnings.filterwarnings('ignore')
```

In [2]:

```python
data = pd.read_csv("Sales-products-tz-mod.csv",index_col='SaleID')
sales_data = data.copy()
sales_data
```

Out[2]:

	RetailerCountry	RetailerType	Product	Sales Revenue ($)	DateOfSale	TimeOfSale	TimeZone
SaleID							
SaleID_1	United States	Outdoors Shop	TrailChef Deluxe Cook Set	200.0	06/01/2020	23:20:56	EST
SaleID_2	United States	Outdoors Shop	TrailChef Double Flame	7.0	05/02/2020	17:27:08	EST
SaleID_3	United States	Outdoors Shop	Star Dome	20.0	30/10/2020	09:04:43	EST



In [2]:
```
data = pd.read_csv("Sales-products-tz-mod.csv",index_col='SaleID')
sales_data = data.copy()
sales_data
```

Out[2]:

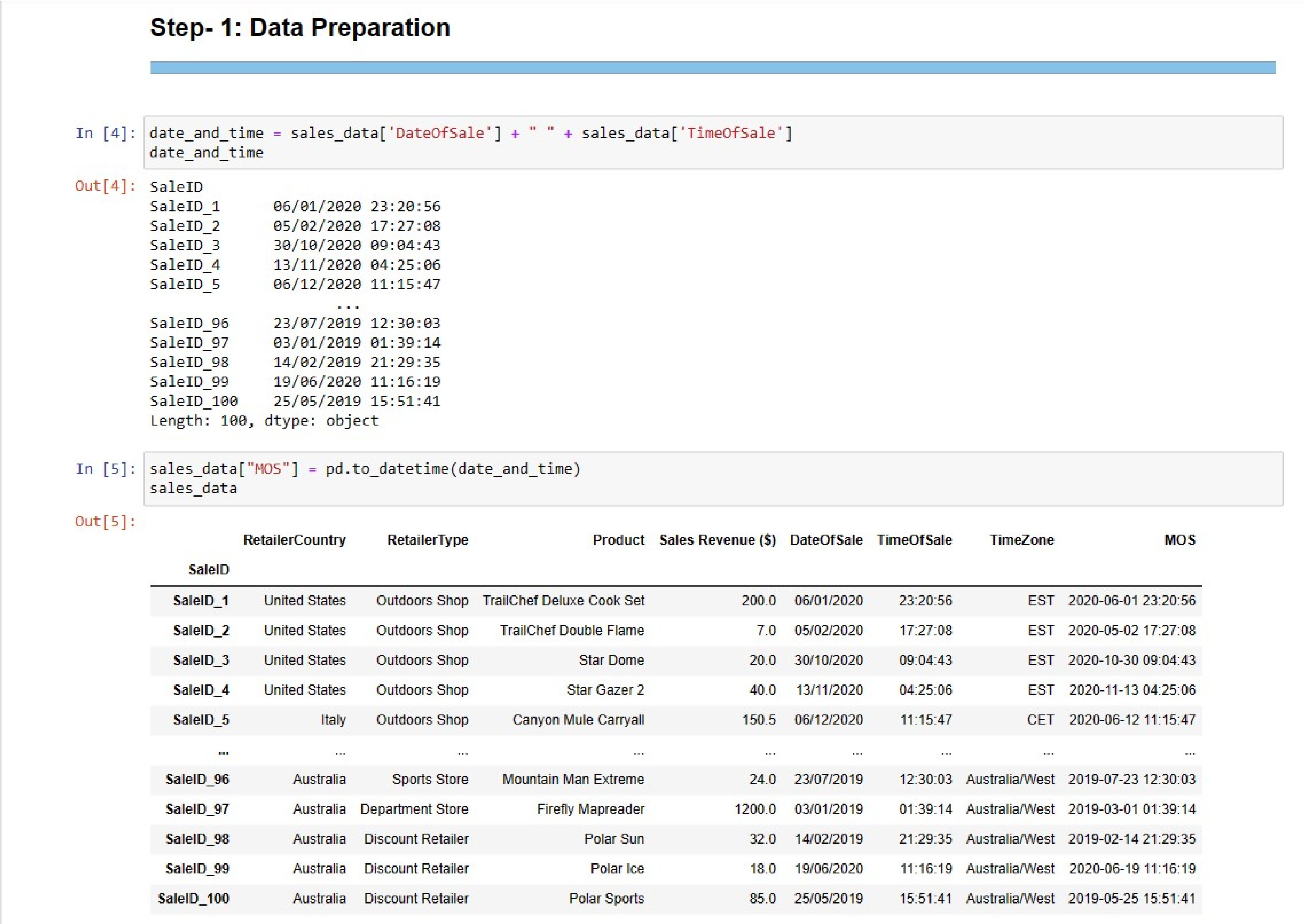
	RetailerCountry	RetailerType	Product	Sales Revenue ($)	DateOfSale	TimeOfSale	TimeZone
SaleID							
SaleID_1	United States	Outdoors Shop	TrailChef Deluxe Cook Set	200.0	06/01/2020	23:20:56	EST
SaleID_2	United States	Outdoors Shop	TrailChef Double Flame	7.0	05/02/2020	17:27:08	EST
SaleID_3	United States	Outdoors Shop	Star Dome	20.0	30/10/2020	09:04:43	EST
SaleID_4	United States	Outdoors Shop	Star Gazer 2	40.0	13/11/2020	04:25:06	EST
SaleID_5	Italy	Outdoors Shop	Canyon Mule Carryall	150.5	06/12/2020	11:15:47	CET
...	...	...	...	...	...	...	...
SaleID_96	Australia	Sports Store	Mountain Man Extreme	24.0	23/07/2019	12:30:03	Australia/West
SaleID_97	Australia	Department Store	Firefly Mapreader	1200.0	03/01/2019	01:39:14	Australia/West
SaleID_98	Australia	Discount Retailer	Polar Sun	32.0	14/02/2019	21:29:35	Australia/West
SaleID_99	Australia	Discount Retailer	Polar Ice	18.0	19/06/2020	11:16:19	Australia/West
SaleID_100	Australia	Discount Retailer	Polar Sports	85.0	25/05/2019	15:51:41	Australia/West

100 rows × 7 columns

In [3]:
```
sales_data[['DateOfSale','TimeOfSale','TimeZone']].head()
```

Out[3]:

	DateOfSale	TimeOfSale	TimeZone
SaleID			
SaleID_1	06/01/2020	23:20:56	EST
SaleID_2	05/02/2020	17:27:08	EST
SaleID_3	30/10/2020	09:04:43	EST
SaleID_4	13/11/2020	04:25:06	EST
SaleID_5	06/12/2020	11:15:47	CET



Step- 1: Data Preparation

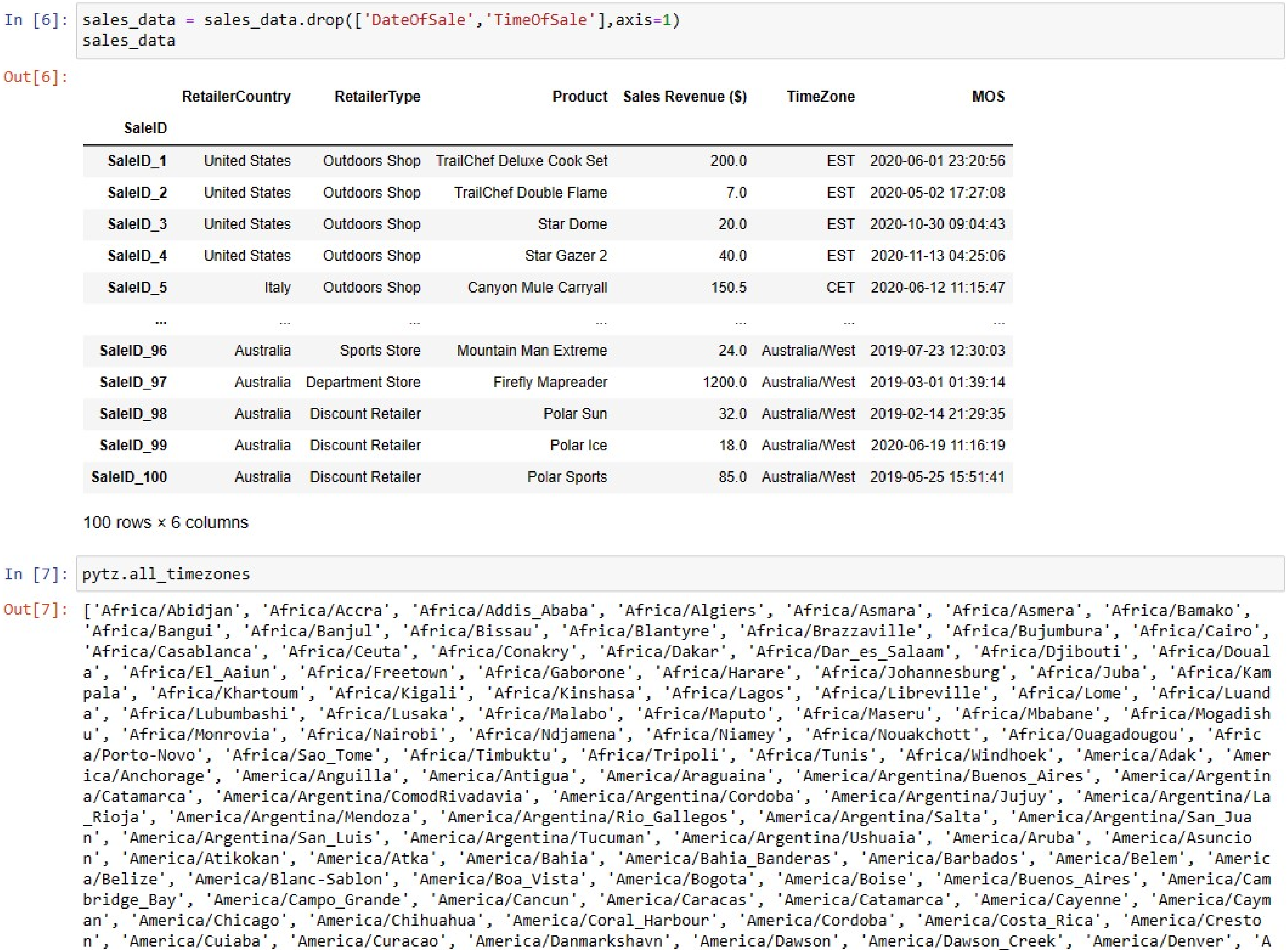
```
In [4]: date_and_time = sales_data['DateOfSale'] + " " + sales_data['TimeOfSale']
        date_and_time
```

```
Out[4]: SaleID
        SaleID_1      06/01/2020 23:20:56
        SaleID_2      05/02/2020 17:27:08
        SaleID_3      30/10/2020 09:04:43
        SaleID_4      13/11/2020 04:25:06
        SaleID_5      06/12/2020 11:15:47
                              ...
        SaleID_96     23/07/2019 12:30:03
        SaleID_97     03/01/2019 01:39:14
        SaleID_98     14/02/2019 21:29:35
        SaleID_99     19/06/2020 11:16:19
        SaleID_100    25/05/2019 15:51:41
        Length: 100, dtype: object
```

```
In [5]: sales_data["MOS"] = pd.to_datetime(date_and_time)
        sales_data
```

Out[5]:

	RetailerCountry	RetailerType	Product	Sales Revenue ($)	DateOfSale	TimeOfSale	TimeZone	MOS
SaleID								
SaleID_1	United States	Outdoors Shop	TrailChef Deluxe Cook Set	200.0	06/01/2020	23:20:56	EST	2020-06-01 23:20:56
SaleID_2	United States	Outdoors Shop	TrailChef Double Flame	7.0	05/02/2020	17:27:08	EST	2020-05-02 17:27:08
SaleID_3	United States	Outdoors Shop	Star Dome	20.0	30/10/2020	09:04:43	EST	2020-10-30 09:04:43
SaleID_4	United States	Outdoors Shop	Star Gazer 2	40.0	13/11/2020	04:25:06	EST	2020-11-13 04:25:06
SaleID_5	Italy	Outdoors Shop	Canyon Mule Carryall	150.5	06/12/2020	11:15:47	CET	2020-06-12 11:15:47
...	...	...	...	...	...	...	...	...
SaleID_96	Australia	Sports Store	Mountain Man Extreme	24.0	23/07/2019	12:30:03	Australia/West	2019-07-23 12:30:03
SaleID_97	Australia	Department Store	Firefly Mapreader	1200.0	03/01/2019	01:39:14	Australia/West	2019-03-01 01:39:14
SaleID_98	Australia	Discount Retailer	Polar Sun	32.0	14/02/2019	21:29:35	Australia/West	2019-02-14 21:29:35
SaleID_99	Australia	Discount Retailer	Polar Ice	18.0	19/06/2020	11:16:19	Australia/West	2020-06-19 11:16:19
SaleID_100	Australia	Discount Retailer	Polar Sports	85.0	25/05/2019	15:51:41	Australia/West	2019-05-25 15:51:41



In [6]:

```
sales_data = sales_data.drop(['DateOfSale','TimeOfSale'],axis=1)
sales_data
```

Out[6]:

SaleID	RetailerCountry	RetailerType	Product	Sales Revenue ($)	TimeZone	MOS
SaleID_1	United States	Outdoors Shop	TrailChef Deluxe Cook Set	200.0	EST	2020-06-01 23:20:56
SaleID_2	United States	Outdoors Shop	TrailChef Double Flame	7.0	EST	2020-05-02 17:27:08
SaleID_3	United States	Outdoors Shop	Star Dome	20.0	EST	2020-10-30 09:04:43
SaleID_4	United States	Outdoors Shop	Star Gazer 2	40.0	EST	2020-11-13 04:25:06
SaleID_5	Italy	Outdoors Shop	Canyon Mule Carryall	150.5	CET	2020-06-12 11:15:47
...	...	...	...	...	...	...
SaleID_96	Australia	Sports Store	Mountain Man Extreme	24.0	Australia/West	2019-07-23 12:30:03
SaleID_97	Australia	Department Store	Firefly Mapreader	1200.0	Australia/West	2019-03-01 01:39:14
SaleID_98	Australia	Discount Retailer	Polar Sun	32.0	Australia/West	2019-02-14 21:29:35
SaleID_99	Australia	Discount Retailer	Polar Ice	18.0	Australia/West	2020-06-19 11:16:19
SaleID_100	Australia	Discount Retailer	Polar Sports	85.0	Australia/West	2019-05-25 15:51:41

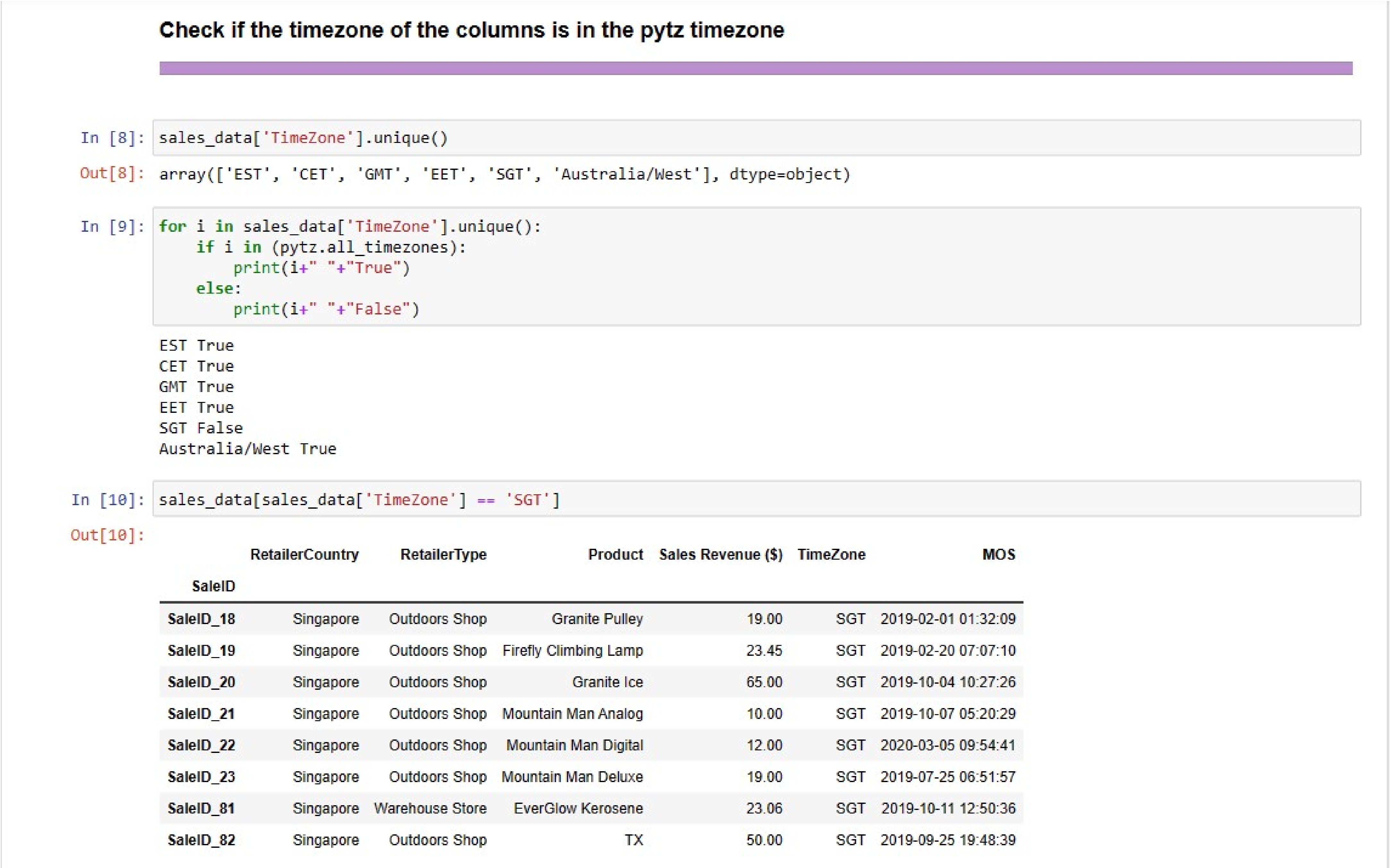
100 rows × 6 columns

In [7]:

```
pytz.all_timezones
```

Out[7]:

```
['Africa/Abidjan', 'Africa/Accra', 'Africa/Addis_Ababa', 'Africa/Algiers', 'Africa/Asmara', 'Africa/Asmera', 'Africa/Bamako',
'Africa/Bangui', 'Africa/Banjul', 'Africa/Bissau', 'Africa/Blantyre', 'Africa/Brazzaville', 'Africa/Bujumbura', 'Africa/Cairo',
'Africa/Casablanca', 'Africa/Ceuta', 'Africa/Conakry', 'Africa/Dakar', 'Africa/Dar_es_Salaam', 'Africa/Djibouti', 'Africa/Doual
a', 'Africa/El_Aaiun', 'Africa/Freetown', 'Africa/Gaborone', 'Africa/Harare', 'Africa/Johannesburg', 'Africa/Juba', 'Africa/Kam
pala', 'Africa/Khartoum', 'Africa/Kigali', 'Africa/Kinshasa', 'Africa/Lagos', 'Africa/Libreville', 'Africa/Lome', 'Africa/Luand
a', 'Africa/Lubumbashi', 'Africa/Lusaka', 'Africa/Malabo', 'Africa/Maputo', 'Africa/Maseru', 'Africa/Mbabane', 'Africa/Mogadish
u', 'Africa/Monrovia', 'Africa/Nairobi', 'Africa/Ndjamena', 'Africa/Niamey', 'Africa/Nouakchott', 'Africa/Ouagadougou', 'Afric
a/Porto-Novo', 'Africa/Sao_Tome', 'Africa/Timbuktu', 'Africa/Tripoli', 'Africa/Tunis', 'Africa/Windhoek', 'America/Adak', 'Amer
ica/Anchorage', 'America/Anguilla', 'America/Antigua', 'America/Araguaina', 'America/Argentina/Buenos_Aires', 'America/Argentin
a/Catamarca', 'America/Argentina/ComodRivadavia', 'America/Argentina/Cordoba', 'America/Argentina/Jujuy', 'America/Argentina/La
_Rioja', 'America/Argentina/Mendoza', 'America/Argentina/Rio_Gallegos', 'America/Argentina/Salta', 'America/Argentina/San_Jua
n', 'America/Argentina/San_Luis', 'America/Argentina/Tucuman', 'America/Argentina/Ushuaia', 'America/Aruba', 'America/Asuncio
n', 'America/Atikokan', 'America/Atka', 'America/Bahia', 'America/Bahia_Banderas', 'America/Barbados', 'America/Belem', 'Americ
a/Belize', 'America/Blanc-Sablon', 'America/Boa_Vista', 'America/Bogota', 'America/Boise', 'America/Buenos_Aires', 'America/Cam
bridge_Bay', 'America/Campo_Grande', 'America/Cancun', 'America/Caracas', 'America/Catamarca', 'America/Cayenne', 'America/Caym
an', 'America/Chicago', 'America/Chihuahua', 'America/Coral_Harbour', 'America/Cordoba', 'America/Costa_Rica', 'America/Cresto
n', 'America/Cuiaba', 'America/Curacao', 'America/Danmarkshavn', 'America/Dawson', 'America/Dawson_Creek', 'America/Denver', 'A
```



Check if the timezone of the columns is in the pytz timezone

```
In [8]: sales_data['TimeZone'].unique()
```

```
Out[8]: array(['EST', 'CET', 'GMT', 'EET', 'SGT', 'Australia/West'], dtype=object)
```

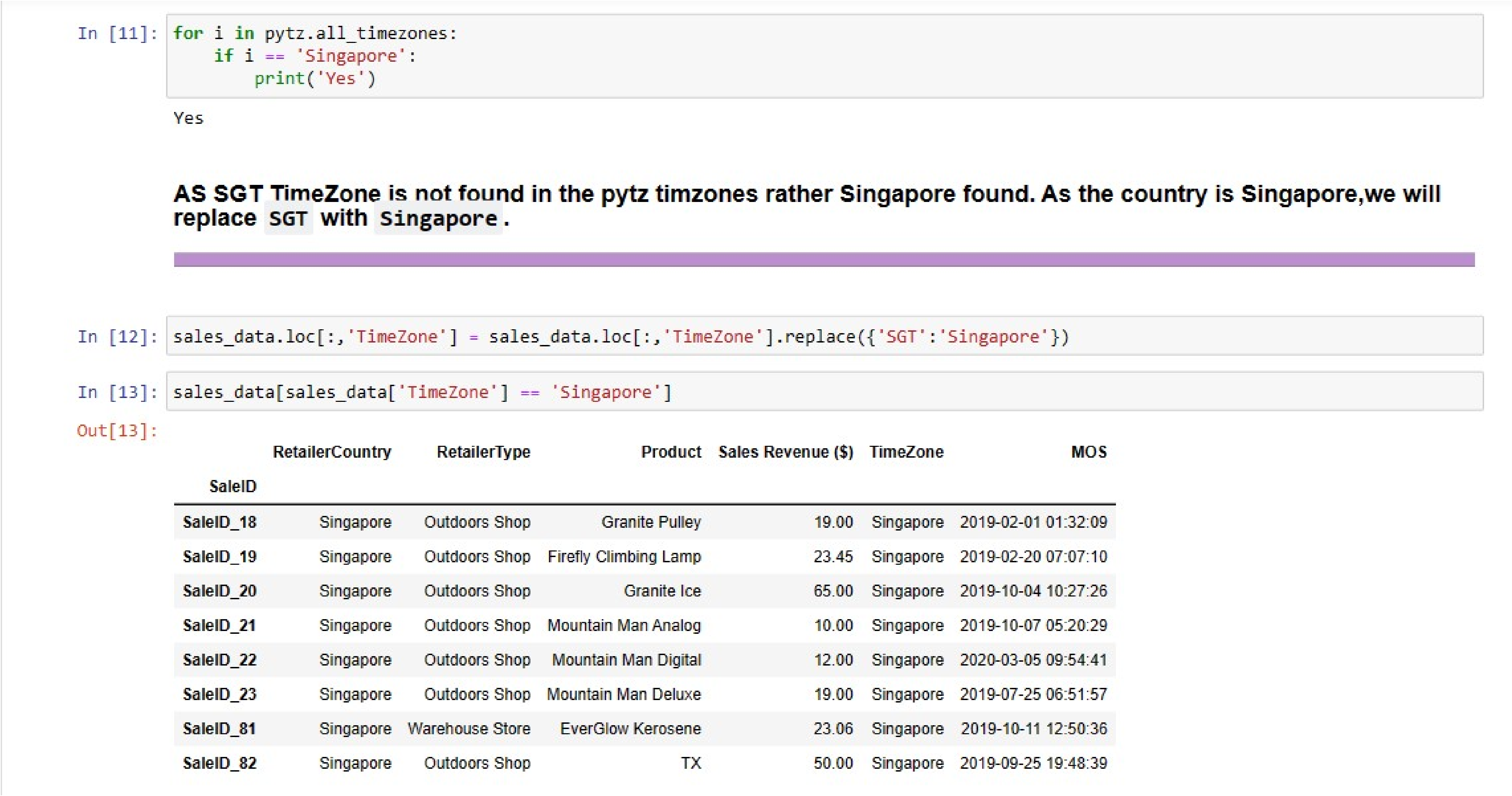
```
In [9]: for i in sales_data['TimeZone'].unique():
            if i in (pytz.all_timezones):
                print(i+" "+"True")
            else:
                print(i+" "+"False")
```

```
EST True
CET True
GMT True
EET True
SGT False
Australia/West True
```

```
In [10]: sales_data[sales_data['TimeZone'] == 'SGT']
```

Out[10]:

	RetailerCountry	RetailerType	Product	Sales Revenue ($)	TimeZone	MOS
SaleID						
SaleID_18	Singapore	Outdoors Shop	Granite Pulley	19.00	SGT	2019-02-01 01:32:09
SaleID_19	Singapore	Outdoors Shop	Firefly Climbing Lamp	23.45	SGT	2019-02-20 07:07:10
SaleID_20	Singapore	Outdoors Shop	Granite Ice	65.00	SGT	2019-10-04 10:27:26
SaleID_21	Singapore	Outdoors Shop	Mountain Man Analog	10.00	SGT	2019-10-07 05:20:29
SaleID_22	Singapore	Outdoors Shop	Mountain Man Digital	12.00	SGT	2020-03-05 09:54:41
SaleID_23	Singapore	Outdoors Shop	Mountain Man Deluxe	19.00	SGT	2019-07-25 06:51:57
SaleID_81	Singapore	Warehouse Store	EverGlow Kerosene	23.06	SGT	2019-10-11 12:50:36
SaleID_82	Singapore	Outdoors Shop	TX	50.00	SGT	2019-09-25 19:48:39



```
In [11]: for i in pytz.all_timezones:
             if i == 'Singapore':
                 print('Yes')
```

```
Yes
```

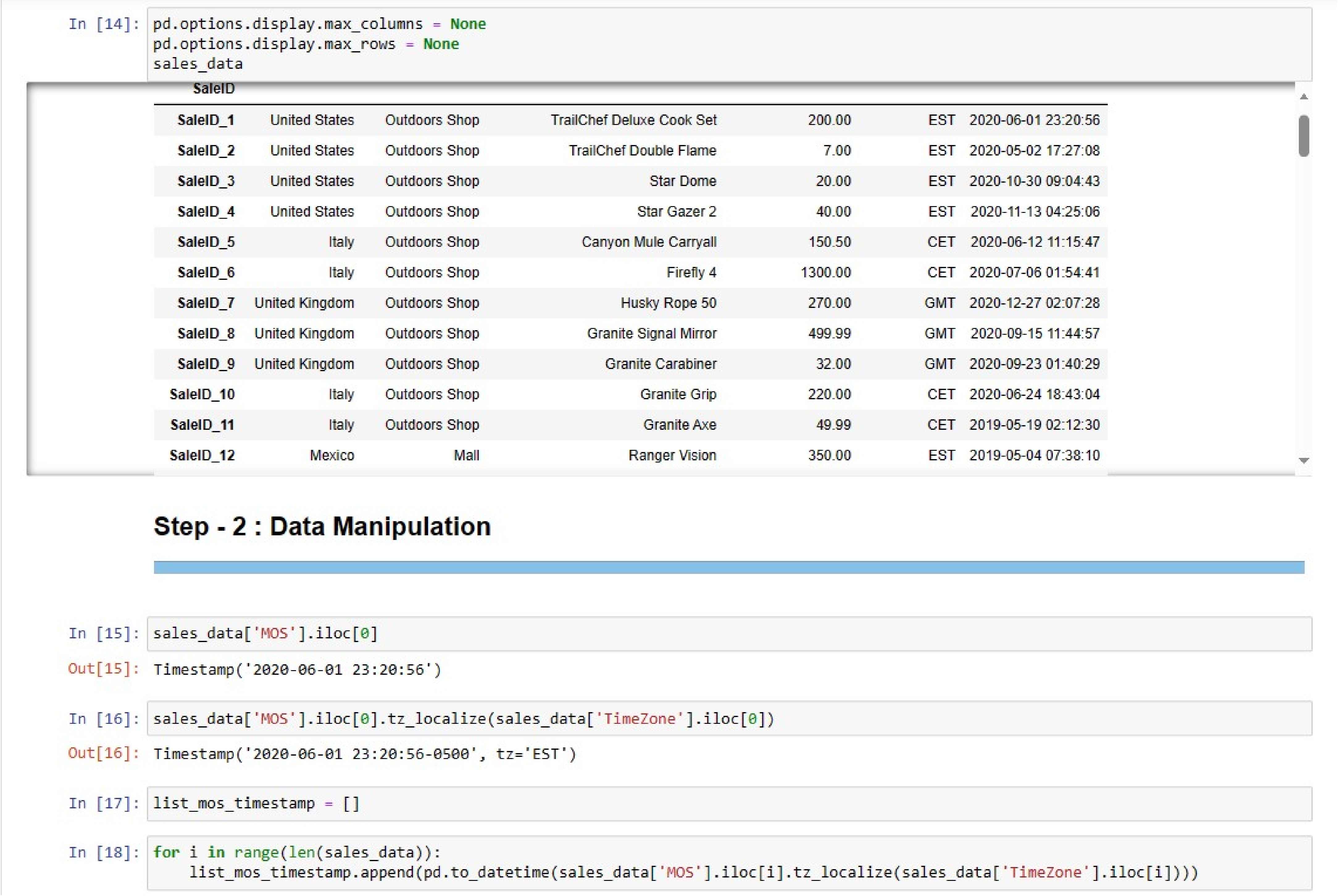
AS SGT TimeZone is not found in the pytz timzones rather Singapore found. As the country is Singapore,we will replace `SGT` with `Singapore`.

```
In [12]: sales_data.loc[:,'TimeZone'] = sales_data.loc[:,'TimeZone'].replace({'SGT':'Singapore'})
```

```
In [13]: sales_data[sales_data['TimeZone'] == 'Singapore']
```

Out[13]:

	RetailerCountry	RetailerType	Product	Sales Revenue ($)	TimeZone	MOS
SaleID						
SaleID_18	Singapore	Outdoors Shop	Granite Pulley	19.00	Singapore	2019-02-01 01:32:09
SaleID_19	Singapore	Outdoors Shop	Firefly Climbing Lamp	23.45	Singapore	2019-02-20 07:07:10
SaleID_20	Singapore	Outdoors Shop	Granite Ice	65.00	Singapore	2019-10-04 10:27:26
SaleID_21	Singapore	Outdoors Shop	Mountain Man Analog	10.00	Singapore	2019-10-07 05:20:29
SaleID_22	Singapore	Outdoors Shop	Mountain Man Digital	12.00	Singapore	2020-03-05 09:54:41
SaleID_23	Singapore	Outdoors Shop	Mountain Man Deluxe	19.00	Singapore	2019-07-25 06:51:57
SaleID_81	Singapore	Warehouse Store	EverGlow Kerosene	23.06	Singapore	2019-10-11 12:50:36
SaleID_82	Singapore	Outdoors Shop	TX	50.00	Singapore	2019-09-25 19:48:39



In [14]:
```
pd.options.display.max_columns = None
pd.options.display.max_rows = None
sales_data
```

SaleID						
SaleID_1	United States	Outdoors Shop	TrailChef Deluxe Cook Set	200.00	EST	2020-06-01 23:20:56
SaleID_2	United States	Outdoors Shop	TrailChef Double Flame	7.00	EST	2020-05-02 17:27:08
SaleID_3	United States	Outdoors Shop	Star Dome	20.00	EST	2020-10-30 09:04:43
SaleID_4	United States	Outdoors Shop	Star Gazer 2	40.00	EST	2020-11-13 04:25:06
SaleID_5	Italy	Outdoors Shop	Canyon Mule Carryall	150.50	CET	2020-06-12 11:15:47
SaleID_6	Italy	Outdoors Shop	Firefly 4	1300.00	CET	2020-07-06 01:54:41
SaleID_7	United Kingdom	Outdoors Shop	Husky Rope 50	270.00	GMT	2020-12-27 02:07:28
SaleID_8	United Kingdom	Outdoors Shop	Granite Signal Mirror	499.99	GMT	2020-09-15 11:44:57
SaleID_9	United Kingdom	Outdoors Shop	Granite Carabiner	32.00	GMT	2020-09-23 01:40:29
SaleID_10	Italy	Outdoors Shop	Granite Grip	220.00	CET	2020-06-24 18:43:04
SaleID_11	Italy	Outdoors Shop	Granite Axe	49.99	CET	2019-05-19 02:12:30
SaleID_12	Mexico	Mall	Ranger Vision	350.00	EST	2019-05-04 07:38:10

Step - 2 : Data Manipulation

In [15]:
```
sales_data['MOS'].iloc[0]
```

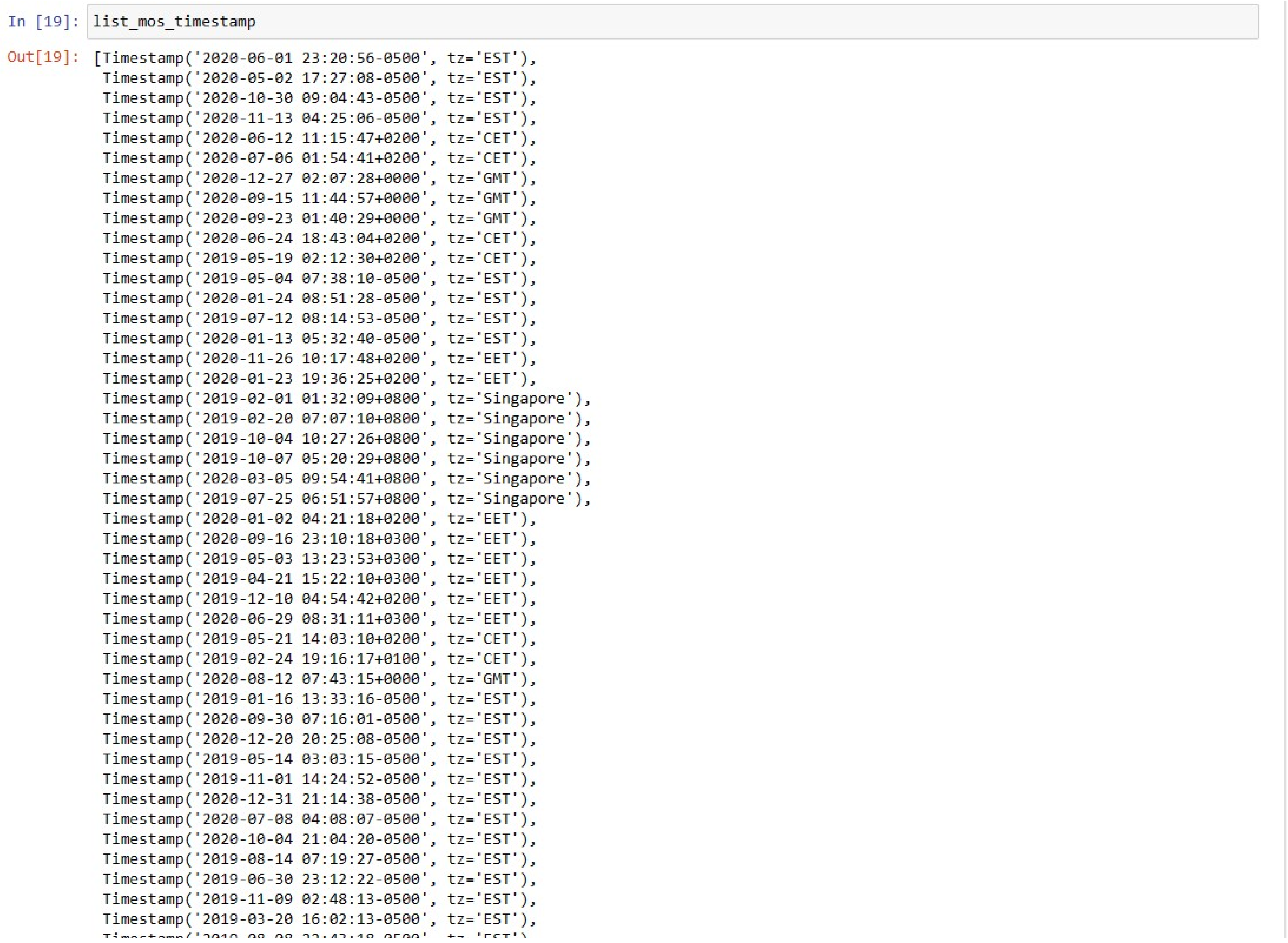
Out[15]:
```
Timestamp('2020-06-01 23:20:56')
```

In [16]:
```
sales_data['MOS'].iloc[0].tz_localize(sales_data['TimeZone'].iloc[0])
```

Out[16]:
```
Timestamp('2020-06-01 23:20:56-0500', tz='EST')
```

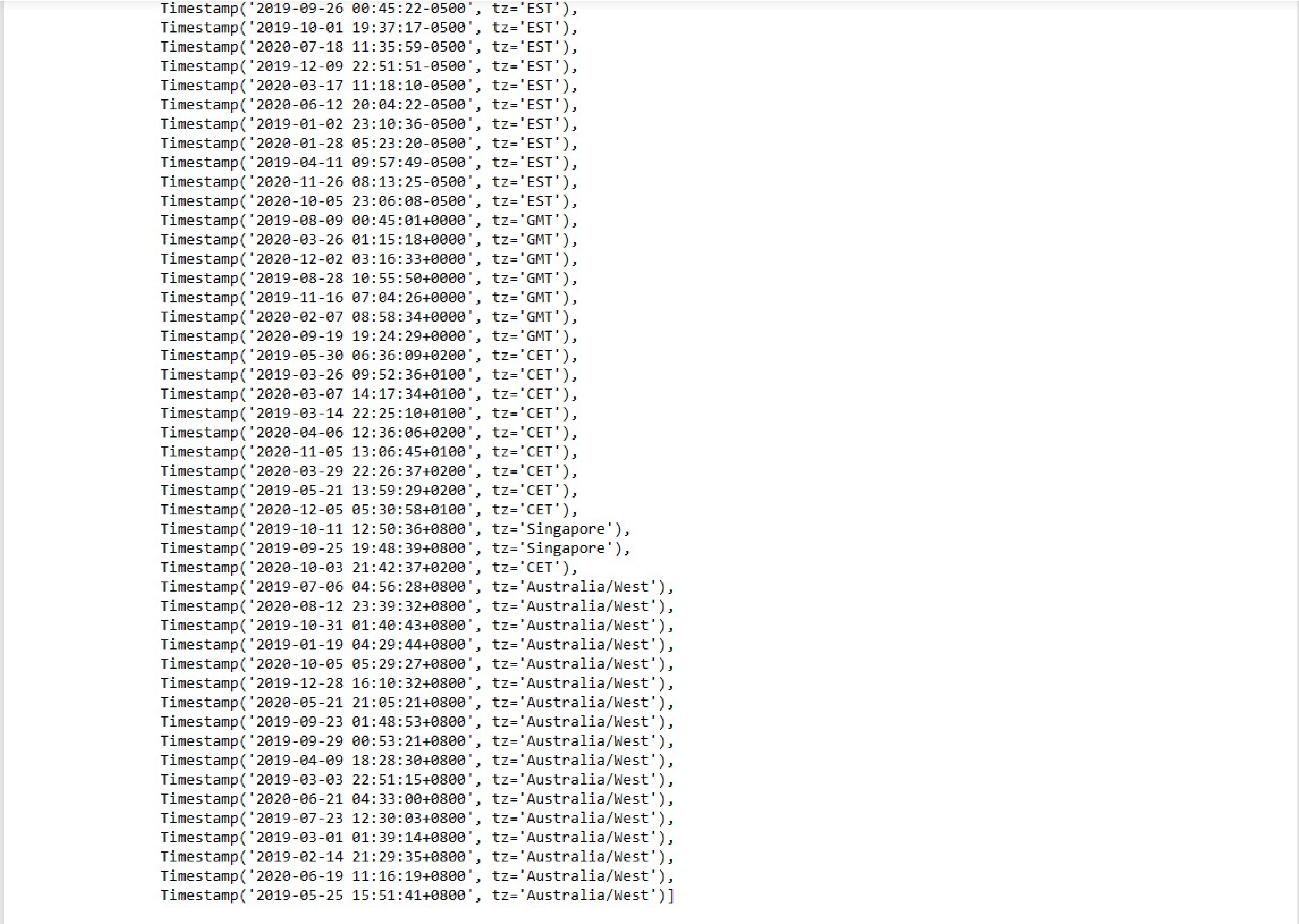
In [17]:
```
list_mos_timestamp = []
```

In [18]:
```
for i in range(len(sales_data)):
    list_mos_timestamp.append(pd.to_datetime(sales_data['MOS'].iloc[i].tz_localize(sales_data['TimeZone'].iloc[i])))
```

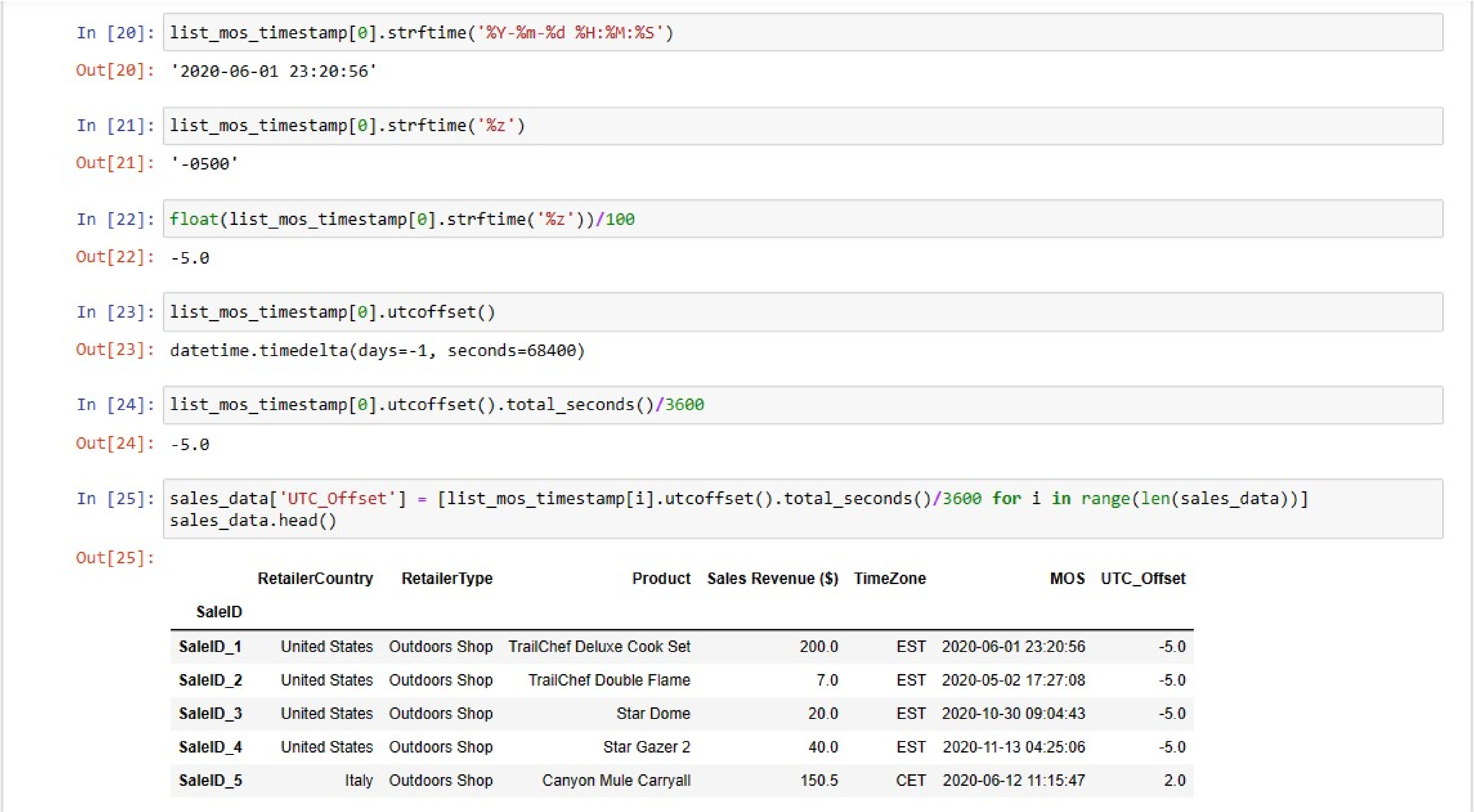


```
In [19]: list_mos_timestamp
```

```
Out[19]: [Timestamp('2020-06-01 23:20:56-0500', tz='EST'),
          Timestamp('2020-05-02 17:27:08-0500', tz='EST'),
          Timestamp('2020-10-30 09:04:43-0500', tz='EST'),
          Timestamp('2020-11-13 04:25:06-0500', tz='EST'),
          Timestamp('2020-06-12 11:15:47+0200', tz='CET'),
          Timestamp('2020-07-06 01:54:41+0200', tz='CET'),
          Timestamp('2020-12-27 02:07:28+0000', tz='GMT'),
          Timestamp('2020-09-15 11:44:57+0000', tz='GMT'),
          Timestamp('2020-09-23 01:40:29+0000', tz='GMT'),
          Timestamp('2020-06-24 18:43:04+0200', tz='CET'),
          Timestamp('2019-05-19 02:12:30+0200', tz='CET'),
          Timestamp('2019-05-04 07:38:10-0500', tz='EST'),
          Timestamp('2020-01-24 08:51:28-0500', tz='EST'),
          Timestamp('2019-07-12 08:14:53-0500', tz='EST'),
          Timestamp('2020-01-13 05:32:40-0500', tz='EST'),
          Timestamp('2020-11-26 10:17:48+0200', tz='EET'),
          Timestamp('2020-01-23 19:36:25+0200', tz='EET'),
          Timestamp('2019-02-01 01:32:09+0800', tz='Singapore'),
          Timestamp('2019-02-20 07:07:10+0800', tz='Singapore'),
          Timestamp('2019-10-04 10:27:26+0800', tz='Singapore'),
          Timestamp('2019-10-07 05:20:29+0800', tz='Singapore'),
          Timestamp('2020-03-05 09:54:41+0800', tz='Singapore'),
          Timestamp('2019-07-25 06:51:57+0800', tz='Singapore'),
          Timestamp('2020-01-02 04:21:18+0200', tz='EET'),
          Timestamp('2020-09-16 23:10:18+0300', tz='EET'),
          Timestamp('2019-05-03 13:23:53+0300', tz='EET'),
          Timestamp('2019-04-21 15:22:10+0300', tz='EET'),
          Timestamp('2019-12-10 04:54:42+0200', tz='EET'),
          Timestamp('2020-06-29 08:31:11+0300', tz='EET'),
          Timestamp('2019-05-21 14:03:10+0200', tz='CET'),
          Timestamp('2019-02-24 19:16:17+0100', tz='CET'),
          Timestamp('2020-08-12 07:43:15+0000', tz='GMT'),
          Timestamp('2019-01-16 13:33:16-0500', tz='EST'),
          Timestamp('2020-09-30 07:16:01-0500', tz='EST'),
          Timestamp('2020-12-20 20:25:08-0500', tz='EST'),
          Timestamp('2019-05-14 03:03:15-0500', tz='EST'),
          Timestamp('2019-11-01 14:24:52-0500', tz='EST'),
          Timestamp('2020-12-31 21:14:38-0500', tz='EST'),
          Timestamp('2020-07-08 04:08:07-0500', tz='EST'),
          Timestamp('2020-10-04 21:04:20-0500', tz='EST'),
          Timestamp('2019-08-14 07:19:27-0500', tz='EST'),
          Timestamp('2019-06-30 23:12:22-0500', tz='EST'),
          Timestamp('2019-11-09 02:48:13-0500', tz='EST'),
          Timestamp('2019-03-20 16:02:13-0500', tz='EST'),
          Timestamp('2019-08-08 22:43:18-0500', tz='EST'),
```

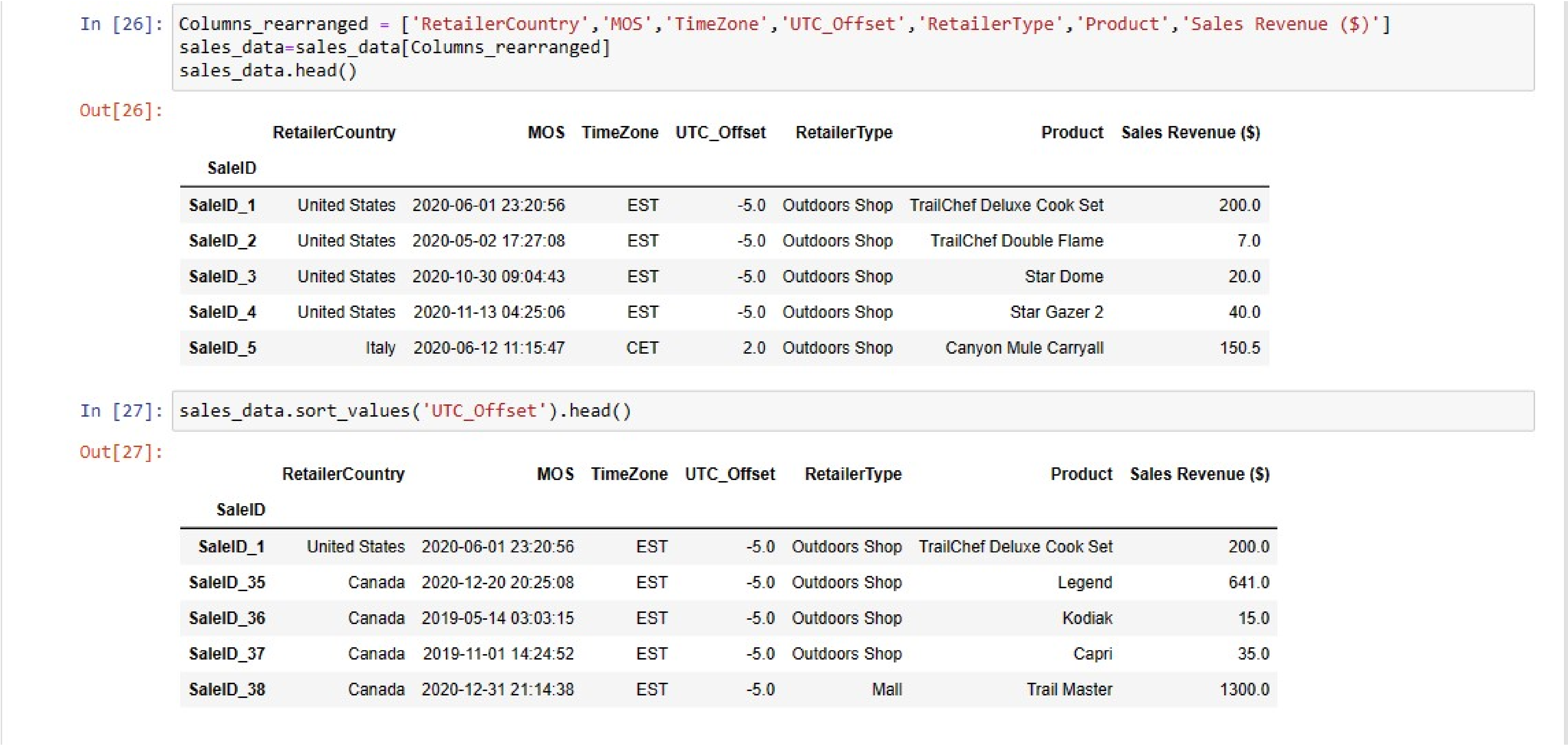


```
           Timestamp('2019-09-26 00:45:22-0500', tz='EST'),
           Timestamp('2019-10-01 19:37:17-0500', tz='EST'),
           Timestamp('2020-07-18 11:35:59-0500', tz='EST'),
           Timestamp('2019-12-09 22:51:51-0500', tz='EST'),
           Timestamp('2020-03-17 11:18:10-0500', tz='EST'),
           Timestamp('2020-06-12 20:04:22-0500', tz='EST'),
           Timestamp('2019-01-02 23:10:36-0500', tz='EST'),
           Timestamp('2020-01-28 05:23:20-0500', tz='EST'),
           Timestamp('2019-04-11 09:57:49-0500', tz='EST'),
           Timestamp('2020-11-26 08:13:25-0500', tz='EST'),
           Timestamp('2020-10-05 23:06:08-0500', tz='EST'),
           Timestamp('2019-08-09 00:45:01+0000', tz='GMT'),
           Timestamp('2020-03-26 01:15:18+0000', tz='GMT'),
           Timestamp('2020-12-02 03:16:33+0000', tz='GMT'),
           Timestamp('2019-08-28 10:55:50+0000', tz='GMT'),
           Timestamp('2019-11-16 07:04:26+0000', tz='GMT'),
           Timestamp('2020-02-07 08:58:34+0000', tz='GMT'),
           Timestamp('2020-09-19 19:24:29+0000', tz='GMT'),
           Timestamp('2019-05-30 06:36:09+0200', tz='CET'),
           Timestamp('2019-03-26 09:52:36+0100', tz='CET'),
           Timestamp('2020-03-07 14:17:34+0100', tz='CET'),
           Timestamp('2019-03-14 22:25:10+0100', tz='CET'),
           Timestamp('2020-04-06 12:36:06+0200', tz='CET'),
           Timestamp('2020-11-05 13:06:45+0100', tz='CET'),
           Timestamp('2020-03-29 22:26:37+0200', tz='CET'),
           Timestamp('2019-05-21 13:59:29+0200', tz='CET'),
           Timestamp('2020-12-05 05:30:58+0100', tz='CET'),
           Timestamp('2019-10-11 12:50:36+0800', tz='Singapore'),
           Timestamp('2019-09-25 19:48:39+0800', tz='Singapore'),
           Timestamp('2020-10-03 21:42:37+0200', tz='CET'),
           Timestamp('2019-07-06 04:56:28+0800', tz='Australia/West'),
           Timestamp('2020-08-12 23:39:32+0800', tz='Australia/West'),
           Timestamp('2019-10-31 01:40:43+0800', tz='Australia/West'),
           Timestamp('2019-01-19 04:29:44+0800', tz='Australia/West'),
           Timestamp('2020-10-05 05:29:27+0800', tz='Australia/West'),
           Timestamp('2019-12-28 16:10:32+0800', tz='Australia/West'),
           Timestamp('2020-05-21 21:05:21+0800', tz='Australia/West'),
           Timestamp('2019-09-23 01:48:53+0800', tz='Australia/West'),
           Timestamp('2019-09-29 00:53:21+0800', tz='Australia/West'),
           Timestamp('2019-04-09 18:28:30+0800', tz='Australia/West'),
           Timestamp('2019-03-03 22:51:15+0800', tz='Australia/West'),
           Timestamp('2020-06-21 04:33:00+0800', tz='Australia/West'),
           Timestamp('2019-07-23 12:30:03+0800', tz='Australia/West'),
           Timestamp('2019-03-01 01:39:14+0800', tz='Australia/West'),
           Timestamp('2019-02-14 21:29:35+0800', tz='Australia/West'),
           Timestamp('2020-06-19 11:16:19+0800', tz='Australia/West'),
           Timestamp('2019-05-25 15:51:41+0800', tz='Australia/West')]
```



```
In [20]: list_mos_timestamp[0].strftime('%Y-%m-%d %H:%M:%S')

Out[20]: '2020-06-01 23:20:56'

In [21]: list_mos_timestamp[0].strftime('%z')

Out[21]: '-0500'

In [22]: float(list_mos_timestamp[0].strftime('%z'))/100

Out[22]: -5.0

In [23]: list_mos_timestamp[0].utcoffset()

Out[23]: datetime.timedelta(days=-1, seconds=68400)

In [24]: list_mos_timestamp[0].utcoffset().total_seconds()/3600

Out[24]: -5.0

In [25]: sales_data['UTC_Offset'] = [list_mos_timestamp[i].utcoffset().total_seconds()/3600 for i in range(len(sales_data))]
         sales_data.head()

Out[25]:
```

	RetailerCountry	RetailerType	Product	Sales Revenue ($)	TimeZone	MOS	UTC_Offset
SaleID							
SaleID_1	United States	Outdoors Shop	TrailChef Deluxe Cook Set	200.0	EST	2020-06-01 23:20:56	-5.0
SaleID_2	United States	Outdoors Shop	TrailChef Double Flame	7.0	EST	2020-05-02 17:27:08	-5.0
SaleID_3	United States	Outdoors Shop	Star Dome	20.0	EST	2020-10-30 09:04:43	-5.0
SaleID_4	United States	Outdoors Shop	Star Gazer 2	40.0	EST	2020-11-13 04:25:06	-5.0
SaleID_5	Italy	Outdoors Shop	Canyon Mule Carryall	150.5	CET	2020-06-12 11:15:47	2.0



In [26]:
```
Columns_rearranged = ['RetailerCountry','MOS','TimeZone','UTC_Offset','RetailerType','Product','Sales Revenue ($)']
sales_data=sales_data[Columns_rearranged]
sales_data.head()
```

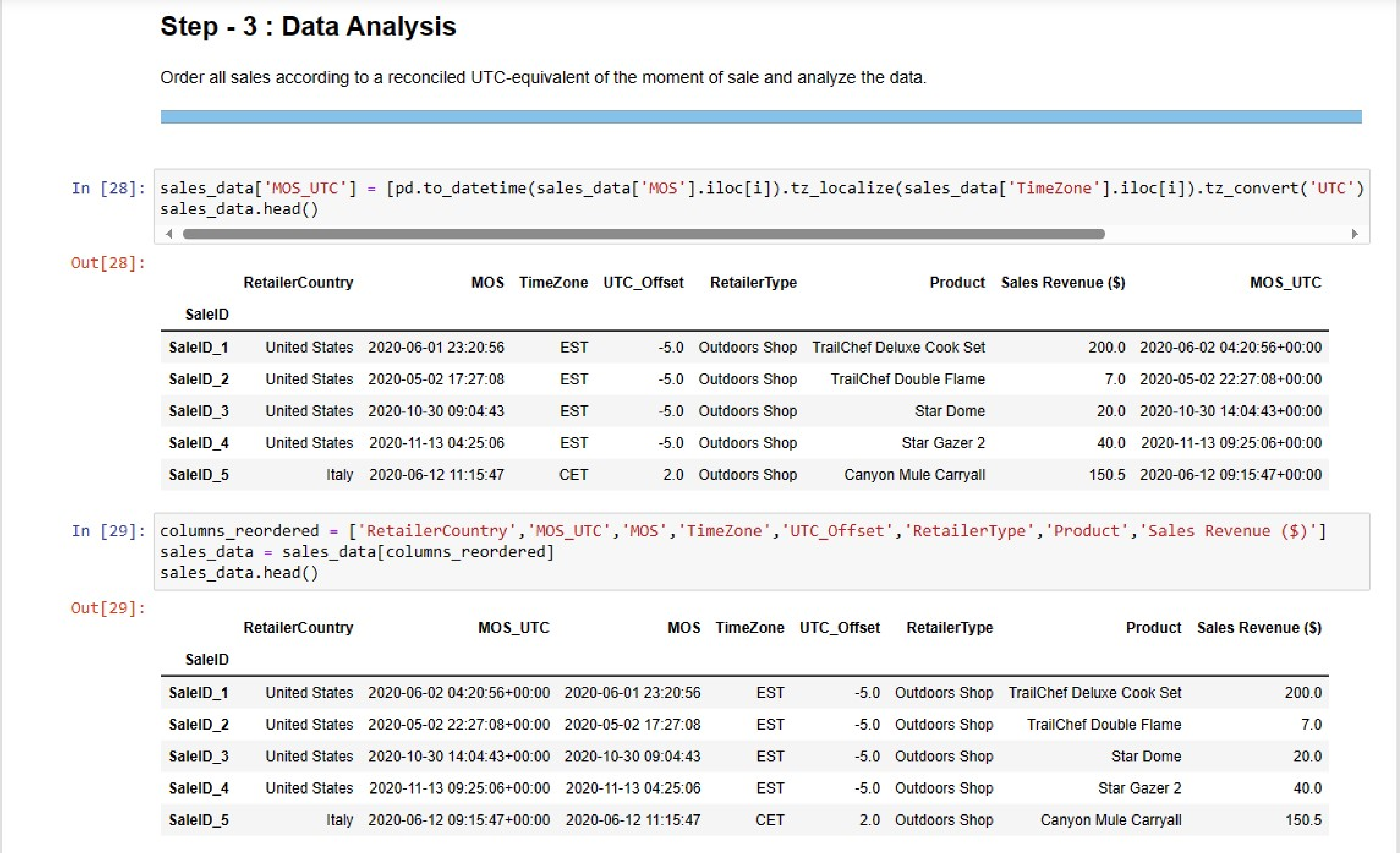
Out[26]:

	RetailerCountry	MOS	TimeZone	UTC_Offset	RetailerType	Product	Sales Revenue ($)
SaleID							
SaleID_1	United States	2020-06-01 23:20:56	EST	-5.0	Outdoors Shop	TrailChef Deluxe Cook Set	200.0
SaleID_2	United States	2020-05-02 17:27:08	EST	-5.0	Outdoors Shop	TrailChef Double Flame	7.0
SaleID_3	United States	2020-10-30 09:04:43	EST	-5.0	Outdoors Shop	Star Dome	20.0
SaleID_4	United States	2020-11-13 04:25:06	EST	-5.0	Outdoors Shop	Star Gazer 2	40.0
SaleID_5	Italy	2020-06-12 11:15:47	CET	2.0	Outdoors Shop	Canyon Mule Carryall	150.5

In [27]:
```
sales_data.sort_values('UTC_Offset').head()
```

Out[27]:

	RetailerCountry	MOS	TimeZone	UTC_Offset	RetailerType	Product	Sales Revenue ($)
SaleID							
SaleID_1	United States	2020-06-01 23:20:56	EST	-5.0	Outdoors Shop	TrailChef Deluxe Cook Set	200.0
SaleID_35	Canada	2020-12-20 20:25:08	EST	-5.0	Outdoors Shop	Legend	641.0
SaleID_36	Canada	2019-05-14 03:03:15	EST	-5.0	Outdoors Shop	Kodiak	15.0
SaleID_37	Canada	2019-11-01 14:24:52	EST	-5.0	Outdoors Shop	Capri	35.0
SaleID_38	Canada	2020-12-31 21:14:38	EST	-5.0	Mall	Trail Master	1300.0



Step - 3 : Data Analysis

Order all sales according to a reconciled UTC-equivalent of the moment of sale and analyze the data.

In [28]:

```
sales_data['MOS_UTC'] = [pd.to_datetime(sales_data['MOS'].iloc[i]).tz_localize(sales_data['TimeZone'].iloc[i]).tz_convert('UTC')
sales_data.head()
```

Out[28]:

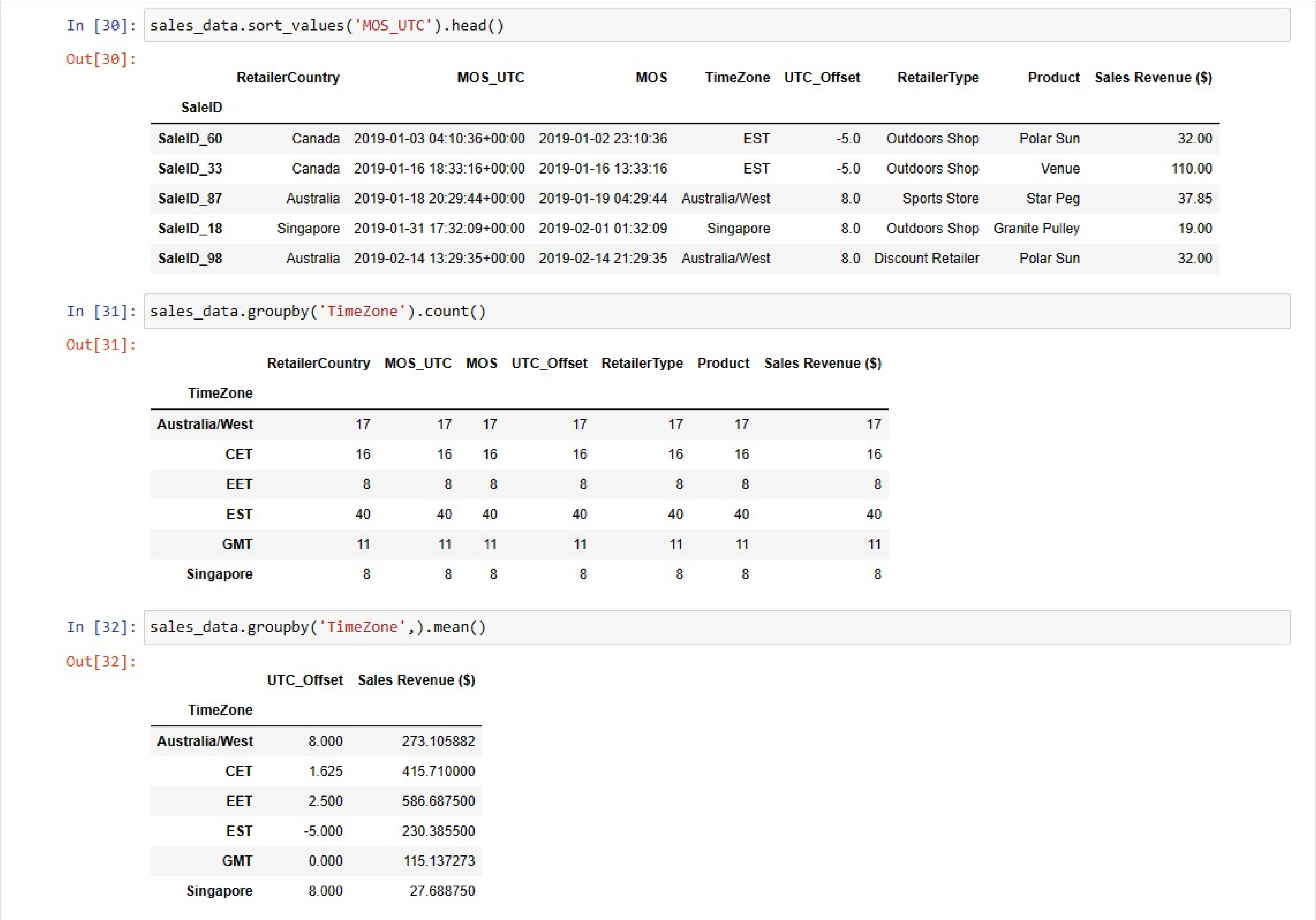
	RetailerCountry	MOS	TimeZone	UTC_Offset	RetailerType	Product	Sales Revenue ($)	MOS_UTC
SaleID								
SaleID_1	United States	2020-06-01 23:20:56	EST	-5.0	Outdoors Shop	TrailChef Deluxe Cook Set	200.0	2020-06-02 04:20:56+00:00
SaleID_2	United States	2020-05-02 17:27:08	EST	-5.0	Outdoors Shop	TrailChef Double Flame	7.0	2020-05-02 22:27:08+00:00
SaleID_3	United States	2020-10-30 09:04:43	EST	-5.0	Outdoors Shop	Star Dome	20.0	2020-10-30 14:04:43+00:00
SaleID_4	United States	2020-11-13 04:25:06	EST	-5.0	Outdoors Shop	Star Gazer 2	40.0	2020-11-13 09:25:06+00:00
SaleID_5	Italy	2020-06-12 11:15:47	CET	2.0	Outdoors Shop	Canyon Mule Carryall	150.5	2020-06-12 09:15:47+00:00

In [29]:

```
columns_reordered = ['RetailerCountry','MOS_UTC','MOS','TimeZone','UTC_Offset','RetailerType','Product','Sales Revenue ($)']
sales_data = sales_data[columns_reordered]
sales_data.head()
```

Out[29]:

	RetailerCountry	MOS_UTC	MOS	TimeZone	UTC_Offset	RetailerType	Product	Sales Revenue ($)
SaleID								
SaleID_1	United States	2020-06-02 04:20:56+00:00	2020-06-01 23:20:56	EST	-5.0	Outdoors Shop	TrailChef Deluxe Cook Set	200.0
SaleID_2	United States	2020-05-02 22:27:08+00:00	2020-05-02 17:27:08	EST	-5.0	Outdoors Shop	TrailChef Double Flame	7.0
SaleID_3	United States	2020-10-30 14:04:43+00:00	2020-10-30 09:04:43	EST	-5.0	Outdoors Shop	Star Dome	20.0
SaleID_4	United States	2020-11-13 09:25:06+00:00	2020-11-13 04:25:06	EST	-5.0	Outdoors Shop	Star Gazer 2	40.0
SaleID_5	Italy	2020-06-12 09:15:47+00:00	2020-06-12 11:15:47	CET	2.0	Outdoors Shop	Canyon Mule Carryall	150.5



```
In [30]: sales_data.sort_values('MOS_UTC').head()
```

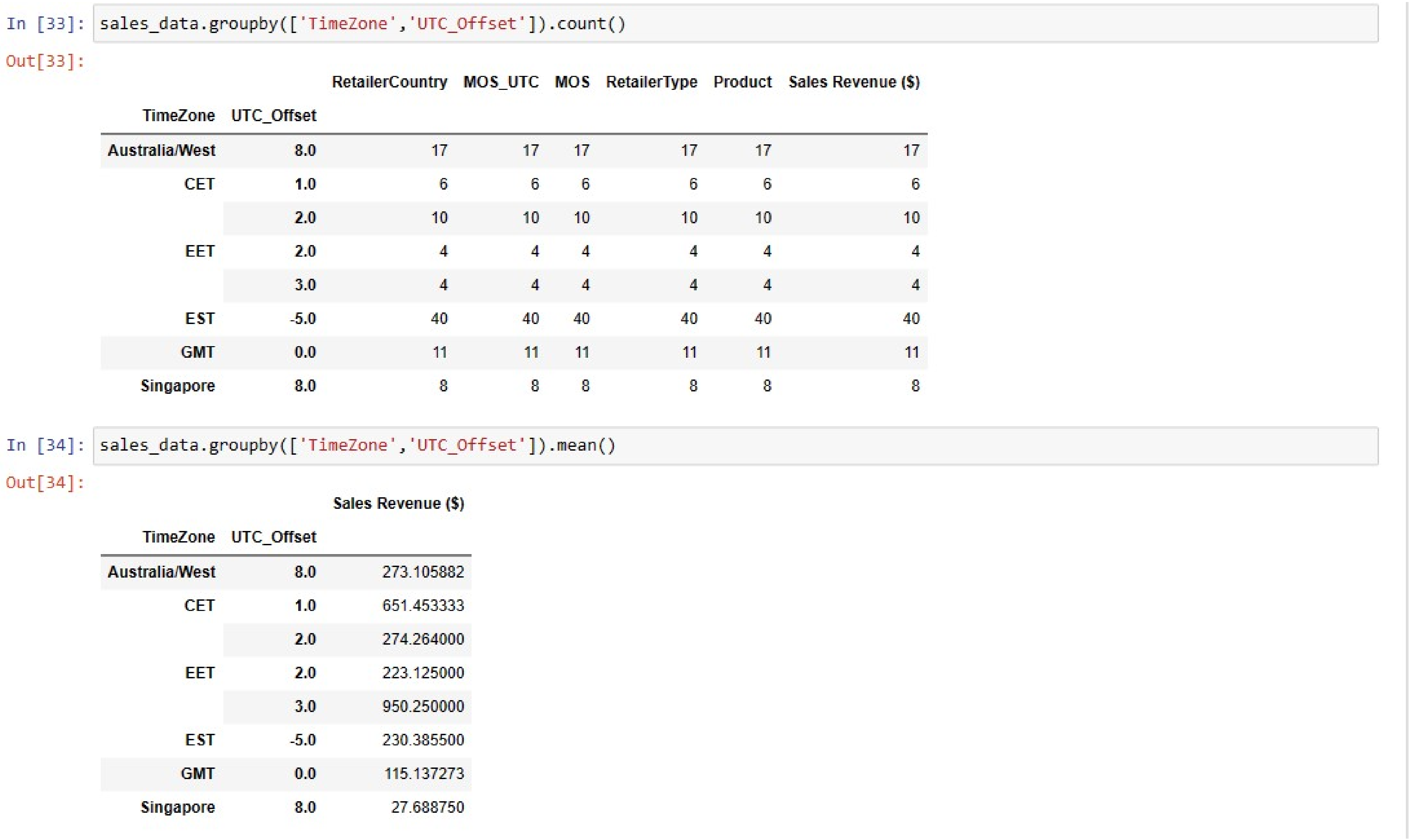
```
Out[30]:
           RetailerCountry                    MOS_UTC                  MOS        TimeZone  UTC_Offset     RetailerType        Product  Sales Revenue ($)
   SaleID
SaleID_60           Canada  2019-01-03 04:10:36+00:00  2019-01-02 23:10:36             EST        -5.0    Outdoors Shop      Polar Sun              32.00
SaleID_33           Canada  2019-01-16 18:33:16+00:00  2019-01-16 13:33:16             EST        -5.0    Outdoors Shop          Venue             110.00
SaleID_87        Australia  2019-01-18 20:29:44+00:00  2019-01-19 04:29:44  Australia/West         8.0     Sports Store       Star Peg              37.85
SaleID_18        Singapore  2019-01-31 17:32:09+00:00  2019-02-01 01:32:09       Singapore         8.0    Outdoors Shop  Granite Pulley              19.00
SaleID_98        Australia  2019-02-14 13:29:35+00:00  2019-02-14 21:29:35  Australia/West         8.0  Discount Retailer      Polar Sun              32.00
```

```
In [31]: sales_data.groupby('TimeZone').count()
```

```
Out[31]:
                RetailerCountry  MOS_UTC  MOS  UTC_Offset  RetailerType  Product  Sales Revenue ($)
       TimeZone
Australia/West               17       17   17          17            17       17                 17
           CET               16       16   16          16            16       16                 16
           EET                8        8    8           8             8        8                  8
           EST               40       40   40          40            40       40                 40
           GMT               11       11   11          11            11       11                 11
     Singapore                8        8    8           8             8        8                  8
```

```
In [32]: sales_data.groupby('TimeZone',).mean()
```

```
Out[32]:
                UTC_Offset  Sales Revenue ($)
       TimeZone
Australia/West       8.000         273.105882
           CET       1.625         415.710000
           EET       2.500         586.687500
           EST      -5.000         230.385500
           GMT       0.000         115.137273
     Singapore       8.000          27.688750
```

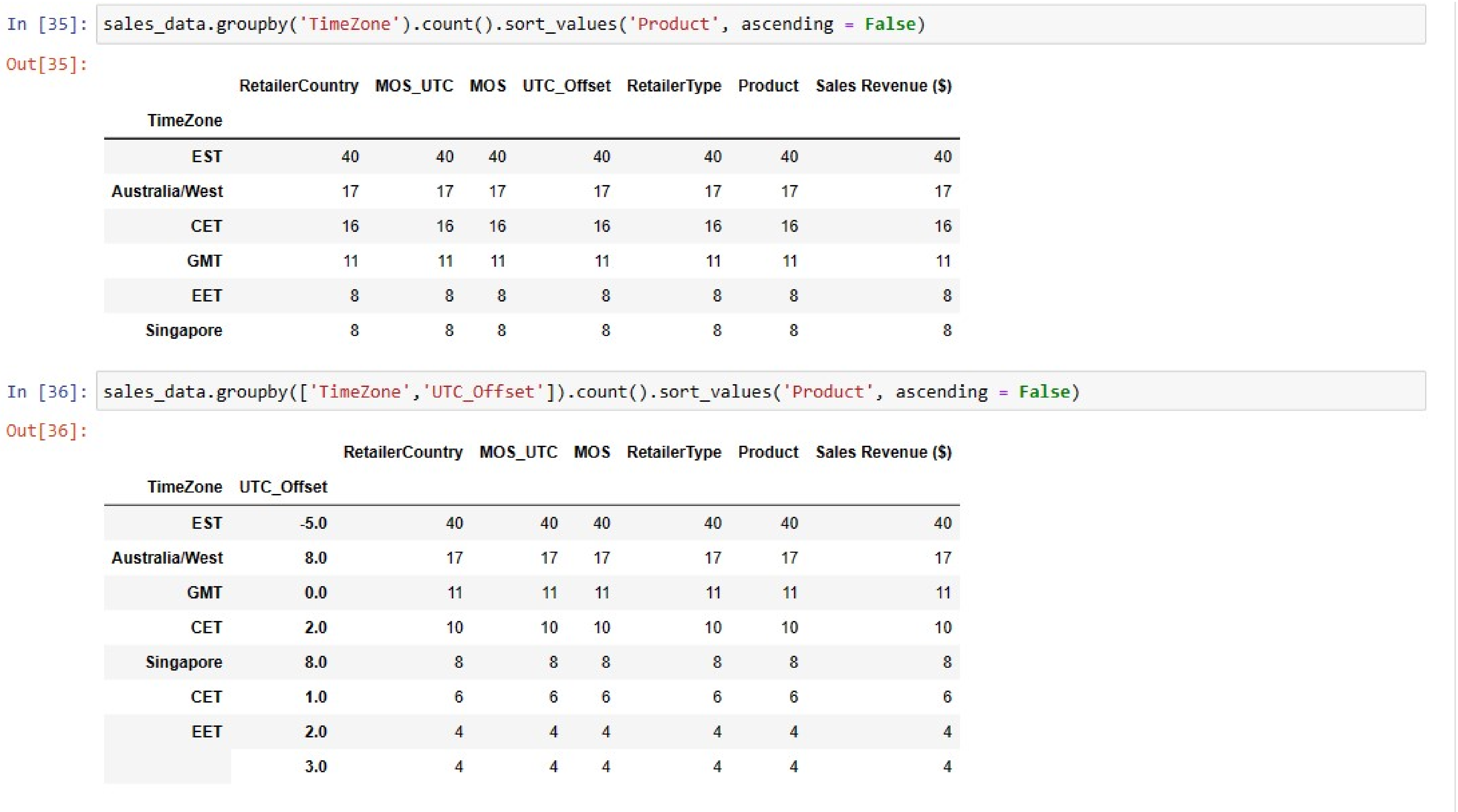


```
In [33]: sales_data.groupby(['TimeZone','UTC_Offset']).count()
Out[33]:
```

TimeZone	UTC_Offset	RetailerCountry	MOS_UTC	MOS	RetailerType	Product	Sales Revenue ($)
Australia/West	8.0	17	17	17	17	17	17
CET	1.0	6	6	6	6	6	6
	2.0	10	10	10	10	10	10
EET	2.0	4	4	4	4	4	4
	3.0	4	4	4	4	4	4
EST	-5.0	40	40	40	40	40	40
GMT	0.0	11	11	11	11	11	11
Singapore	8.0	8	8	8	8	8	8

```
In [34]: sales_data.groupby(['TimeZone','UTC_Offset']).mean()
Out[34]:
```

TimeZone	UTC_Offset	Sales Revenue ($)
Australia/West	8.0	273.105882
CET	1.0	651.453333
	2.0	274.264000
EET	2.0	223.125000
	3.0	950.250000
EST	-5.0	230.385500
GMT	0.0	115.137273
Singapore	8.0	27.688750



In [35]:
```
sales_data.groupby('TimeZone').count().sort_values('Product', ascending = False)
```

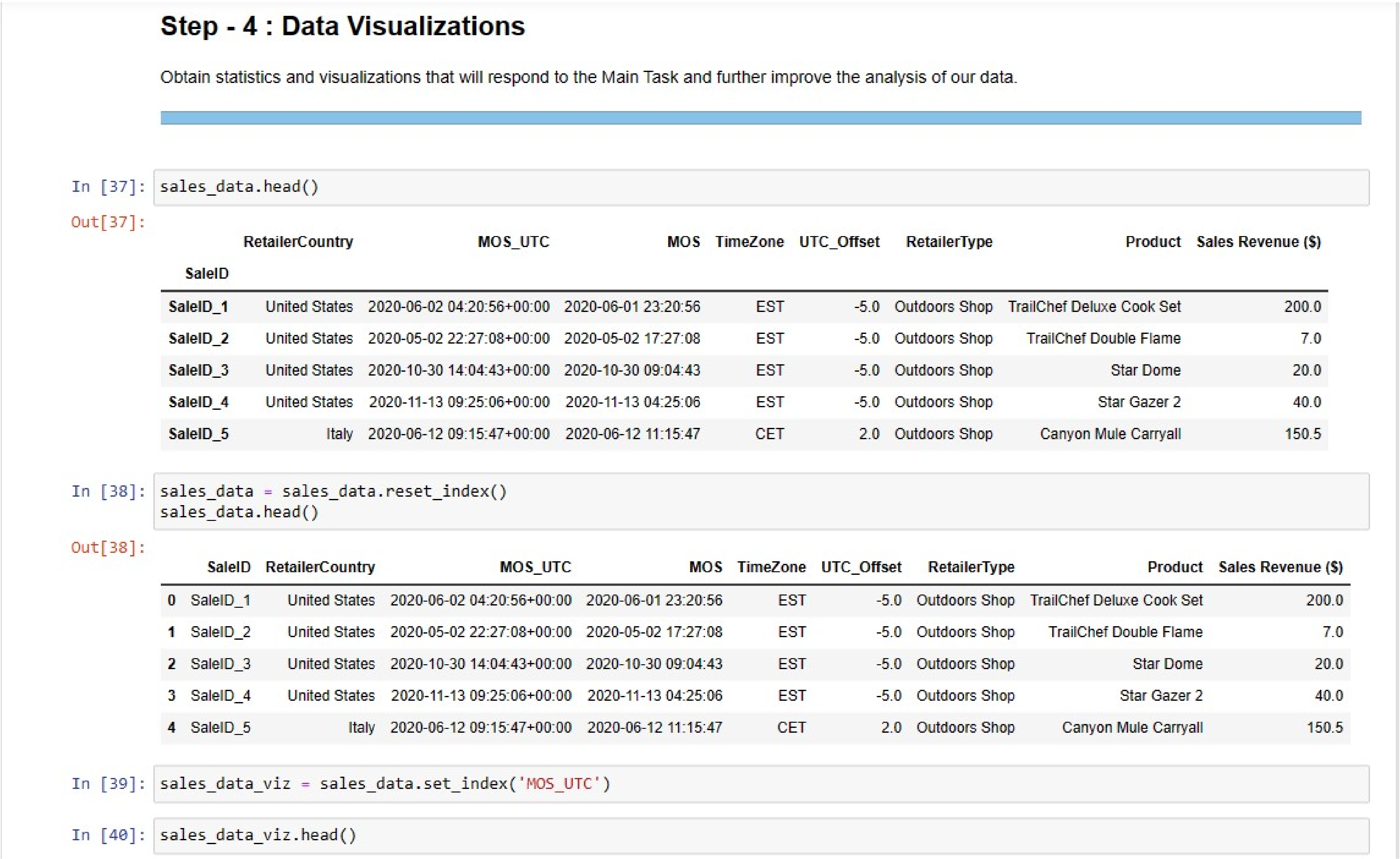
Out[35]:

	RetailerCountry	MOS_UTC	MOS	UTC_Offset	RetailerType	Product	Sales Revenue ($)
TimeZone							
EST	40	40	40	40	40	40	40
Australia/West	17	17	17	17	17	17	17
CET	16	16	16	16	16	16	16
GMT	11	11	11	11	11	11	11
EET	8	8	8	8	8	8	8
Singapore	8	8	8	8	8	8	8

In [36]:
```
sales_data.groupby(['TimeZone','UTC_Offset']).count().sort_values('Product', ascending = False)
```

Out[36]:

		RetailerCountry	MOS_UTC	MOS	RetailerType	Product	Sales Revenue ($)
TimeZone	**UTC_Offset**						
EST	**-5.0**	40	40	40	40	40	40
Australia/West	**8.0**	17	17	17	17	17	17
GMT	**0.0**	11	11	11	11	11	11
CET	**2.0**	10	10	10	10	10	10
Singapore	**8.0**	8	8	8	8	8	8
CET	**1.0**	6	6	6	6	6	6
EET	**2.0**	4	4	4	4	4	4
	3.0	4	4	4	4	4	4



Step - 4 : Data Visualizations

Obtain statistics and visualizations that will respond to the Main Task and further improve the analysis of our data.

In [37]:
```
sales_data.head()
```

Out[37]:

	RetailerCountry	MOS_UTC	MOS	TimeZone	UTC_Offset	RetailerType	Product	Sales Revenue ($)
SaleID								
SaleID_1	United States	2020-06-02 04:20:56+00:00	2020-06-01 23:20:56	EST	-5.0	Outdoors Shop	TrailChef Deluxe Cook Set	200.0
SaleID_2	United States	2020-05-02 22:27:08+00:00	2020-05-02 17:27:08	EST	-5.0	Outdoors Shop	TrailChef Double Flame	7.0
SaleID_3	United States	2020-10-30 14:04:43+00:00	2020-10-30 09:04:43	EST	-5.0	Outdoors Shop	Star Dome	20.0
SaleID_4	United States	2020-11-13 09:25:06+00:00	2020-11-13 04:25:06	EST	-5.0	Outdoors Shop	Star Gazer 2	40.0
SaleID_5	Italy	2020-06-12 09:15:47+00:00	2020-06-12 11:15:47	CET	2.0	Outdoors Shop	Canyon Mule Carryall	150.5

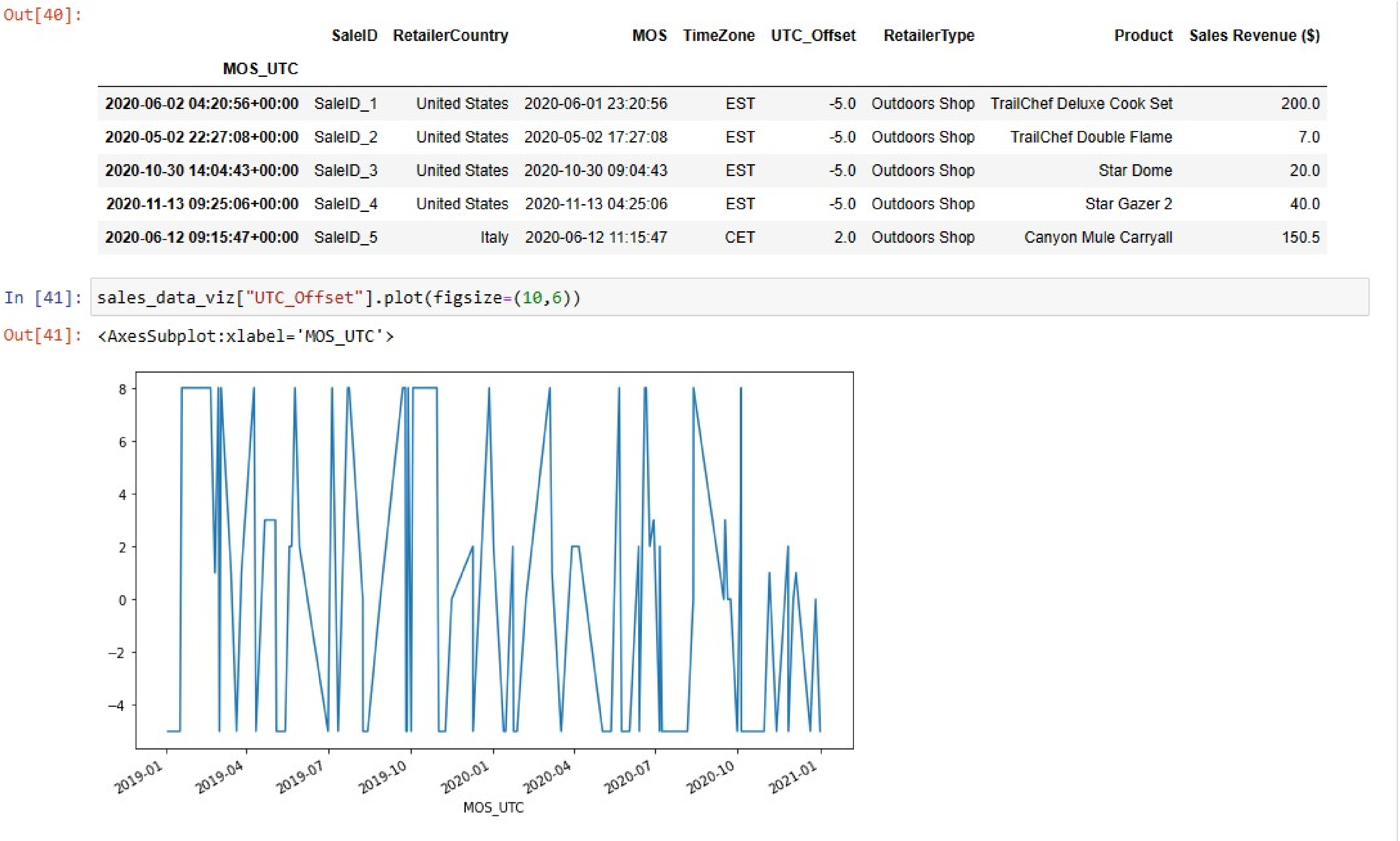
In [38]:
```
sales_data = sales_data.reset_index()
sales_data.head()
```

Out[38]:

	SaleID	RetailerCountry	MOS_UTC	MOS	TimeZone	UTC_Offset	RetailerType	Product	Sales Revenue ($)
0	SaleID_1	United States	2020-06-02 04:20:56+00:00	2020-06-01 23:20:56	EST	-5.0	Outdoors Shop	TrailChef Deluxe Cook Set	200.0
1	SaleID_2	United States	2020-05-02 22:27:08+00:00	2020-05-02 17:27:08	EST	-5.0	Outdoors Shop	TrailChef Double Flame	7.0
2	SaleID_3	United States	2020-10-30 14:04:43+00:00	2020-10-30 09:04:43	EST	-5.0	Outdoors Shop	Star Dome	20.0
3	SaleID_4	United States	2020-11-13 09:25:06+00:00	2020-11-13 04:25:06	EST	-5.0	Outdoors Shop	Star Gazer 2	40.0
4	SaleID_5	Italy	2020-06-12 09:15:47+00:00	2020-06-12 11:15:47	CET	2.0	Outdoors Shop	Canyon Mule Carryall	150.5

In [39]:
```
sales_data_viz = sales_data.set_index('MOS_UTC')
```

In [40]:
```
sales_data_viz.head()
```



Out[40]:

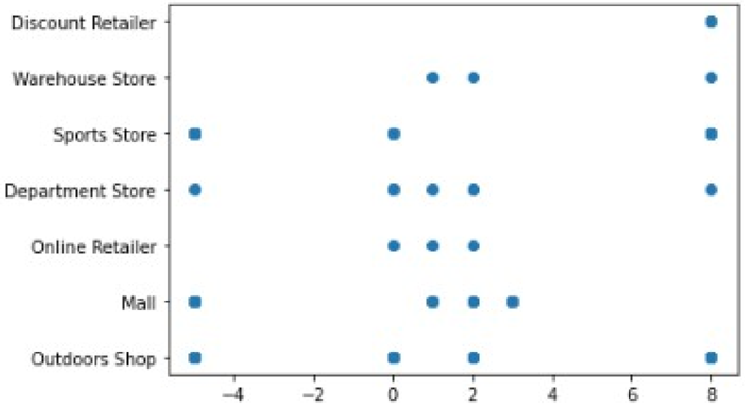
	SaleID	RetailerCountry	MOS	TimeZone	UTC_Offset	RetailerType	Product	Sales Revenue ($)
MOS_UTC								
2020-06-02 04:20:56+00:00	SaleID_1	United States	2020-06-01 23:20:56	EST	-5.0	Outdoors Shop	TrailChef Deluxe Cook Set	200.0
2020-05-02 22:27:08+00:00	SaleID_2	United States	2020-05-02 17:27:08	EST	-5.0	Outdoors Shop	TrailChef Double Flame	7.0
2020-10-30 14:04:43+00:00	SaleID_3	United States	2020-10-30 09:04:43	EST	-5.0	Outdoors Shop	Star Dome	20.0
2020-11-13 09:25:06+00:00	SaleID_4	United States	2020-11-13 04:25:06	EST	-5.0	Outdoors Shop	Star Gazer 2	40.0
2020-06-12 09:15:47+00:00	SaleID_5	Italy	2020-06-12 11:15:47	CET	2.0	Outdoors Shop	Canyon Mule Carryall	150.5

```
In [41]: sales_data_viz["UTC_Offset"].plot(figsize=(10,6))
```

```
Out[41]: <AxesSubplot:xlabel='MOS_UTC'>
```

In [42]:
```
plt.scatter(sales_data_viz['UTC_Offset'],sales_data_viz['RetailerType'])
```

Out[42]:
```
<matplotlib.collections.PathCollection at 0x1cb99deea90>
```



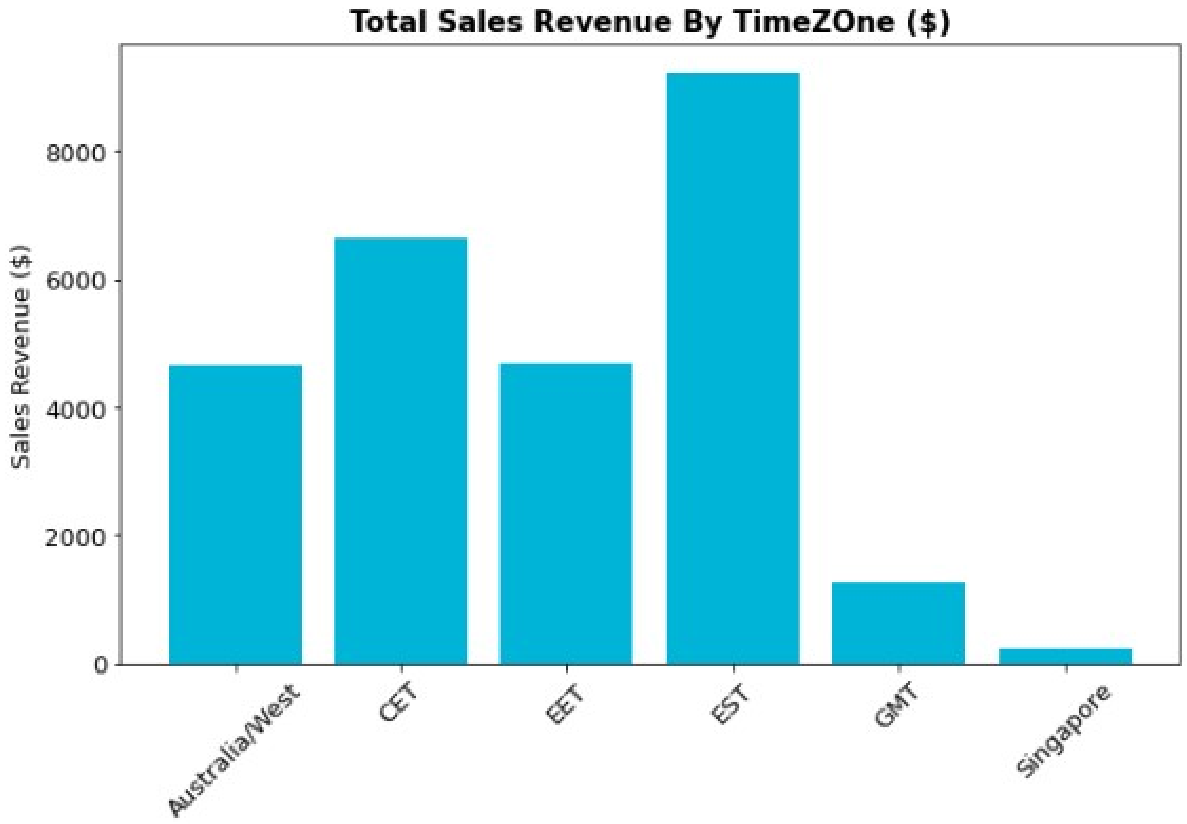
Revenue by TimeZone

In [43]:
```
sales_data_viz_revenue = sales_data_viz.groupby(['TimeZone']).sum()
sales_data_viz_revenue
```

Out[43]:

	UTC_Offset	Sales Revenue ($)
TimeZone		
Australia/West	136.0	4642.80
CET	26.0	6651.36
EET	20.0	4693.50
EST	-200.0	9215.42
GMT	0.0	1266.51
Singapore	64.0	221.51

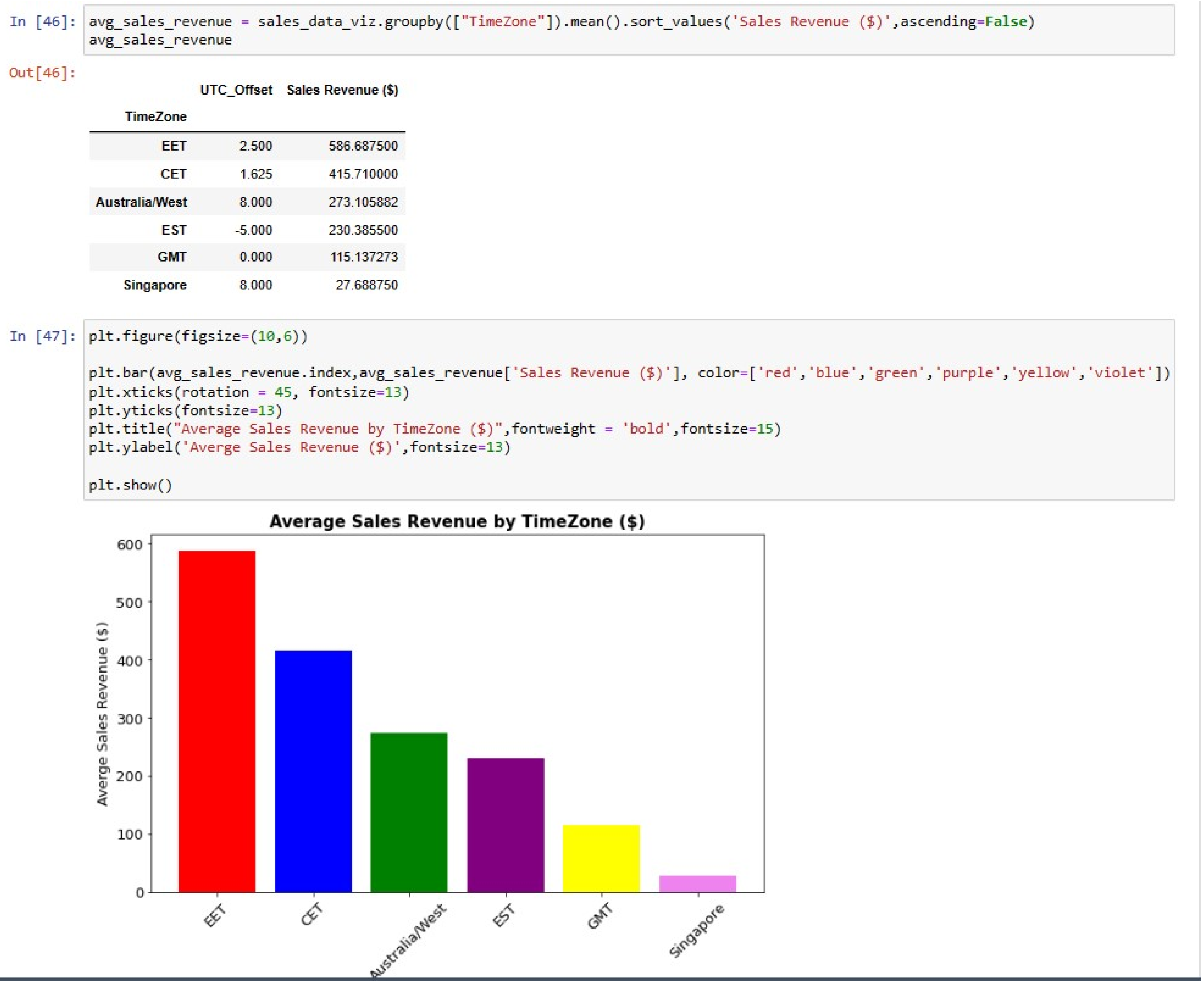
In [44]:
```
plt.figure(figsize=(10,6))

plt.bar(sales_data_viz_revenue.index, sales_data_viz_revenue["Sales Revenue ($)"], color='#00b4d8')

plt.xticks(rotation = 45, fontsize=13)
plt.yticks(fontsize=13)

plt.title('Total Sales Revenue By TimeZOne ($)', fontweight='bold', fontsize=15)
plt.ylabel('Sales Revenue ($)', fontsize=13)

plt.show()
```



```
In [45]: sales_data_viz.groupby(["TimeZone"]).mean().sort_values('Sales Revenue ($)')
```

Out[45]:

TimeZone	UTC_Offset	Sales Revenue ($)
Singapore	8.000	27.688750
GMT	0.000	115.137273
EST	-5.000	230.385500
Australia/West	8.000	273.105882
CET	1.625	415.710000
EET	2.500	586.687500

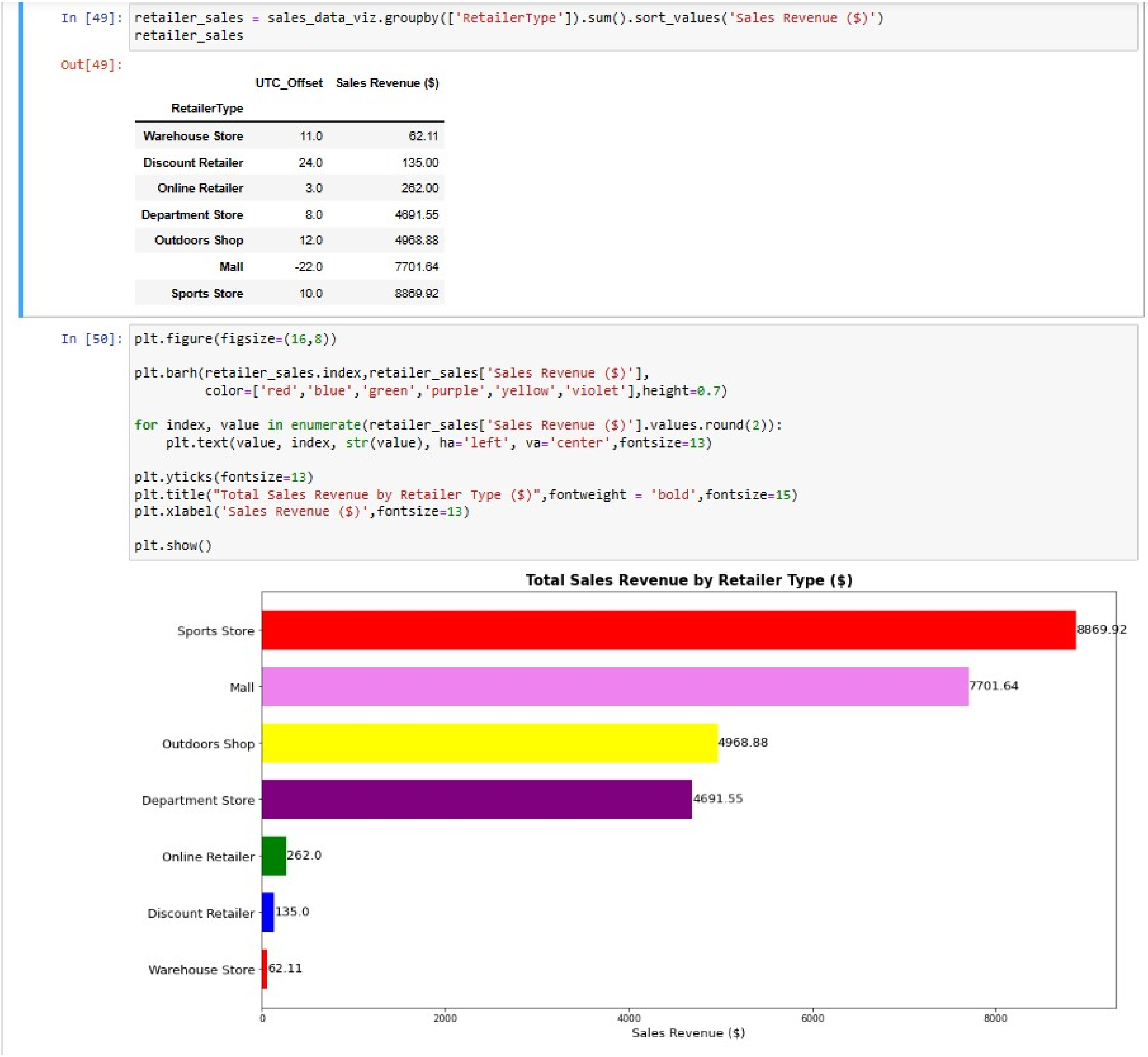


```
In [46]: avg_sales_revenue = sales_data_viz.groupby(["TimeZone"]).mean().sort_values('Sales Revenue ($)',ascending=False)
         avg_sales_revenue
```

Out[46]:

TimeZone	UTC_Offset	Sales Revenue ($)
EET	2.500	586.687500
CET	1.625	415.710000
Australia/West	8.000	273.105882
EST	-5.000	230.385500
GMT	0.000	115.137273
Singapore	8.000	27.688750

```
In [47]: plt.figure(figsize=(10,6))

         plt.bar(avg_sales_revenue.index,avg_sales_revenue['Sales Revenue ($)'], color=['red','blue','green','purple','yellow','violet'])
         plt.xticks(rotation = 45, fontsize=13)
         plt.yticks(fontsize=13)
         plt.title("Average Sales Revenue by TimeZone ($)",fontweight = 'bold',fontsize=15)
         plt.ylabel('Averge Sales Revenue ($)',fontsize=13)

         plt.show()
```



In [49]:

```
retailer_sales = sales_data_viz.groupby(['RetailerType']).sum().sort_values('Sales Revenue ($)')
retailer_sales
```

Out[49]:

RetailerType	UTC_Offset	Sales Revenue ($)
Warehouse Store	11.0	62.11
Discount Retailer	24.0	135.00
Online Retailer	3.0	262.00
Department Store	8.0	4691.55
Outdoors Shop	12.0	4968.88
Mall	-22.0	7701.64
Sports Store	10.0	8869.92

In [50]:

```
plt.figure(figsize=(16,8))

plt.barh(retailer_sales.index,retailer_sales['Sales Revenue ($)'],
         color=['red','blue','green','purple','yellow','violet'],height=0.7)

for index, value in enumerate(retailer_sales['Sales Revenue ($)'].values.round(2)):
    plt.text(value, index, str(value), ha='left', va='center',fontsize=13)

plt.yticks(fontsize=13)
plt.title("Total Sales Revenue by Retailer Type ($)",fontweight = 'bold',fontsize=15)
plt.xlabel('Sales Revenue ($)',fontsize=13)

plt.show()
```