m15_case-study

December 31, 2024

1 Statistical Foundations (Self-Paced)

2 Module 15 – Exploratory Data Analysis

Case Study: EDA On Import/Export HS Data

This assignment involves Exploratory Data Analysis (EDA) on international trade data classified using the Harmonized System (HS). The primary focus is to analyze and visualize trade patterns, with a special emphasis on India's imports and exports.

2.0.1 Case Study Overview

The goal is to examine and uncover trends in import and export activities by analyzing trade data from various countries.

2.0.2 Data Details:

- HS Code: A standardized code to classify goods in international trade.
- Commodity: Name of the item.
- Country: Import/export partner.
- Year: Year of transaction.
- Value: Monetary value in million USD.

[2]:
```
#Import required libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
import warnings
warnings.filterwarnings("ignore")
```

[11]:
```
#Load data from the csv files
data_export = pd.read_csv('2018-2010_export.csv')
data_import = pd.read_csv('2018-2010_import.csv')
data_export.info()
data_import.info()
print(data_export.isnull().sum())
print(data_import.isnull().sum())
```

```
data_export.info()

print('Data export: ', data_export.head())
print('\nData import: ', data_import.head())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 137023 entries, 0 to 137022
Data columns (total 5 columns):
 #   Column     Non-Null Count   Dtype
---  ------     --------------   -----
 0   HSCode     137023 non-null  int64
 1   Commodity  137023 non-null  object
 2   value      122985 non-null  float64
 3   country    137023 non-null  object
 4   year       137023 non-null  int64
dtypes: float64(1), int64(2), object(2)
memory usage: 5.2+ MB
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 93095 entries, 0 to 93094
Data columns (total 5 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   HSCode     93095 non-null  int64
 1   Commodity  93095 non-null  object
 2   value      79068 non-null  float64
 3   country    93095 non-null  object
 4   year       93095 non-null  int64
dtypes: float64(1), int64(2), object(2)
memory usage: 3.6+ MB
HSCode           0
Commodity        0
value        14038
country          0
year             0
dtype: int64
HSCode           0
Commodity        0
value        14027
country          0
year             0
dtype: int64
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 137023 entries, 0 to 137022
Data columns (total 5 columns):
 #   Column     Non-Null Count   Dtype
---  ------     --------------   -----
 0   HSCode     137023 non-null  int64
 1   Commodity  137023 non-null  object
```

```
 2   value      122985 non-null  float64
 3   country    137023 non-null  object
 4   year       137023 non-null  int64
dtypes: float64(1), int64(2), object(2)
memory usage: 5.2+ MB
Data export:     HSCode                                             Commodity
value  \
0       2                         MEAT AND EDIBLE MEAT OFFAL.   0.18
1       3  FISH AND CRUSTACEANS, MOLLUSCS AND OTHER AQUAT…   0.00
2       4  DAIRY PRODUCE; BIRDS' EGGS; NATURAL HONEY; EDI…  12.48
3       6  LIVE TREES AND OTHER PLANTS; BULBS; ROOTS AND …   0.00
4       7    EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS.   1.89

           country  year
0  AFGHANISTAN TIS  2018
1  AFGHANISTAN TIS  2018
2  AFGHANISTAN TIS  2018
3  AFGHANISTAN TIS  2018
4  AFGHANISTAN TIS  2018

Data import:     HSCode                                             Commodity
value  \
0       5  PRODUCTS OF ANIMAL ORIGIN, NOT ELSEWHERE SPECI…    0.00
1       7    EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS.   12.38
2       8  EDIBLE FRUIT AND NUTS; PEEL OR CITRUS FRUIT OR…  268.60
3       9                      COFFEE, TEA, MATE AND SPICES.   35.48
4      11  PRODUCTS OF THE MILLING INDUSTRY; MALT; STARCH…     NaN

           country  year
0  AFGHANISTAN TIS  2018
1  AFGHANISTAN TIS  2018
2  AFGHANISTAN TIS  2018
3  AFGHANISTAN TIS  2018
4  AFGHANISTAN TIS  2018
```

[9]:
```python
# Task 1: Data Cleaning

def cleanup(data_df):
    # Replace 'UNSPECIFIED' with NaN
    data_df['country'] = data_df['country'].apply(lambda x: np.nan if x ==␣
 ↪"UNSPECIFIED" else x)

    # Remove rows where value is 0
    data_df = data_df[data_df['value'] != 0]

    # Drop rows with any NaN values
    data_df.dropna(inplace=True)
```

```
    # Convert year to categorical
    data_df['year'] = pd.Categorical(data_df['year'])

    # Remove duplicate rows
    data_df.drop_duplicates(keep="first", inplace=True)

    return data_df

data_export = cleanup(data_export)
data_import = cleanup(data_import)
print('Data export: ', data_export.head())
print('\nData import: ', data_import.head())
```

```
Data export:     HSCode                                         Commodity
value  \
0       2                         MEAT AND EDIBLE MEAT OFFAL.   0.18
2       4  DAIRY PRODUCE; BIRDS' EGGS; NATURAL HONEY; EDI…  12.48
4       7    EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS.   1.89
5       8  EDIBLE FRUIT AND NUTS; PEEL OR CITRUS FRUIT OR…  25.01
6       9                       COFFEE, TEA, MATE AND SPICES.  13.75

           country  year
0  AFGHANISTAN TIS  2018
2  AFGHANISTAN TIS  2018
4  AFGHANISTAN TIS  2018
5  AFGHANISTAN TIS  2018
6  AFGHANISTAN TIS  2018

Data import:     HSCode                                         Commodity
value  \
1       7    EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS.   12.38
2       8  EDIBLE FRUIT AND NUTS; PEEL OR CITRUS FRUIT OR…  268.60
3       9                       COFFEE, TEA, MATE AND SPICES.   35.48
5      12  OIL SEEDS AND OLEA. FRUITS; MISC. GRAINS, SEED…    8.32
6      13  LAC; GUMS, RESINS AND OTHER VEGETABLE SAPS AND…  108.78

           country  year
1  AFGHANISTAN TIS  2018
2  AFGHANISTAN TIS  2018
3  AFGHANISTAN TIS  2018
5  AFGHANISTAN TIS  2018
6  AFGHANISTAN TIS  2018
```

[9]:

```
    HSCode                                         Commodity   value  \
1       7    EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS.   12.38
2       8  EDIBLE FRUIT AND NUTS; PEEL OR CITRUS FRUIT OR…  268.60
```

```
3       9                       COFFEE, TEA, MATE AND SPICES.   35.48
5      12  OIL SEEDS AND OLEA. FRUITS; MISC. GRAINS, SEED…    8.32
6      13  LAC; GUMS, RESINS AND OTHER VEGETABLE SAPS AND…  108.78

           country  year
1  AFGHANISTAN TIS  2018
2  AFGHANISTAN TIS  2018
3  AFGHANISTAN TIS  2018
5  AFGHANISTAN TIS  2018
6  AFGHANISTAN TIS  2018
```

[13]:
```
data_export['cat'] = 'E'
data_import['cat'] = 'I'

df = pd.concat([data_export,data_import],ignore_index=True)

print(df.head())
print(df.tail())
```

```
   HSCode                                          Commodity  value  \
0       2                         MEAT AND EDIBLE MEAT OFFAL.   0.18
1       3  FISH AND CRUSTACEANS, MOLLUSCS AND OTHER AQUAT…   0.00
2       4  DAIRY PRODUCE; BIRDS' EGGS; NATURAL HONEY; EDI…  12.48
3       6  LIVE TREES AND OTHER PLANTS; BULBS; ROOTS AND …   0.00
4       7    EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS.   1.89

           country  year cat
0  AFGHANISTAN TIS  2018   E
1  AFGHANISTAN TIS  2018   E
2  AFGHANISTAN TIS  2018   E
3  AFGHANISTAN TIS  2018   E
4  AFGHANISTAN TIS  2018   E
        HSCode                                          Commodity  value  \
230113      81      OTHER BASE METALS; CERMETS; ARTICLES THEREOF.   0.14
230114      82  TOOLS IMPLEMENTS, CUTLERY, SPOONS AND FORKS, O…   0.00
230115      84  NUCLEAR REACTORS, BOILERS, MACHINERY AND MECHA…    NaN
230116      85  ELECTRICAL MACHINERY AND EQUIPMENT AND PARTS T…    NaN
230117      99                              MISCELLANEOUS GOODS.    NaN

         country  year cat
230113  ZIMBABWE  2010   I
230114  ZIMBABWE  2010   I
230115  ZIMBABWE  2010   I
230116  ZIMBABWE  2010   I
230117  ZIMBABWE  2010   I
```

[19]:
```
# Task 2: Top 10 Export Destinations of India (2010-2018)
 # Group data by country and sum up export values.
 # Sort and pick the top 10.
 # Plot a horizontal bar chart

df_q1 = data_export.groupby('country').agg({'value':'sum'})
df_q1 = df_q1.sort_values(by='value', ascending = False)
df_q1 = df_q1[:10]

sns.set(rc={'figure.figsize': (15, 6)})
sns.barplot(y='value', x=df_q1.index, data=df_q1.reset_index()).set_title('Top␣
 ↪10 Export Destinations of India (2010-2018)');
```

[20]:
```
# Task 3: Skewness Analysis for 2018
 # Skewness: Measures asymmetry in data distribution

from scipy.stats import skew

# Conditions for import/export in 2018
imports_2018 = df[(df['year'] == 2018) & (df['cat'] == 'I')].
 ↪groupby('country')['value'].sum()
exports_2018 = df[(df['year'] == 2018) & (df['cat'] == 'E')].
 ↪groupby('country')['value'].sum()

# Calculate skewness
skew_import = skew(imports_2018)
skew_export = skew(exports_2018)

print(f"Import Skewness: {skew_import}, Export Skewness: {skew_export}")
```

```
Import Skewness: 5.983923321211679, Export Skewness: 7.872378364531886
```

Explanation of Skewness Import Skewness: 5.98 A few countries account for most of India's imports. India imports much less from most other countries.

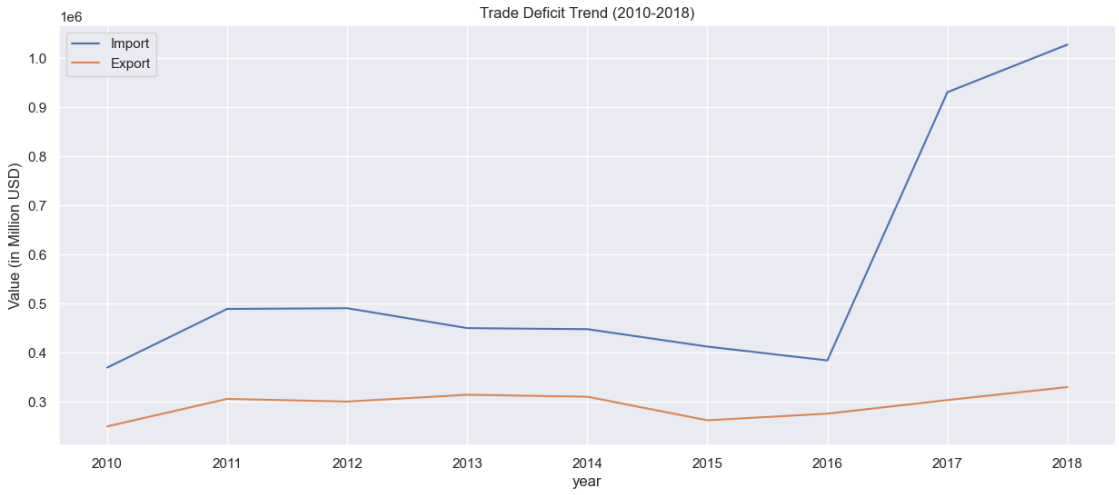
Export Skewness: 7.87 A very small number of countries dominate India's exports. Most countries receive much smaller export values from India.

Key Point Exports are more concentrated than imports. This means India relies heavily on just a few countries for export trade.

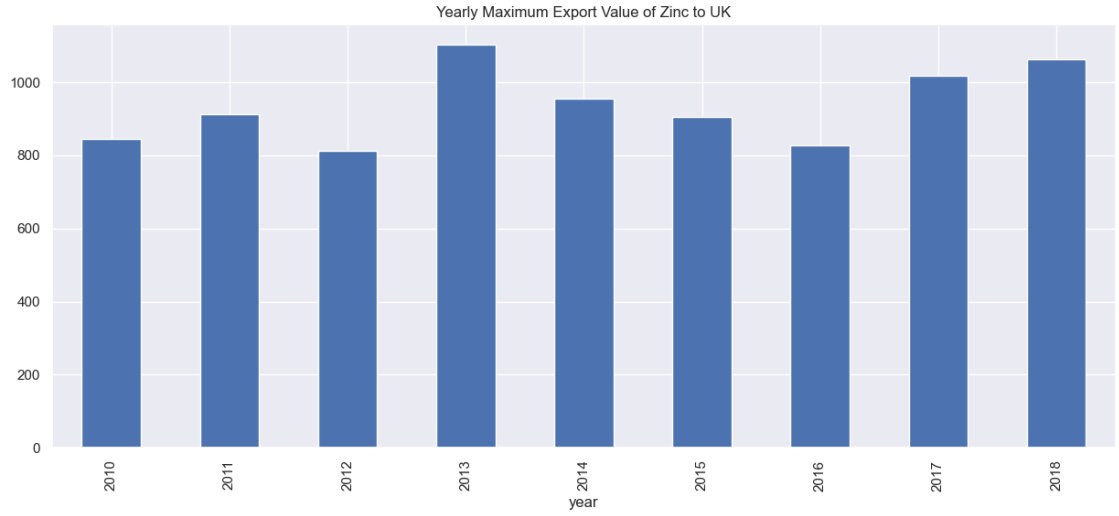
Conclusion India's trade (especially exports) is not evenly distributed. It's important to explore more trade partners to reduce risks of over-dependence on a few countries.

[21]:
```
# Task 4: Trade Deficit Trend
 # Compare total yearly import/export values

df[df['cat'] == 'I'].groupby('year')['value'].sum().plot(label='Import',␣
 ↪legend=True)
df[df['cat'] == 'E'].groupby('year')['value'].sum().plot(label='Export',␣
 ↪legend=True)
plt.title('Trade Deficit Trend (2010-2018)')
plt.ylabel('Value (in Million USD)')
```

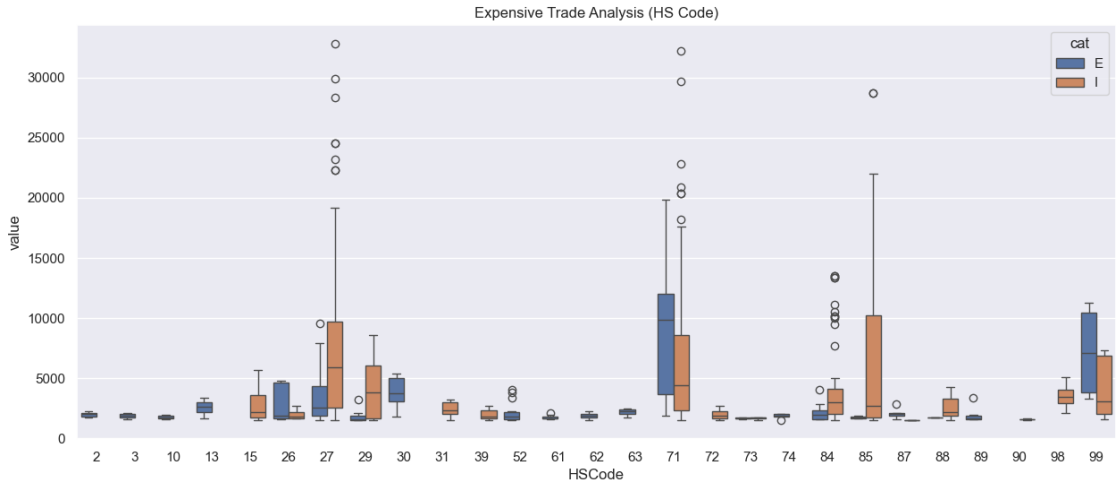
[21]:
```
Text(0, 0.5, 'Value (in Million USD)')
```



[22]:
```
# Task 5: Zinc Export to the UK
 # Filter data for the UK and ZINC AND ARTICLES THEREOF.
 # Find the maximum export values by year and plot a bar chart

zinc_uk = df[(df['country'] == 'U K') & (df['cat'] == 'E')].groupby('year').
 ↪max()['value']
zinc_uk.plot(kind='bar', title='Yearly Maximum Export Value of Zinc to UK');
```



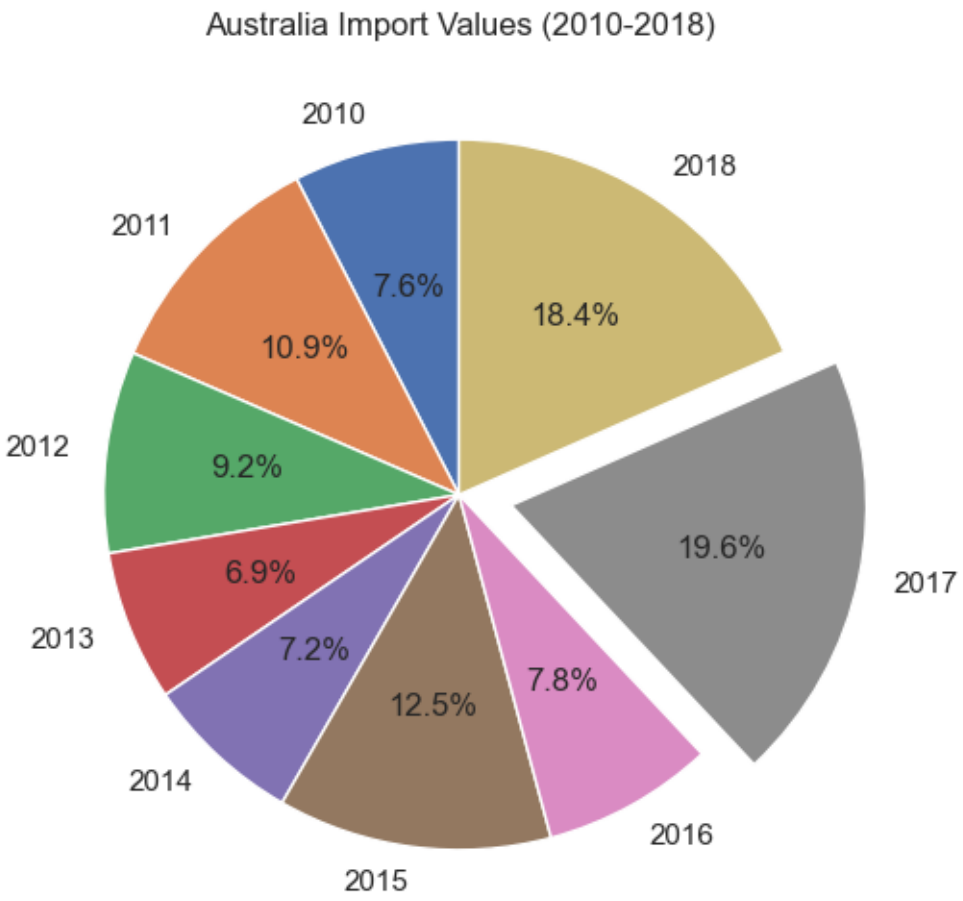
[23]:
```
# Task 6: Expensive Trade Analysis
 # Define "expensive" transactions as those with value > 1500.
 # Create boxplots for import/export values grouped by HSCode

expensive_trades = df[df['value'] > 1500]
sns.boxplot(x='HSCode', y='value', hue='cat', data=expensive_trades).
 ↪set_title('Expensive Trade Analysis (HS Code)');
```



[25]:
```
# Task 7: Australia's Imports Analysis (2010-2018)
 # Summarize yearly import values for Australia.
 # Create a pie chart with an exploded slice for the maximum value.
```

```
aus_imports = df[(df['country'] == 'AUSTRALIA') & (df['cat'] == 'I')].
 ↪groupby('year')['value'].sum()
max_idx = aus_imports.idxmax()
explode = [0.15 if i == max_idx else 0 for i in aus_imports.index]
plt.pie(aus_imports, labels=aus_imports.index, explode=explode, autopct='%1.
 ↪1f%%', startangle=90)
plt.title('Australia Import Values (2010-2018)')
```

[25]: `Text(0.5, 1.0, 'Australia Import Values (2010-2018)')`



[ ]: