Task 3:- Operations on Multi-Index

1. Task Description:

Work with multi-index DataFrames and perform operations on different levels.

2. Task Output Screenshot:

```
# We will do multiIndex DataFrame using 'Country' and 'Item_Type
data.set_index(['Country', 'Item_Type'], inplace=True)
print("\nMultiIndex DataFrame:\n", data)
```

```
MultiIndex DataFrame:
                                                          Region  \
Country               Item_Type
Tuvalu                Baby Food                  Australia and Oceania
Grenada               Cereal          Central America and the Caribbean
Russia                Office Supplies                          Europe
Sao Tome and Principe Fruits                  Sub-Saharan Africa
Rwanda                Office Supplies         Sub-Saharan Africa
...                                                          ...
Mali                  Clothes                 Sub-Saharan Africa
Malaysia              Fruits                            Asia
Sierra Leone          Vegetables              Sub-Saharan Africa
Mexico                Personal Care                North America
Mozambique            Household               Sub-Saharan Africa

                                  Sales_Channel Order_Priority  \
Country               Item_Type
Tuvalu                Baby Food         Offline              H
Grenada               Cereal             Online              C
Russia                Office Supplies   Offline              L
Sao Tome and Principe Fruits             Online              C
Rwanda                Office Supplies   Offline              L
...                                        ...            ...
Mali                  Clothes            Online              M
Malaysia              Fruits            Offline              L
Sierra Leone          Vegetables        Offline              C
Mexico                Personal Care     Offline              M
Mozambique            Household         Offline              L

                                   Ship_Date  Unit_Cost  Total_Revenue  \
Country               Item_Type
Tuvalu                Baby Food    27/06/2010     159.42     2533654.00
Grenada               Cereal       15/09/2012     117.11      576782.80
Russia                Office Supplies  05/08/2014     524.96     1158582.59
Sao Tome and Principe Fruits       07/05/2014       6.92       75591.66
Rwanda                Office Supplies  02/06/2013     524.96     3296425.02
...                                        ...        ...            ...
Mali                  Clothes      09/03/2011      35.84       97848.64
Malaysia              Fruits       28/12/2011       6.92       58471.11
Sierra Leone          Vegetables   29/06/2016      90.93      228779.10
Mexico                Personal Care  08/08/2015      56.67      471336.91
Mozambique            Household    15/02/2012     582.54     3586685.09

                                  Total_Profit
Country               Item_Type
Tuvalu                Baby Food       951410.50
Grenada               Cereal          248406.36
Russia                Office Supplies  224598.75
Sao Tome and Principe Fruits           19525.82
Rwanda                Office Supplies  639877.50
...                                       ...
Mali                  Clothes          65214.72
Malaysia              Fruits           15103.47
Sierra Leone          Vegetables       93748.05
Mexico                Personal Care    144521.02
Mozambique            Household        889472.91

[100 rows x 7 columns]
```

```
print("\nData for Country 'Mexico':\n", data.loc['Mexico'])
```

```
Data for Country 'Mexico':
                    Region Sales_Channel Order_Priority   Ship_Date  \
Item_Type
Household      North America       Offline              C  12/12/2014
Personal Care  North America       Offline              L  20/03/2012
Personal Care  North America       Offline              M  08/08/2015

               Unit_Cost  Total_Revenue  Total_Profit
Item_Type
Household         502.54     4647149.58    1152486.42
Personal Care      56.67      524878.86     160935.32
Personal Care      56.67      471336.91     144521.02
```

```
print("\nData for Country 'Mexico' and Item Type 'Personal Care':\n", data.loc['Mexico', 'Personal Care'])
```

```
Data for Country 'Mexico' and Item Type 'Personal Care':
                            Region Sales_Channel Order_Priority   Ship_Date  \
Country Item_Type
Mexico  Personal Care  North America       Offline              L  20/03/2012
        Personal Care  North America       Offline              M  08/08/2015

                      Unit_Cost  Total_Revenue  Total_Profit
Country Item_Type
Mexico  Personal Care      56.67      524878.86     160935.32
        Personal Care      56.67      471336.91     144521.02
```

```
#Calculate the mean of Total Revenue for each country
mean_revenue_by_country_item = data.groupby(level=[0, 1])['Total_Revenue'].mean()
print("\nMean Total Revenue by Country and Item Type:\n", mean_revenue_by_country_item)
```

```
Mean Total Revenue by Country and Item Type:
 Country         Item_Type
Albania         Clothes            247956.32
Angola          Household         2798846.49
Australia       Beverages          445588.05
                Cereal             140287.40
                Office Supplies   1984138.04
                                      ...
Turkmenistan    Household         2559474.10
                Office Supplies   3262562.10
Tuvalu          Baby Food         2533654.00
United Kingdom  Household          188452.14
Zambia          Snacks             623289.30
Name: Total_Revenue, Length: 97, dtype: float64
```

```
# Swapping Levels
swapped_sales = data.swaplevel()
print("\nSwapped MultiIndex DataFrame:\n", swapped_sales)
```

```
Swapped MultiIndex DataFrame:
                                                                Region  \
Item_Type       Country
Baby Food       Tuvalu                                 Australia and Oceania
Cereal          Grenada                 Central America and the Caribbean
Office Supplies Russia                                             Europe
Fruits          Sao Tome and Principe                  Sub_Saharan Africa
Office Supplies Rwanda                                 Sub_Saharan Africa
...                                                                   ...
Clothes         Mali                                   Sub_Saharan Africa
Fruits          Malaysia                                             Asia
Vegetables      Sierra Leone                           Sub_Saharan Africa
Personal Care   Mexico                                      North America
Household       Mozambique                             Sub_Saharan Africa

                                    Sales_Channel Order_Priority  \
Item_Type       Country
Baby Food       Tuvalu                    Offline              H
Cereal          Grenada                    Online              C
Office Supplies Russia                    Offline              L
Fruits          Sao Tome and Principe      Online              C
Office Supplies Rwanda                    Offline              L
...                                           ...            ...
Clothes         Mali                       Online              M
Fruits          Malaysia                  Offline              L
Vegetables      Sierra Leone              Offline              C
Personal Care   Mexico                    Offline              M
Household       Mozambique                Offline              L

                                      Ship_Date  Unit_Cost  Total_Revenue  \
Item_Type       Country
Baby Food       Tuvalu                27/06/2010     159.42     2533654.00
Cereal          Grenada               15/09/2012     117.11      576782.88
Office Supplies Russia                05/08/2014     524.96     1158502.59
Fruits          Sao Tome and Principe 07/05/2014       6.92       75591.66
Office Supplies Rwanda                02/06/2013     524.96     3296425.02
...                                          ...        ...            ...
Clothes         Mali                  09/03/2011      35.84       97848.64
Fruits          Malaysia              28/12/2011       6.92       58471.11
Vegetables      Sierra Leone          29/06/2016      98.93      228779.10
Personal Care   Mexico                08/08/2015      56.67      471336.91
Household       Mozambique            15/02/2012     582.54     3586685.09

                                    Total_Profit
Item_Type       Country
Baby Food       Tuvalu                951418.58
Cereal          Grenada               248486.36
Office Supplies Russia                224598.75
Fruits          Sao Tome and Principe  19525.82
Office Supplies Rwanda                639877.58
...                                        ...
Clothes         Mali                   65214.72
Fruits          Malaysia               15183.47
Vegetables      Sierra Leone           93748.85
Personal Care   Mexico                144521.82
Household       Mozambique            889472.91

[100 rows x 7 columns]
```

```
#Sorting the MultiIndex
sorted_sales = data.sort_index()
print("\nSorted MultiIndex DataFrame:\n", sorted_sales)
```

```
Sorted MultiIndex DataFrame:
                                              Region Sales_Channel  \
Country        Item_Type
Albania        Clothes                        Europe        Online
Angola         Household          Sub_Saharan Africa       Offline
Australia      Beverages       Australia and Oceania       Offline
               Cereal          Australia and Oceania       Offline
               Office Supplies Australia and Oceania        Online
...                                              ...           ...
Turkmenistan   Household                        Asia       Offline
               Office Supplies                  Asia        Online
Tuvalu         Baby Food       Australia and Oceania       Offline
United Kingdom Household                      Europe        Online
Zambia         Snacks             Sub_Saharan Africa        Online

                              Order_Priority   Ship_Date  Unit_Cost  \
Country        Item_Type
Albania        Clothes                     C  18/03/2010      35.84
Angola         Household                   M  27/04/2011     502.54
Australia      Beverages                   H  07/11/2014      31.79
               Cereal                      H  07/02/2013     117.11
               Office Supplies             C  25/11/2015     524.96
...                                      ...         ...        ...
Turkmenistan   Household                   L  20/01/2011     502.54
               Office Supplies             M  20/05/2013     524.96
Tuvalu         Baby Food                   H  27/06/2010     159.42
United Kingdom Household                   L  14/02/2012     502.54
Zambia         Snacks                      L  01/05/2011      97.44

                              Total_Revenue  Total_Profit
Country        Item_Type
Albania        Clothes               247956.32     166635.36
Angola         Household            2798846.49     693911.51
Australia      Beverages             445588.05     147031.74
               Cereal                140287.40      68418.38
               Office Supplies      1984138.04     369155.00
...                                        ...          ...
Turkmenistan   Household            2559474.10     634745.90
               Office Supplies      3262562.10     632512.50
Tuvalu         Baby Food            2533654.00     951410.50
United Kingdom Household             188452.14      46735.86
Zambia         Snacks                623289.30     225246.90

[100 rows x 7 columns]
```

```
#Let's Calculate the total profit for each country
total_profit_by_country = data.groupby(level=0)['Total_Profit'].sum()
print("\nTotal Profit by Country:\n", total_profit_by_country)
```

```
Total Profit by Country:
 Country
Albania             166635.36
Angola              693911.51
Australia           576605.12
Austria             495807.89
Azerbaijan         1512926.83
                        ...
The Gambia         1385883.27
Turkmenistan       1267258.40
Tuvalu              951410.50
United Kingdom       46735.86
Zambia              225246.90
Name: Total_Profit, Length: 76, dtype: float64
```

```
#Let's Calculate the total revenue for each item type across all countries
total_revenue_by_item_type = data.groupby(level=1)['Total_Revenue'].sum()
print("\nTotal Revenue by Item Type:\n", total_revenue_by_item_type)
```

```
Total Revenue by Item Type:
 Item_Type
Baby Food          10350327.60
Beverages           2690794.60
Cereal              5322898.90
Clothes             7787292.80
Cosmetics          36681589.60
Fruits               466481.34
Household          29889712.29
Meat                4583675.75
Office Supplies    30585388.07
Personal Care       3980984.84
Snacks              2888733.46
Vegetables          3889057.06
Name: Total_Revenue, dtype: float64
```

3. Algorithm Used In Task:

- The concept of MultiIndex is used, which allows for more complex and hierarchical data representations, with multiple levels of indexing (e.g., Country and Item_Type).
- Used groupby() to aggregate data based on the multi-index levels (e.g., calculating mean revenue or total profit by country or item type).
- Methods like here used are swaplevel() to swap index levels and sort_index() to reorder the multi-index based on different criteria.
- Operations like loc is used for selecting specific data, and sum() or mean() for aggregating numeric values.