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Master of Data Science

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Assessment Title:
Optimizing Profitability of UK Pet Stores through Data Visualization

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Word Count:
2,814

Introduction:

In this project, through the presentation of visual elements and interactive insights using the **Python** programming language and Streamlit dashboard, a report on the net profitability of pet stores across the United Kingdom in 2020 is provided to the Board of Directors. This study focuses on analysing the relationships between key factors such as **revenue**, **expenses**, **store location**, and the **type of animals** sold, in order to calculate the **profitability** of each store. The purpose of this analysis is to offer strategies for reducing costs and increasing revenue, as well as recommendations for modifying or potentially closing down certain branches to minimize losses and improve overall performance. In this study, special attention has been paid to their visualization and its importance in data analysis.

The Necessity and Benefits of Visualization:

"Data graphics visually display measured quantities by means of the combined use of points, lines, a coordinate system, numbers, symbols, words, shading, and color. The use of abstract, non-representational pictures to show numbers is a surprisingly recent invention, perhaps because of the diversity of skills required -the visual-artistic, empirical-statistical, and mathematical. Often the most effective way to describe, explore, and summarize a set of numbers - even a very large set - is to look at pictures of those numbers. Furchermore, of all methods for analyzing and communicating statistical information, well-designed data graphics are usually the simplest and ar the same time the most powerful" (Tufte, 2001, p.7).

Task 1: Implementation, and visualization based on Python and Streamlit interactive dashboard

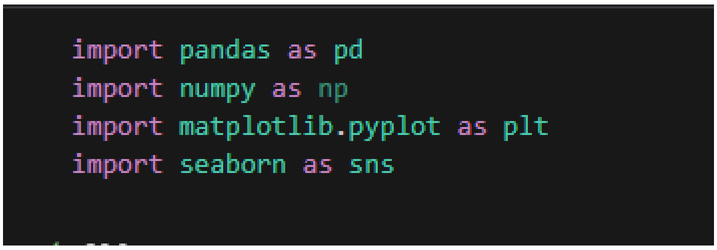
Feature Exploration:

Managers First Name:	**string & Nominal**
Managers Surname:	string & Nominal
Area:	string & Nominal
Pet:	string & Nominal
Units Sld:	float & Discrete
Revenue:	float & Continuous
Cost:	float & Continuous
Profit:	float & Continuous Target variable
Date:	Date & Time

Table 1- Features

The amount of **profit** is derived from the reduction of the its costs from net income will be obtained, and in this review, it will be our goal variable because decisions are supposed to be made for each branch based on this feature.

Importing Libraries:



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

Figure 1- python codes for importing libraries

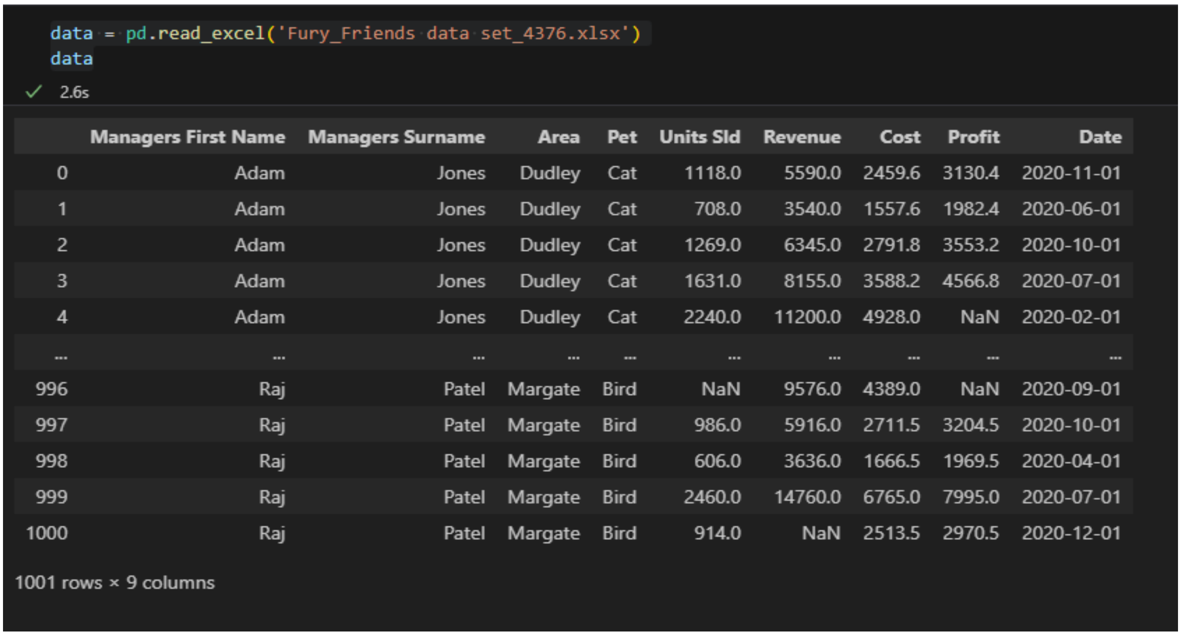
Pandas and Numpy: The most important libraries for working with data frames, arrays, and matrixes.

Since one of the main goals in this assignment is visualization and interaction, we will take a special look at libraries and visualization functions.

Matplotlib: "matplotlib is the primary scientific plotting library in Python. It provides functions for making publication-quality visualizations such as line charts, histograms, scatter plots, and so on. Visualizing your data and different aspects of your analysis can give you important insights, and we will be using matplotlib for all our visualizations. When working inside the Jupyter Notebook, you can show figures directly in the browser by using the %matplotlib notebook and %matplotlib inline commands. We recommend using %matplotlib notebook, which provides an interactive envi ronment (though we are using %matplotlib inline to produce this book)",(Müller & Guido, 2016, p. 9).

Seaborn: Another library for drawing 2D and 3D charts, which gives the developer the ability to apply more settings.

Importing Dataset:



```python
data = pd.read_excel('Fury_Friends data set_4376.xlsx')
data
```

✓ 2.6s

	Managers First Name	Managers Surname	Area	Pet	Units Sld	Revenue	Cost	Profit	Date
0	Adam	Jones	Dudley	Cat	1118.0	5590.0	2459.6	3130.4	2020-11-01
1	Adam	Jones	Dudley	Cat	708.0	3540.0	1557.6	1982.4	2020-06-01
2	Adam	Jones	Dudley	Cat	1269.0	6345.0	2791.8	3553.2	2020-10-01
3	Adam	Jones	Dudley	Cat	1631.0	8155.0	3588.2	4566.8	2020-07-01
4	Adam	Jones	Dudley	Cat	2240.0	11200.0	4928.0	NaN	2020-02-01
...	...	...	...	...	...	...	...	...	...
996	Raj	Patel	Margate	Bird	NaN	9576.0	4389.0	NaN	2020-09-01
997	Raj	Patel	Margate	Bird	986.0	5916.0	2711.5	3204.5	2020-10-01
998	Raj	Patel	Margate	Bird	606.0	3636.0	1666.5	1969.5	2020-04-01
999	Raj	Patel	Margate	Bird	2460.0	14760.0	6765.0	7995.0	2020-07-01
1000	Raj	Patel	Margate	Bird	914.0	NaN	2513.5	2970.5	2020-12-01

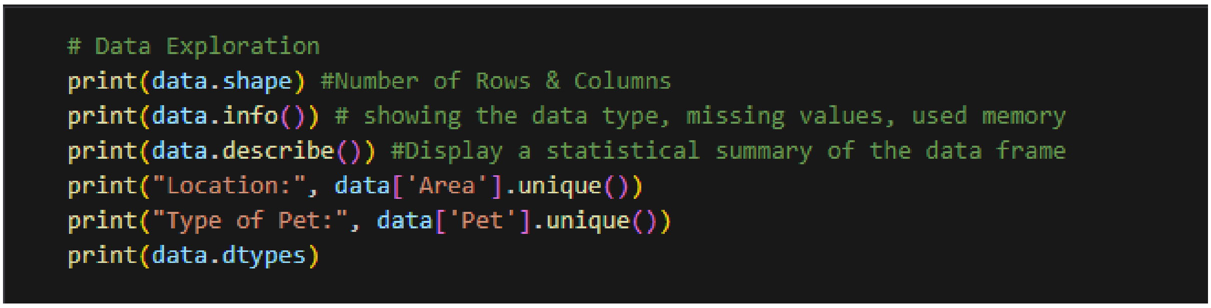
1001 rows × 9 columns

Figure 2- Preview of Data Set

Dataset contain 1001 records and 9 features about the Animal Products Stores. And there is an overview of 5 first and last records.

Data Exploration:

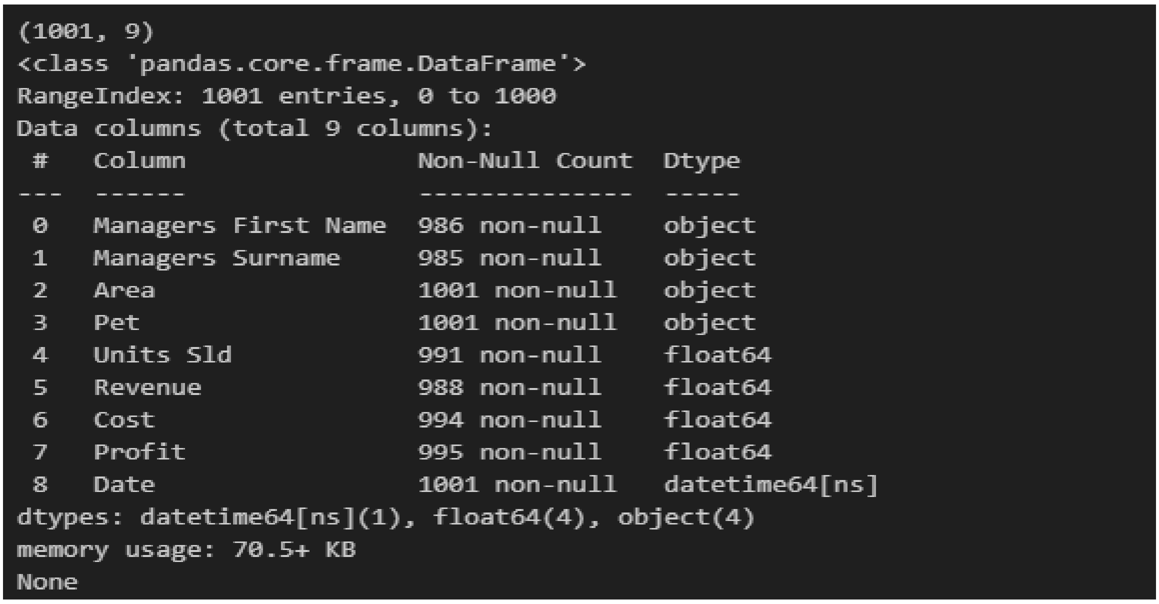
Basic knowledge of dataset leads to a better mastery of features and a greater ability to control or understand relationships and their impact on each other.



```
# Data Exploration
print(data.shape) #Number of Rows & Columns
print(data.info()) # showing the data type, missing values, used memory
print(data.describe()) #Display a statistical summary of the data frame
print("Location:", data['Area'].unique())
print("Type of Pet:", data['Pet'].unique())
print(data.dtypes)
```

Figure 3- python codes for Data Exploration

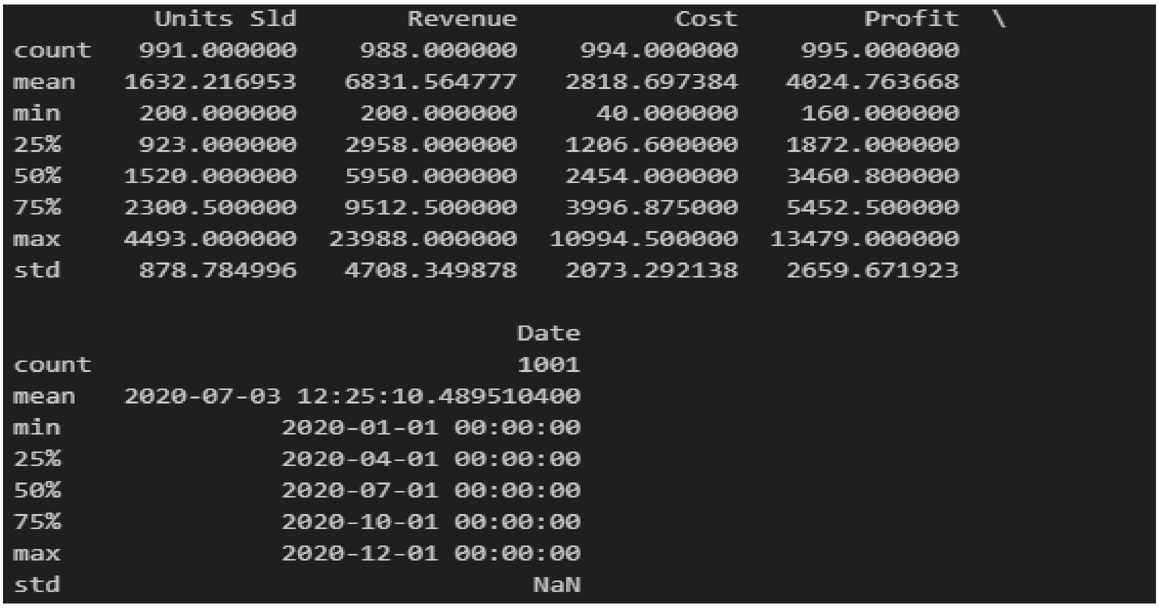
After obtaining information about the number of rows and columns, and descriptive statistics from the dataset, we will display an array of all types of animals, as well as the name of the location of the stores.



```
(1001, 9)
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1001 entries, 0 to 1000
Data columns (total 9 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
 0   Managers First Name   986 non-null    object
 1   Managers Surname      985 non-null    object
 2   Area                  1001 non-null   object
 3   Pet                   1001 non-null   object
 4   Units Sld             991 non-null    float64
 5   Revenue               988 non-null    float64
 6   Cost                  994 non-null    float64
 7   Profit                995 non-null    float64
 8   Date                  1001 non-null   datetime64[ns]
dtypes: datetime64[ns](1), float64(4), object(4)
memory usage: 70.5+ KB
None
```

Figure 4- Data set Information

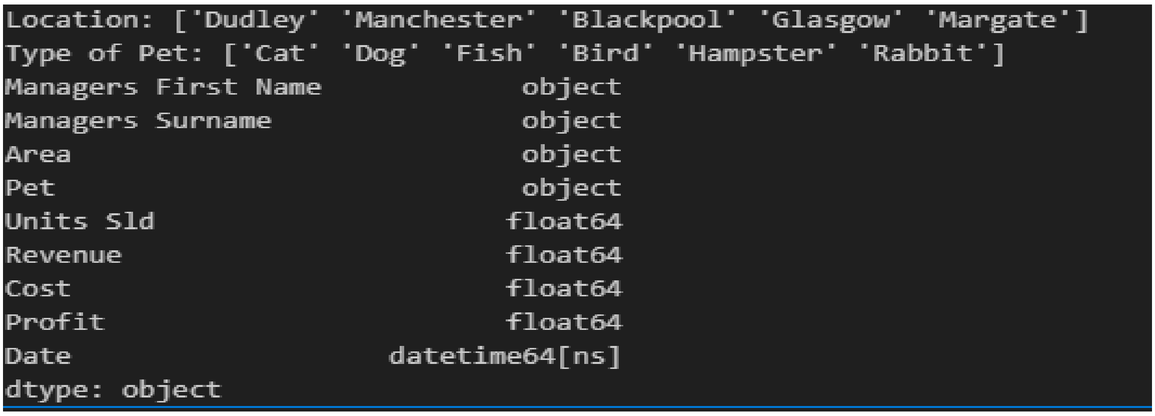
Data set contain 4 object type features, 4 float64, and 1 datetime64 variables, and use 70.5+ KB of memory.



```
           Units Sld        Revenue          Cost         Profit  \
count   991.000000     988.000000    994.000000     995.000000
mean   1632.216953    6831.564777   2818.697384    4024.763668
min     200.000000     200.000000     40.000000     160.000000
25%     923.000000    2958.000000   1206.600000    1872.000000
50%    1520.000000    5950.000000   2454.000000    3460.800000
75%    2300.500000    9512.500000   3996.875000    5452.500000
max    4493.000000   23988.000000  10994.500000   13479.000000
std     878.784996    4708.349878   2073.292138    2659.671923

                                Date
count                           1001
mean   2020-07-03 12:25:10.489510400
min              2020-01-01 00:00:00
25%              2020-04-01 00:00:00
50%              2020-07-01 00:00:00
75%              2020-10-01 00:00:00
max              2020-12-01 00:00:00
std                              NaN
```

Figure 5- Statistical Descriptive

Descriptive information from the dataset.



```
Location: ['Dudley' 'Manchester' 'Blackpool' 'Glasgow' 'Margate']
Type of Pet: ['Cat' 'Dog' 'Fish' 'Bird' 'Hampster' 'Rabbit']
Managers First Name               object
Managers Surname                  object
Area                              object
Pet                               object
Units Sld                        float64
Revenue                          float64
Cost                             float64
Profit                           float64
Date                      datetime64[ns]
dtype: object
```

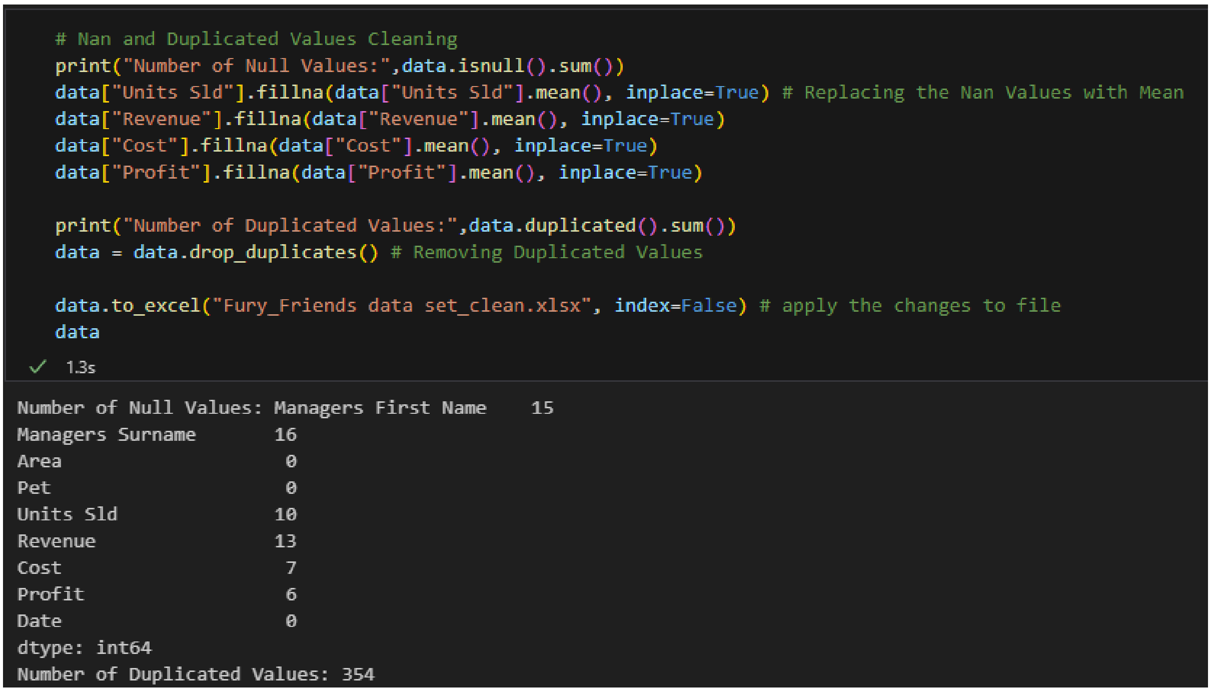
Figure 6- Data set information

A representation of two arrays including the name of the pets and the name of the location of the stores.

Data preparation

In the rest of the study, we will explore the relationships between variables and **profit** to determine which one has a positive or negative effect on it. Therefore, pre- processing increases the accuracy of the discovered relationships.

Exploring and Removing Nan values and Duplicated Rows:



```
# Nan and Duplicated Values Cleaning
print("Number of Null Values:",data.isnull().sum())
data["Units Sld"].fillna(data["Units Sld"].mean(), inplace=True) # Replacing the Nan Values with Mean
data["Revenue"].fillna(data["Revenue"].mean(), inplace=True)
data["Cost"].fillna(data["Cost"].mean(), inplace=True)
data["Profit"].fillna(data["Profit"].mean(), inplace=True)

print("Number of Duplicated Values:",data.duplicated().sum())
data = data.drop_duplicates() # Removing Duplicated Values

data.to_excel("Fury_Friends data set_clean.xlsx", index=False) # apply the changes to file
data
```

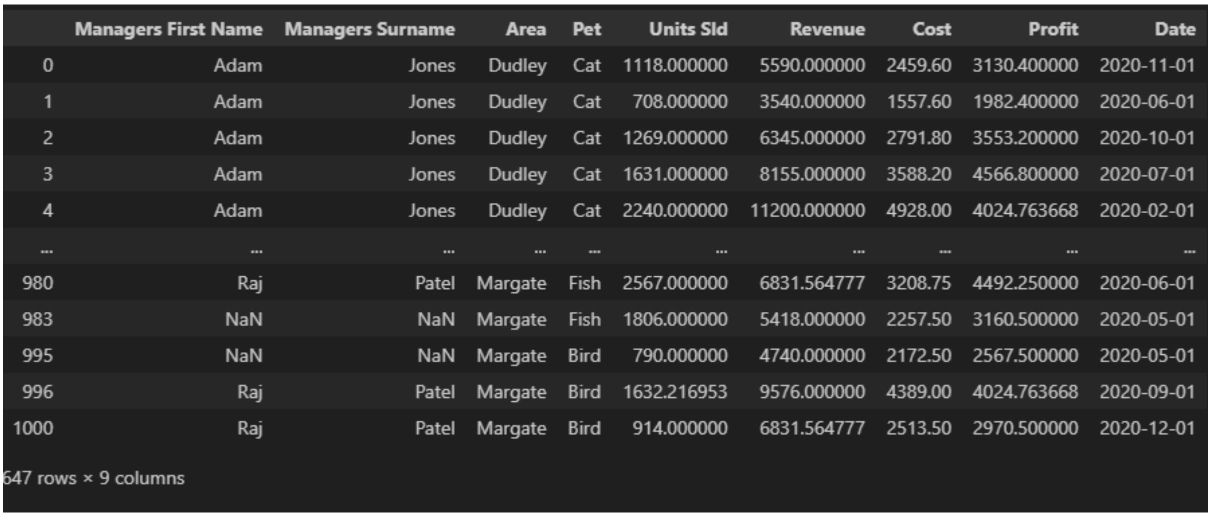
```
Number of Null Values: Managers First Name    15
Managers Surname       16
Area                    0
Pet                     0
Units Sld              10
Revenue                13
Cost                    7
Profit                  6
Date                    0
dtype: int64
Number of Duplicated Values: 354
```

Figure 7- Python Codes for Finding,Filling, and removing Nan and duplicated Values

About **67** Nan values are found in dataset which are replaced with the mean of their columns.

354 duplicated rows are eliminated, and Cleaned dataset are saved in a new dataset.

Preview of cleaned Dataset:

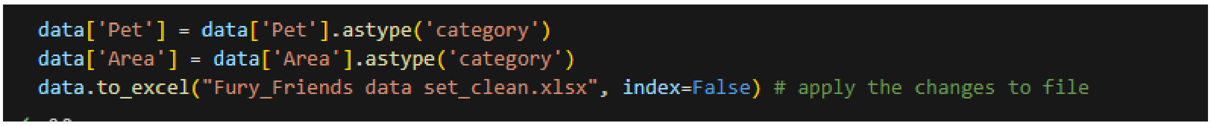


	Managers First Name	Managers Surname	Area	Pet	Units Sld	Revenue	Cost	Profit	Date
0	Adam	Jones	Dudley	Cat	1118.000000	5590.000000	2459.60	3130.400000	2020-11-01
1	Adam	Jones	Dudley	Cat	708.000000	3540.000000	1557.60	1982.400000	2020-06-01
2	Adam	Jones	Dudley	Cat	1269.000000	6345.000000	2791.80	3553.200000	2020-10-01
3	Adam	Jones	Dudley	Cat	1631.000000	8155.000000	3588.20	4566.800000	2020-07-01
4	Adam	Jones	Dudley	Cat	2240.000000	11200.000000	4928.00	4024.763668	2020-02-01
...	...	...	...	...	...	...	...	...	...
980	Raj	Patel	Margate	Fish	2567.000000	6831.564777	3208.75	4492.250000	2020-06-01
983	NaN	NaN	Margate	Fish	1806.000000	5418.000000	2257.50	3160.500000	2020-05-01
995	NaN	NaN	Margate	Bird	790.000000	4740.000000	2172.50	2567.500000	2020-05-01
996	Raj	Patel	Margate	Bird	1632.216953	9576.000000	4389.00	4024.763668	2020-09-01
1000	Raj	Patel	Margate	Bird	914.000000	6831.564777	2513.50	2970.500000	2020-12-01

647 rows × 9 columns

Figure 8- Preview of cleaned data set

Categorization:



```
data['Pet'] = data['Pet'].astype('category')
data['Area'] = data['Area'].astype('category')
data.to_excel("Fury_Friends data set_clean.xlsx", index=False) # apply the changes to file
```

Figure 9- Python Codes for Categorization

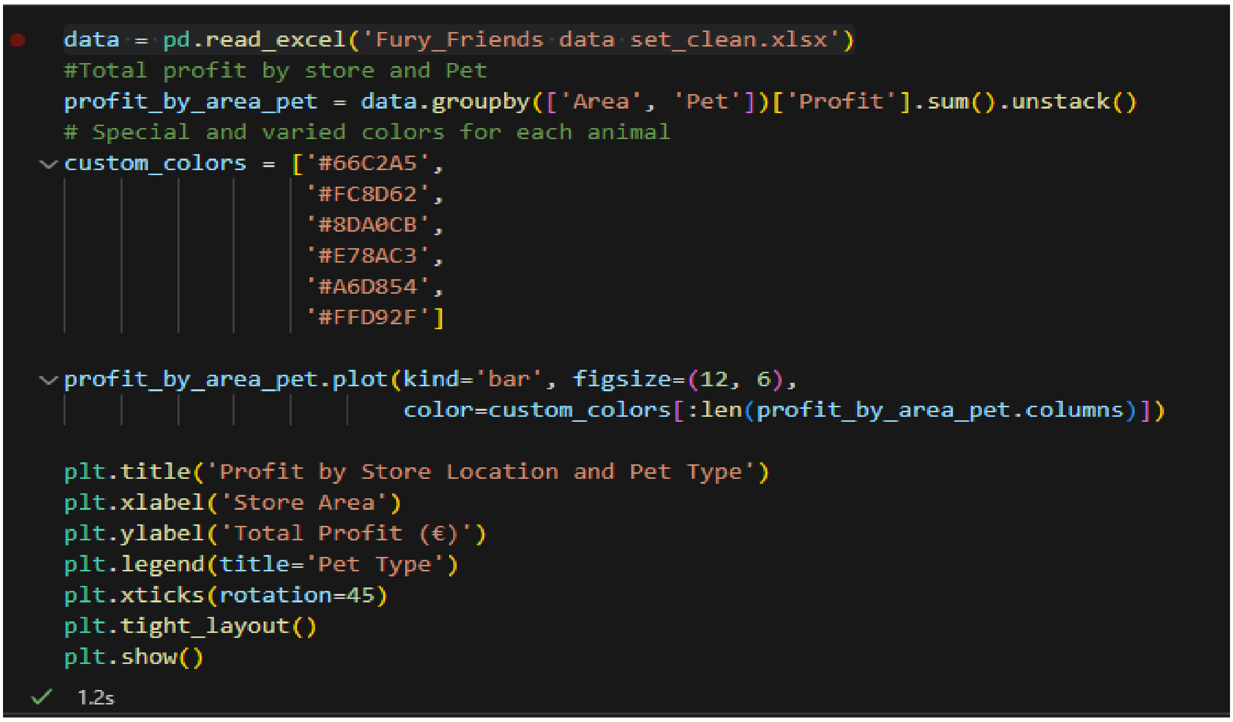
astype('category'): a method of converting string data that has duplicate values into categorized data. When data is stored as Category, it reduces memory consumption and Python processes the data faster.

Note:

Since the purpose of this analysis is to explore, compare, and visualize data rather than performing advanced modelling or clustering, there is no need for standardization and transformation for symmetry. The desired analyses can be performed effectively using raw data without alteration. Also, the outlets are not removed because the goal is to display unusual patterns as well.

Explorer Data Analysis (EDA)

Analyzing profit by store location (Area) and pet type to identify which segments are the most profitable:



```
data = pd.read_excel('Fury_Friends data set_clean.xlsx')
#Total profit by store and Pet
profit_by_area_pet = data.groupby(['Area', 'Pet'])['Profit'].sum().unstack()
# Special and varied colors for each animal
custom_colors = ['#66C2A5',
                 '#FC8D62',
                 '#8DA0CB',
                 '#E78AC3',
                 '#A6D854',
                 '#FFD92F']

profit_by_area_pet.plot(kind='bar', figsize=(12, 6),
                        color=custom_colors[:len(profit_by_area_pet.columns)])

plt.title('Profit by Store Location and Pet Type')
plt.xlabel('Store Area')
plt.ylabel('Total Profit (€)')
plt.legend(title='Pet Type')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```

Figure 10- Python Codes for analyzing profit on store and pet

It groups the data based on the two characteristics of **Area** and **Pet** and calculates the amount of **profit** for each combination.

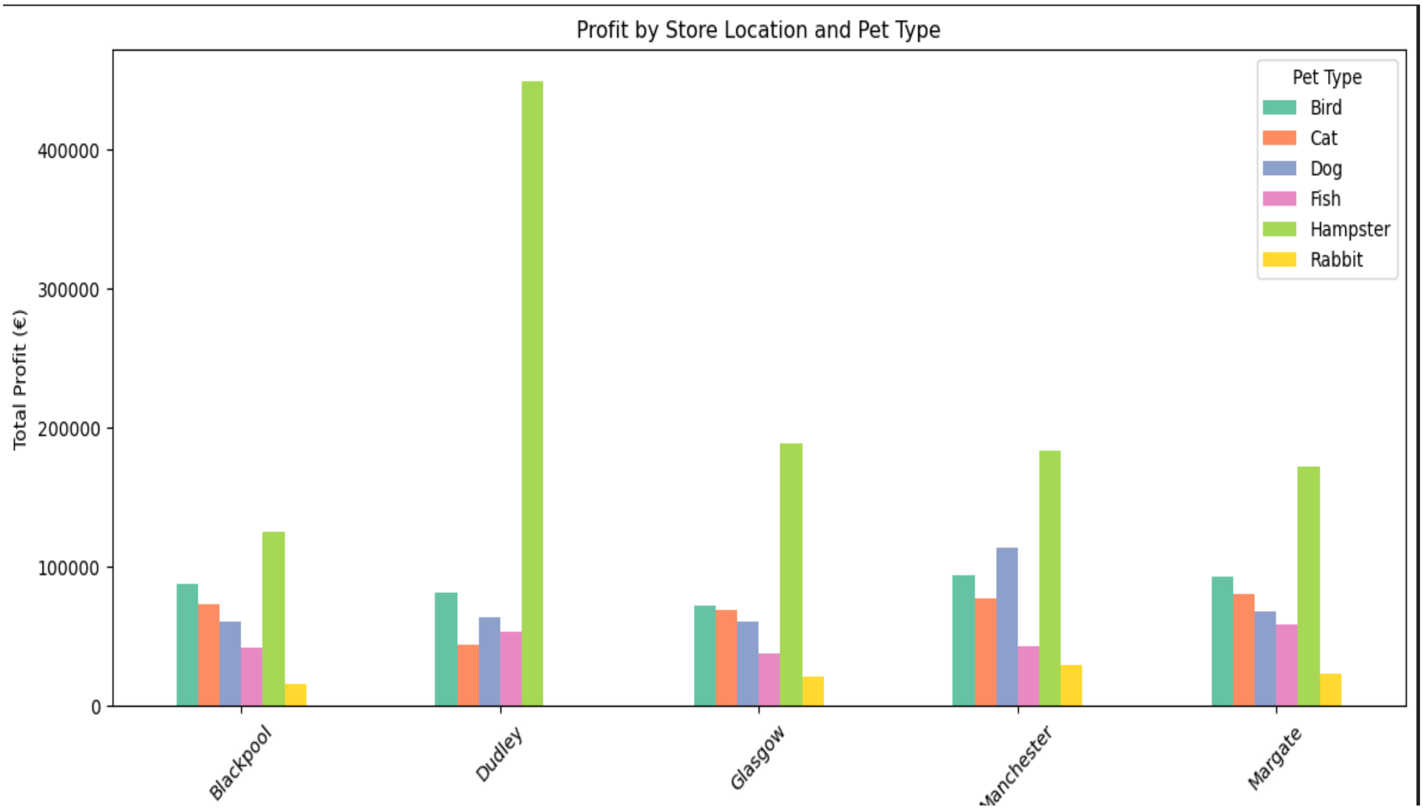
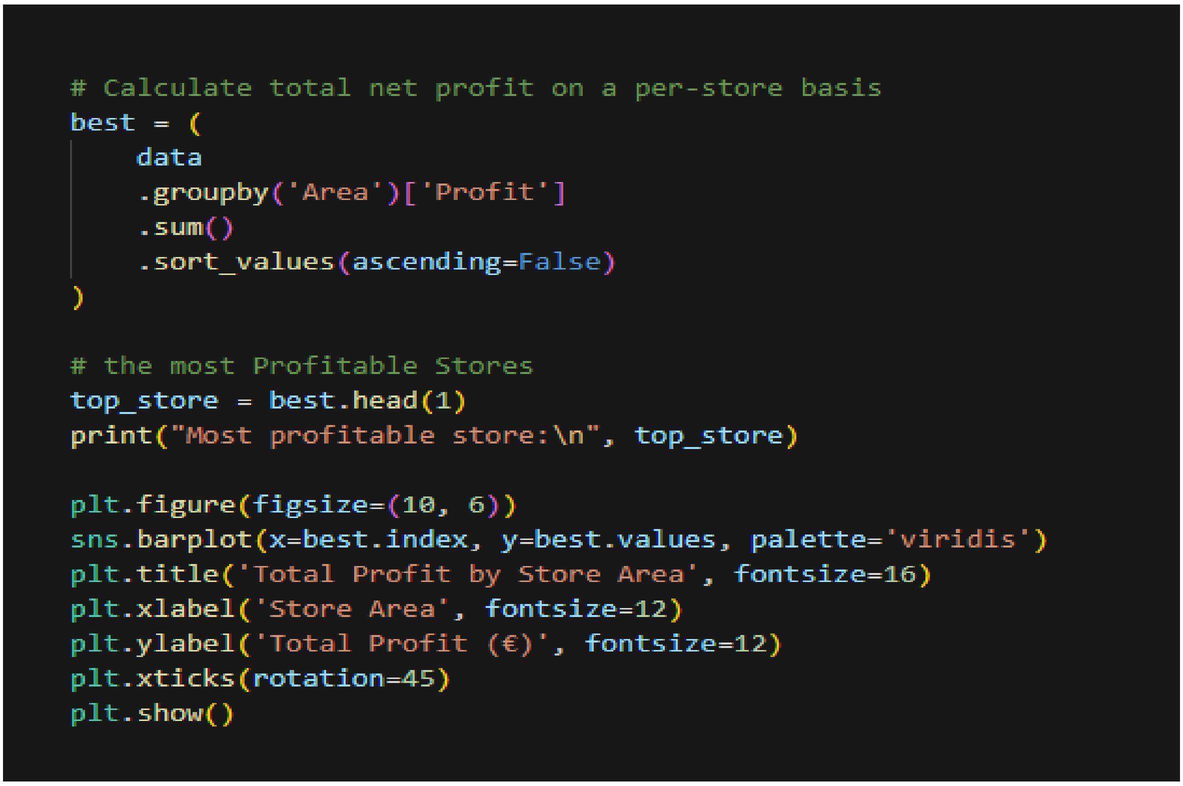


Figure 11- Preview of Bar chart

Hamsters were the most in-demand products across the other store branches .Obviously, **Rabbit** has the lowest market share and out of all the branches . **Dudley** is only store that makes the most profit from **hamsters**, and it is a special market for hamsters, but it does not make any profit from the sale of **rabbit-**related products. **Blackpool** has a more balanced distribution, meaning that the profits of **Bird**, **Cat**, and **Dog** are at the same level, which indicates that there is more diversified demand. **Glasgow**, **Manchester** and **Margate** are on the middle level, where the hamsters are the highest and the rest of the pets are medium and close to each other.

The most Profitable Stores:



```
# Calculate total net profit on a per-store basis
best = (
    data
    .groupby('Area')['Profit']
    .sum()
    .sort_values(ascending=False)
)

# the most Profitable Stores
top_store = best.head(1)
print("Most profitable store:\n", top_store)

plt.figure(figsize=(10, 6))
sns.barplot(x=best.index, y=best.values, palette='viridis')
plt.title('Total Profit by Store Area', fontsize=16)
plt.xlabel('Store Area', fontsize=12)
plt.ylabel('Total Profit (€)', fontsize=12)
plt.xticks(rotation=45)
plt.show()
```

Figure 12- Python Codes for analyzing profit on store and pet

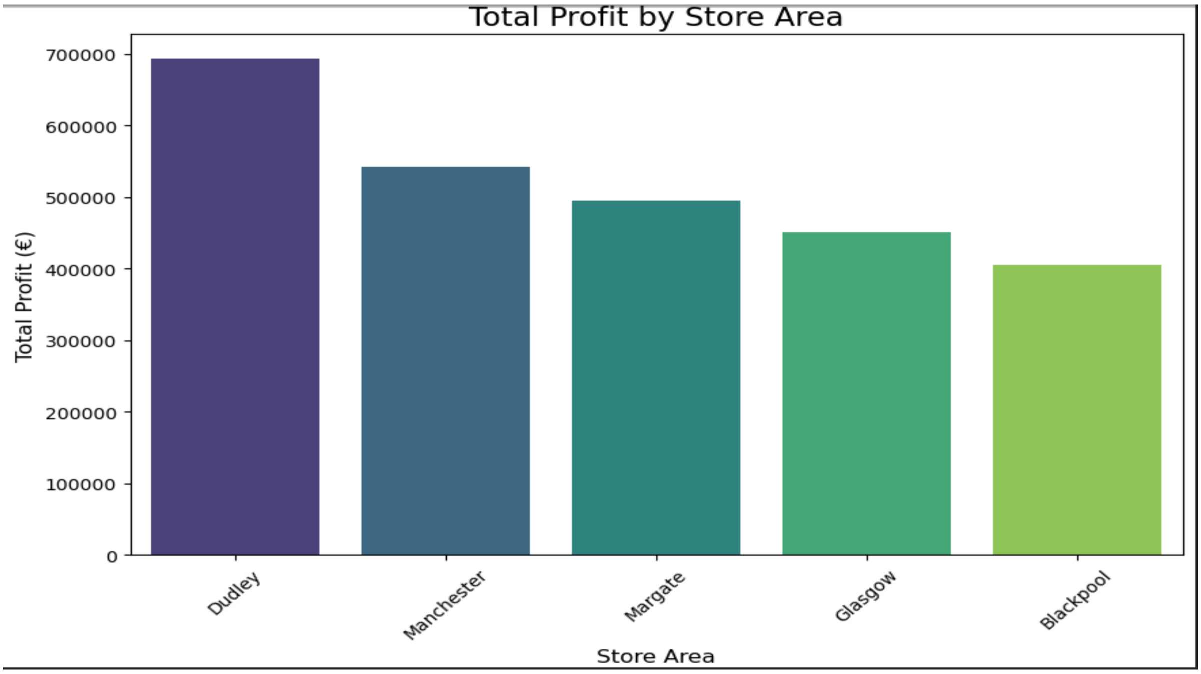
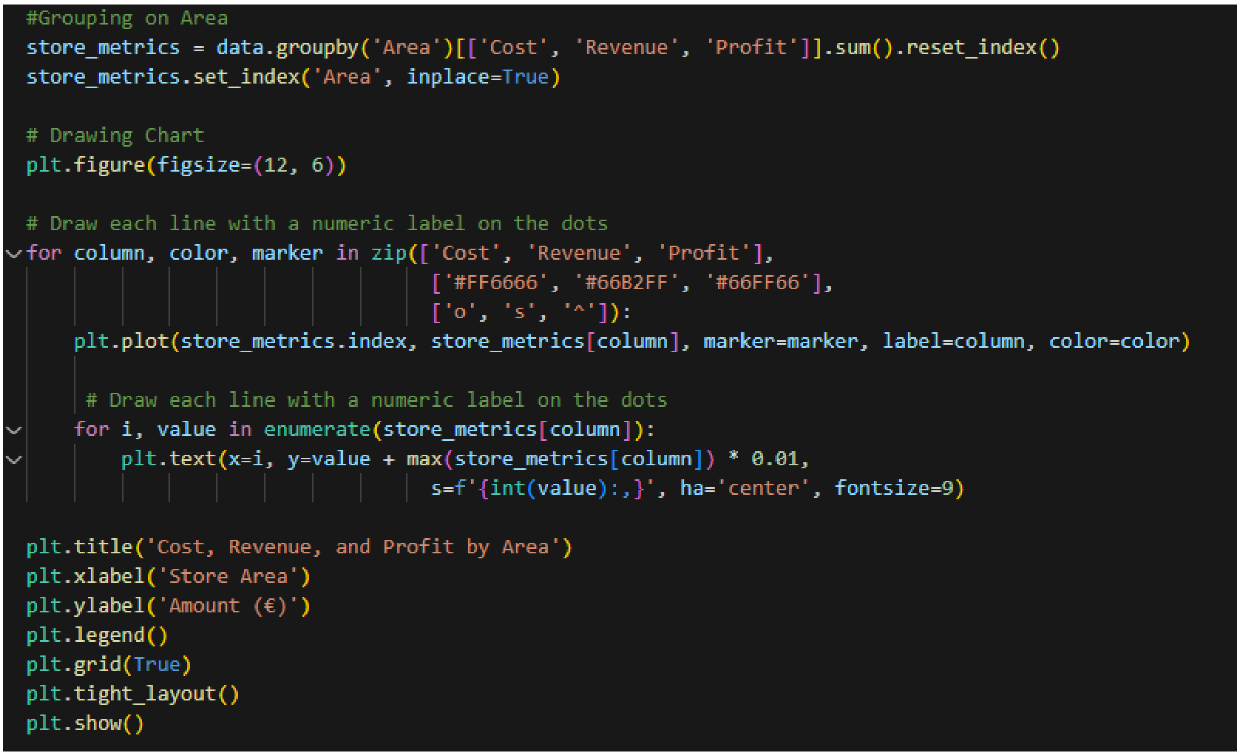


Figure 13- Preview of Bar chart

According to the chart, **Dudley** and **Manchester** are the most profitable stores, at approximately 700,000 and 550,000 respectively. On the other hand, **Blackpool** is The least profitable area at about 400,000.

Investigating the Effect of Area on Cost, Revenue, and Profit:



```
#Grouping on Area
store_metrics = data.groupby('Area')[['Cost', 'Revenue', 'Profit']].sum().reset_index()
store_metrics.set_index('Area', inplace=True)

# Drawing Chart
plt.figure(figsize=(12, 6))

# Draw each line with a numeric label on the dots
for column, color, marker in zip(['Cost', 'Revenue', 'Profit'],
                                 ['#FF6666', '#66B2FF', '#66FF66'],
                                 ['o', 's', '^']):
    plt.plot(store_metrics.index, store_metrics[column], marker=marker, label=column, color=color)

     # Draw each line with a numeric label on the dots
    for i, value in enumerate(store_metrics[column]):
        plt.text(x=i, y=value + max(store_metrics[column]) * 0.01,
                                 s=f'{int(value):,}', ha='center', fontsize=9)

plt.title('Cost, Revenue, and Profit by Area')
plt.xlabel('Store Area')
plt.ylabel('Amount (€)')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```

Figure 14- Python Codes for analyzing Area on cost, Revenue, and profit

It groups the **regions** based on **Revenue**, **Cost**, and **Profit**.

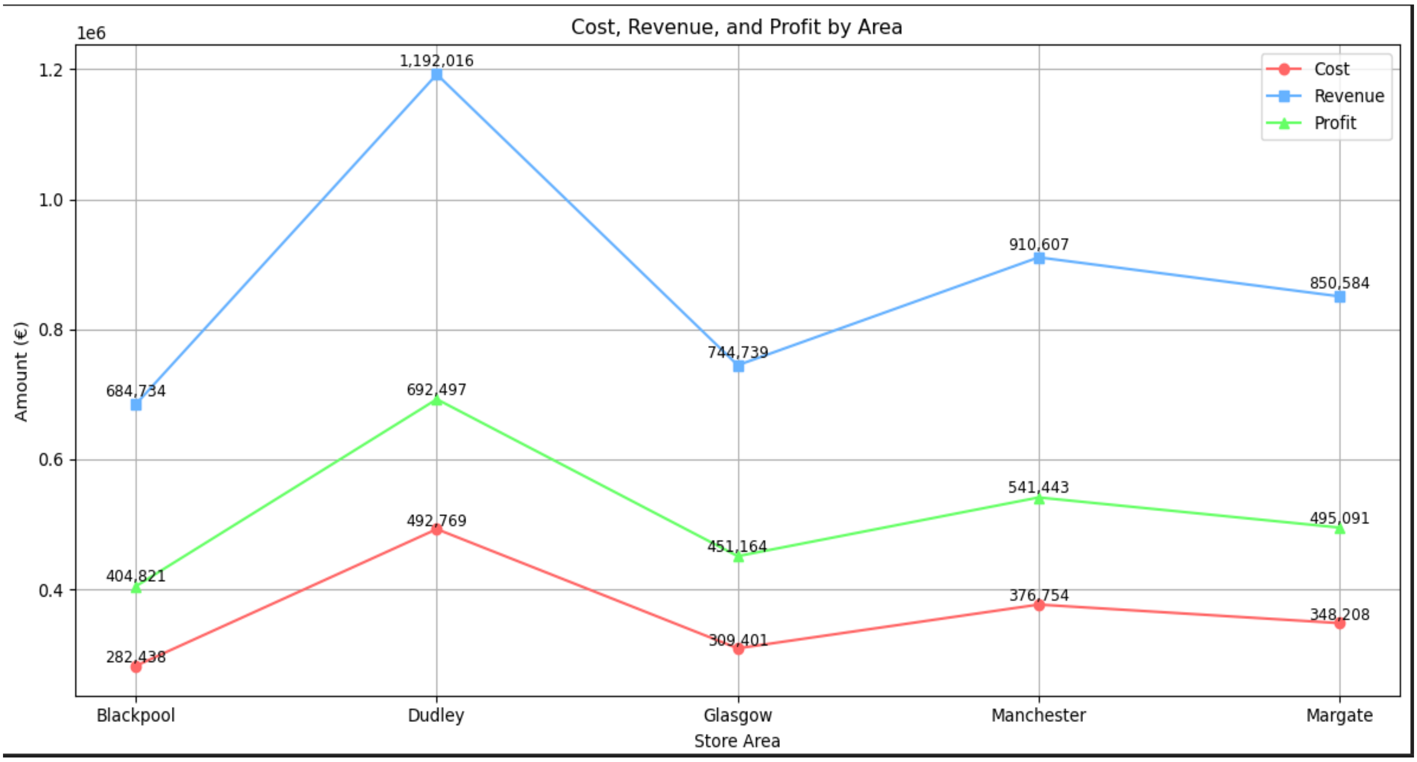


Figure 15- Preview of line plot

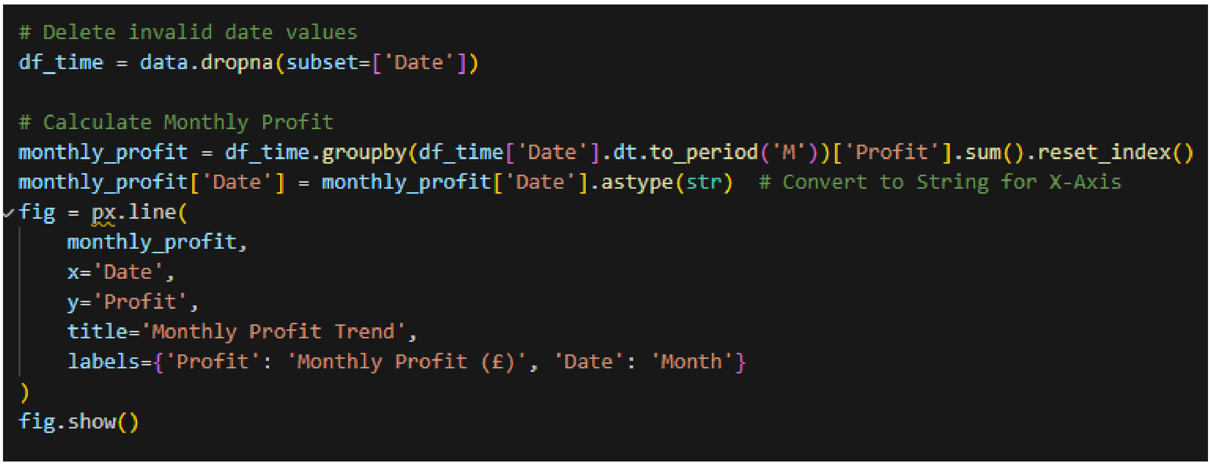
- **Revenue** reached its highest and lowest values in the **Dudley** and **Blackpool** areas at **1,192,016** and **684.734**, respectively.

- **Costs** are low across all regions, it reached their highest and lowest levels in the **Dudley** and **Blackpool** at **492,769** and **282,438**, in order.

- highest **profit** is related to **Dudley**, while the lowest profit belongs to **Blackpool** at **692,497** and **404,821**, respectively.

All stores have been profitable compare to their revenues. By revising the sales strategy and managing costs, we can increase profitability in the branches.

Calculating Monthly Profit:



```
# Delete invalid date values
df_time = data.dropna(subset=['Date'])

# Calculate Monthly Profit
monthly_profit = df_time.groupby(df_time['Date'].dt.to_period('M'))['Profit'].sum().reset_index()
monthly_profit['Date'] = monthly_profit['Date'].astype(str)  # Convert to String for X-Axis
fig = px.line(
    monthly_profit,
    x='Date',
    y='Profit',
    title='Monthly Profit Trend',
    labels={'Profit': 'Monthly Profit (£)', 'Date': 'Month'}
)
fig.show()
```

Figure 16- Python Codes for Monthly Profit

At first, invalid values are removed from the Date column. Then it is grouped according to the profit, and the numerical values convert to string.

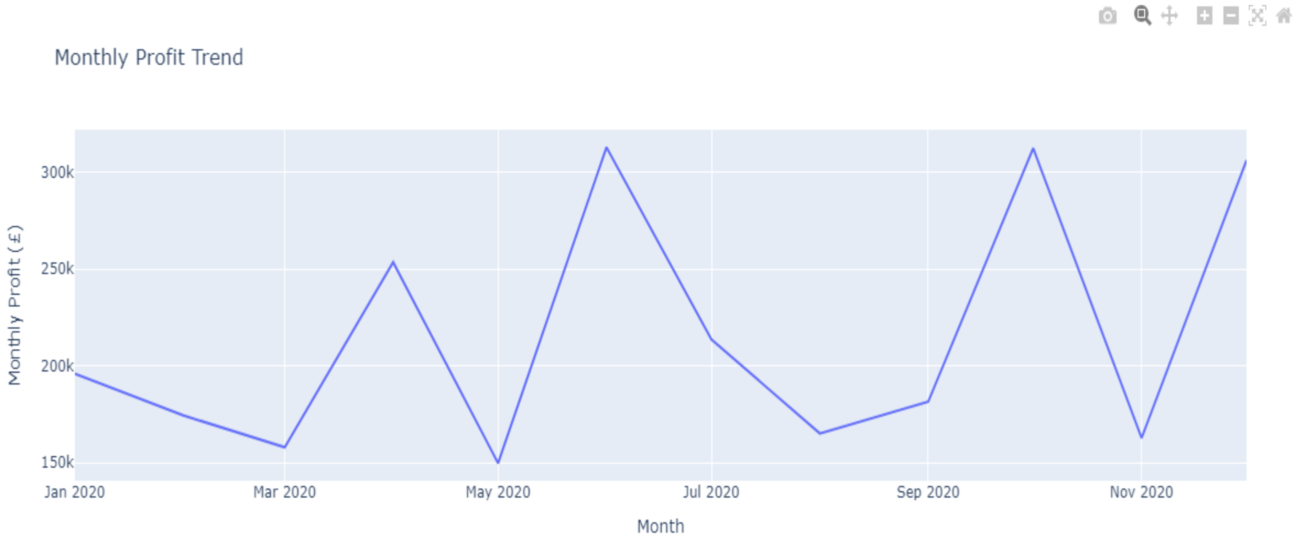
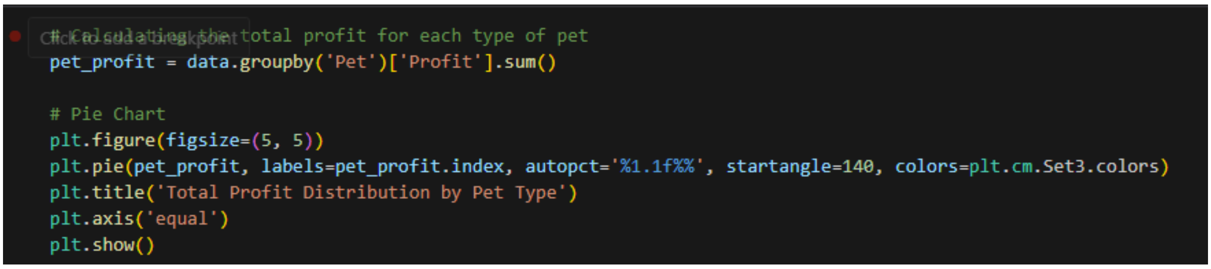


Figure 17- Preview of Lin chart of Monthly Profit

They have reached the maximum profit every month and then dropped the next month, which indicates a lack of stability in the sales strategy. Profits reached the head in **June**, **October**, and **December**, at over **300,000**£, and May had the lowest amount of profitability at around **150,000**£.

Investigating the Effect of pet on Profit:



```
# Calculating the total profit for each type of pet
pet_profit = data.groupby('Pet')['Profit'].sum()

# Pie Chart
plt.figure(figsize=(5, 5))
plt.pie(pet_profit, labels=pet_profit.index, autopct='%1.1f%%', startangle=140, colors=plt.cm.Set3.colors)
plt.title('Total Profit Distribution by Pet Type')
plt.axis('equal')
plt.show()
```

Figure 18- Python Codes for effect of pet on profit

In this code, pets are categorized on profit

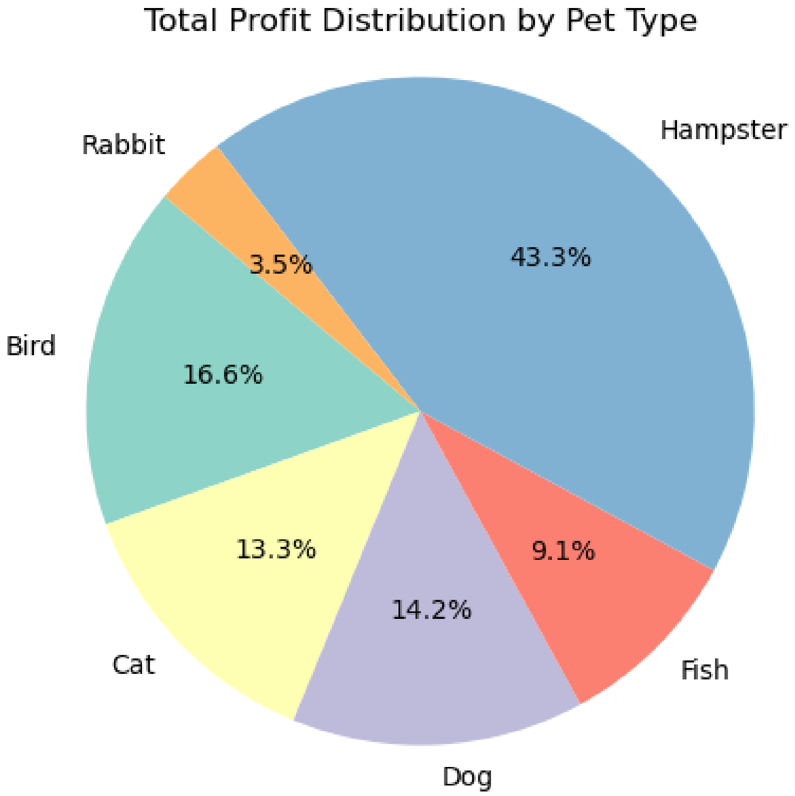
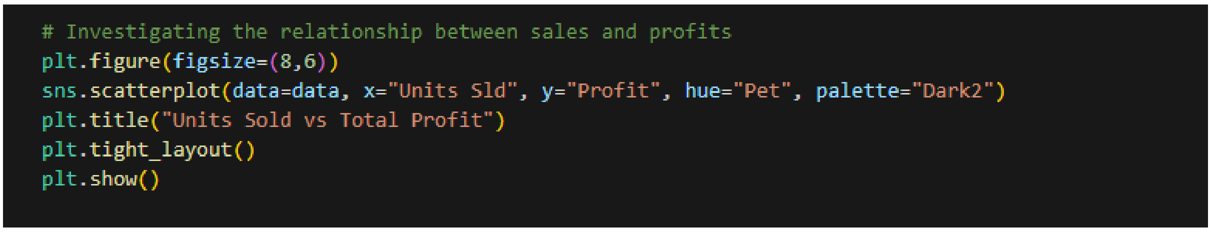


Figure 19- Preview of Pie chart

Hamsters account for the highest profit, at 43.3%, and it appear to be the most in-demand pet during the observed period. On the other hand**, rabbits** are the least demanded, at 3.5%, and consequently the least profitable pet type. The profit percentages for **dogs**, **cats**, and **birds** indicate a relatively stable demand for these three categories at **14.2%**, **13.3%**, and **16.6%**, respectively.

Survey the relationship sale & profits:



```
# Investigating the relationship between sales and profits
plt.figure(figsize=(8,6))
sns.scatterplot(data=data, x="Units Sld", y="Profit", hue="Pet", palette="Dark2")
plt.title("Units Sold vs Total Profit")
plt.tight_layout()
plt.show()
```

Figure 20- Python Codes for analyzing sale unit and profit

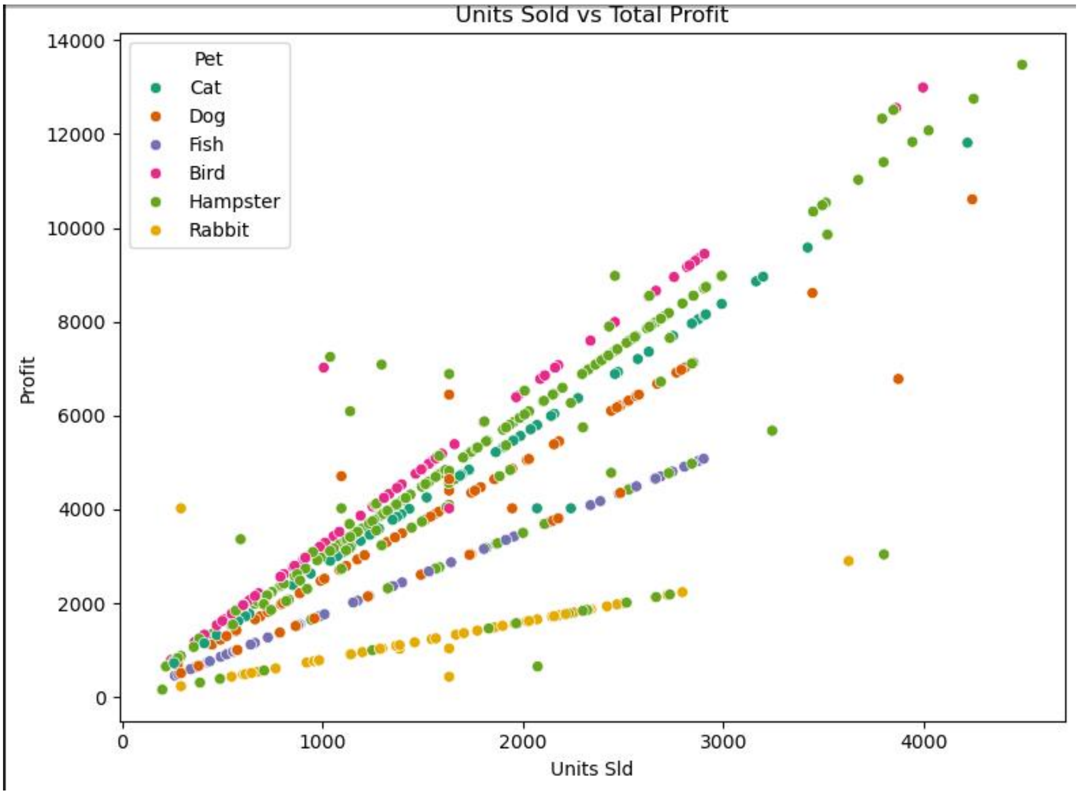
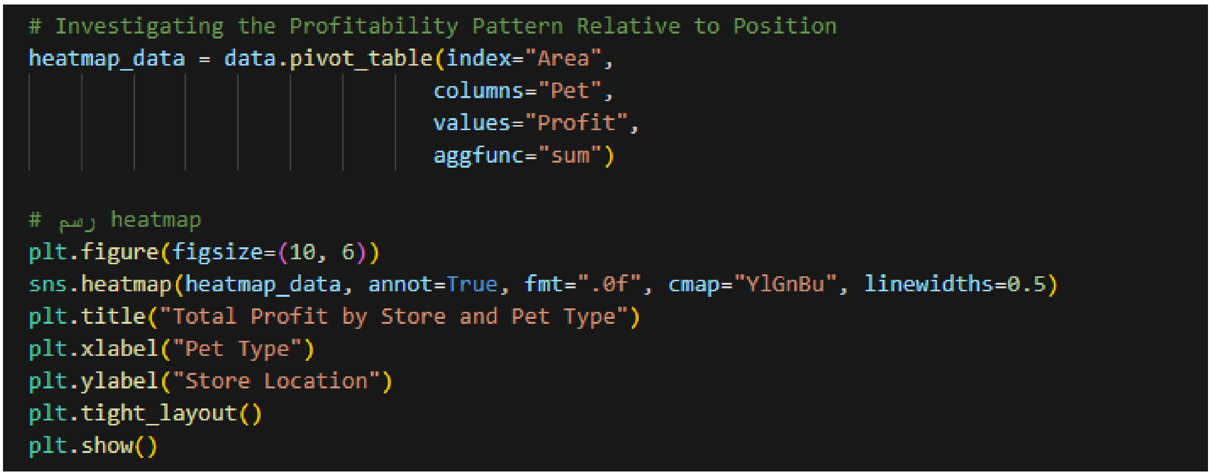


Figure 21- Preview of Scatter Plot

Hamsters and **birds** had the most upward trends, respectively. **Rabbits** had the slowest trend. Overall, all pets had an upward trend in unit sales and profits over time.

Area & Pet



```
# Investigating the Profitability Pattern Relative to Position
heatmap_data = data.pivot_table(index="Area",
                                columns="Pet",
                                values="Profit",
                                aggfunc="sum")

# رسم heatmap
plt.figure(figsize=(10, 6))
sns.heatmap(heatmap_data, annot=True, fmt=".0f", cmap="YlGnBu", linewidths=0.5)
plt.title("Total Profit by Store and Pet Type")
plt.xlabel("Pet Type")
plt.ylabel("Store Location")
plt.tight_layout()
plt.show()
```

Figure 22- Python Codes for analyzing Area on pet

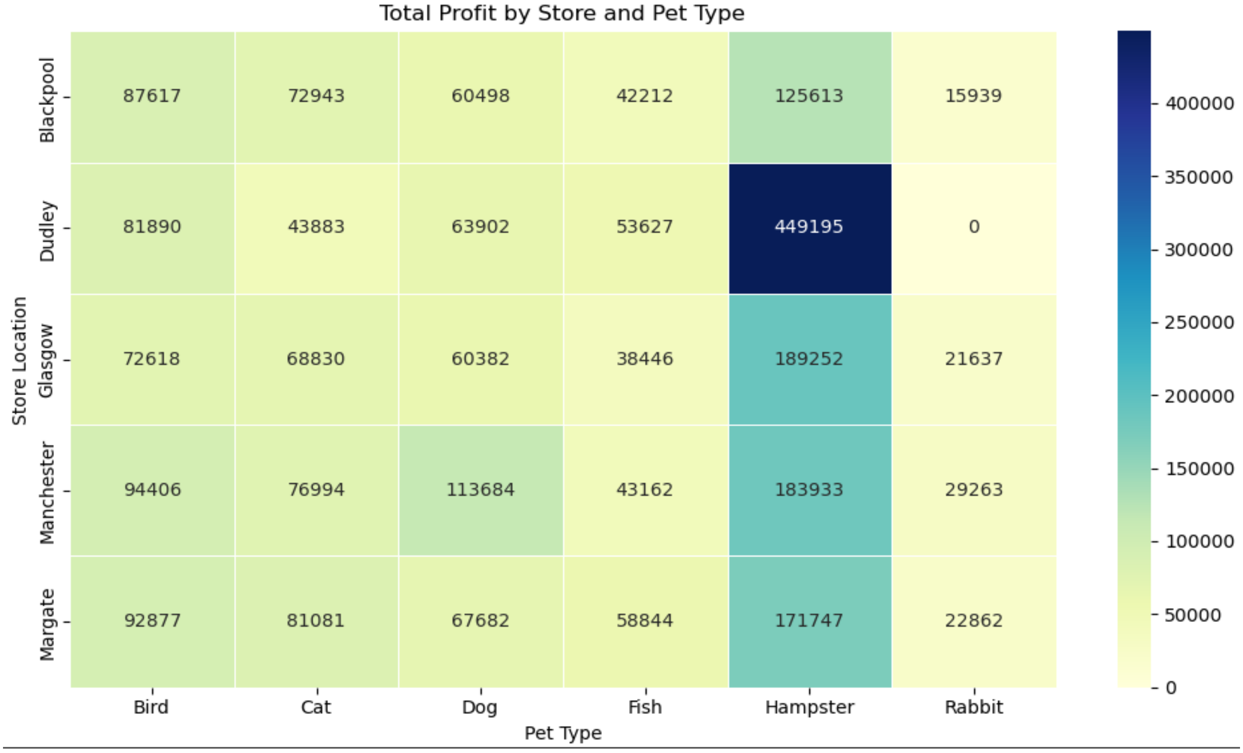


Figure 23- Preview of Heatmap

The focus of all branches is on **Hamster**. Unlike Dudley, which has not made a profit from the sale of rabbits, **Manchester** has managed to strike a profitable balance across all of its products, yet it is still the second most profitable store after Dudley. **Dog** is the second most profitable animal for Manchester.

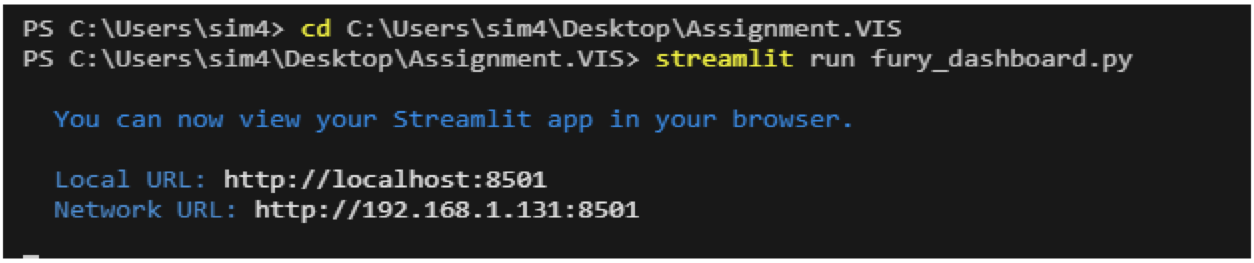
An Overview of Streamlit's Interactive Dashboard

Streamlit Dashboard is a high-level user interface built on Python that allows users to visually explore data through dynamic and interactive controls (Cody, 2020).

Dashboard goals:

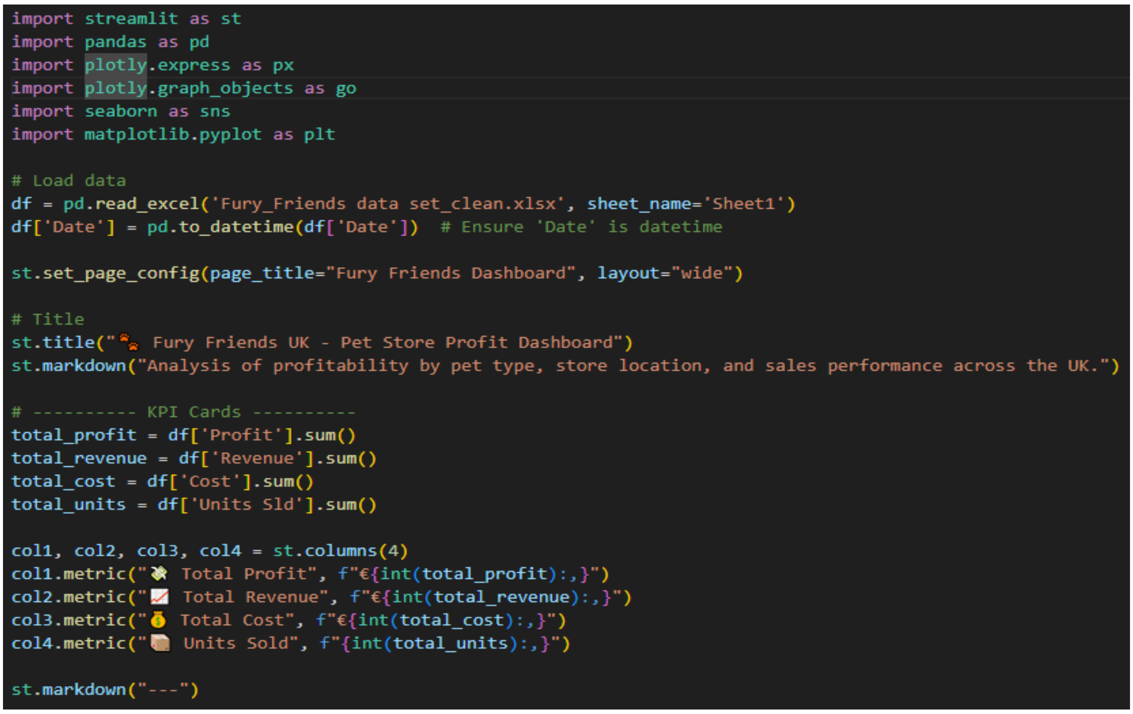
- A simple visual representation of the operation of pet stores across the UK.
- Helping administrators to quickly access important information using filters, interactive charts, and summary tables.
- Supporting decisions about reducing costs, increasing revenue, and identifying profitable or loss-making stores

After creating a new file in the Python notebook and adding the Python Visual Builder codes, we save it with **.py** extension and run Terminal, go to the root of the project file and run it. The result will be displayed in a new window in the browser.

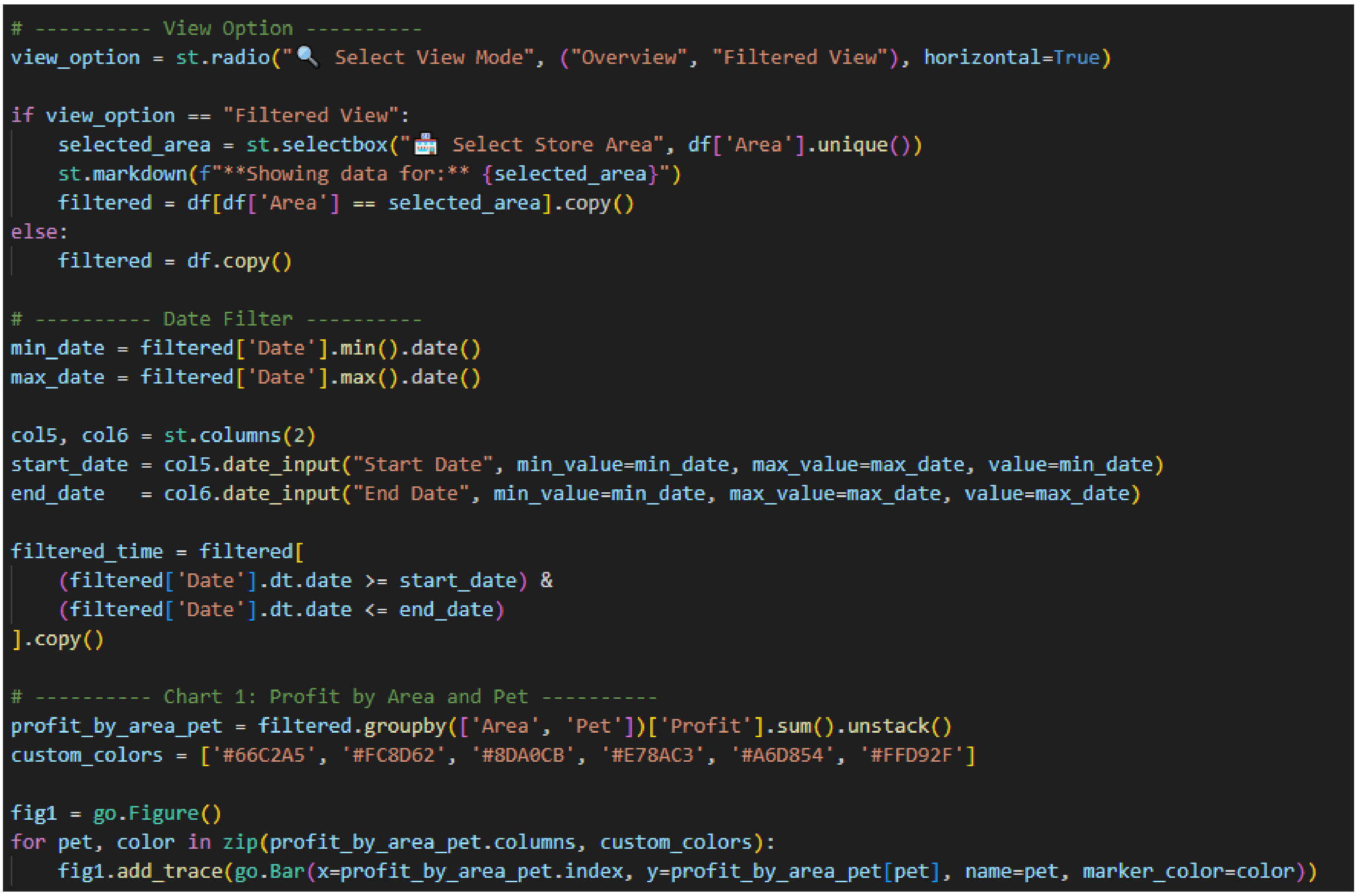


```
PS C:\Users\sim4> cd C:\Users\sim4\Desktop\Assignment.VIS
PS C:\Users\sim4\Desktop\Assignment.VIS> streamlit run fury_dashboard.py

  You can now view your Streamlit app in your browser.

  Local URL: http://localhost:8501
  Network URL: http://192.168.1.131:8501
```

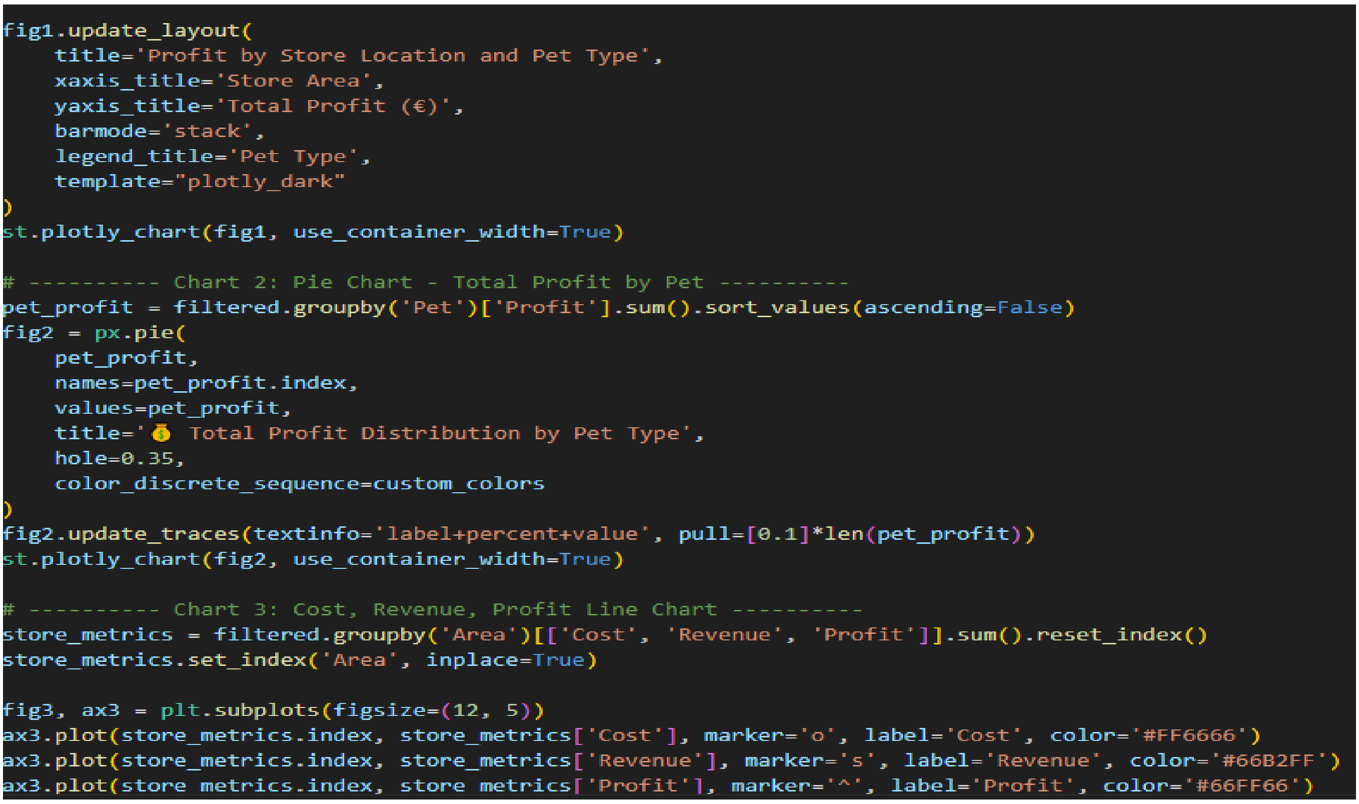
Figure 25- Python Codes for analyzing Area on pet



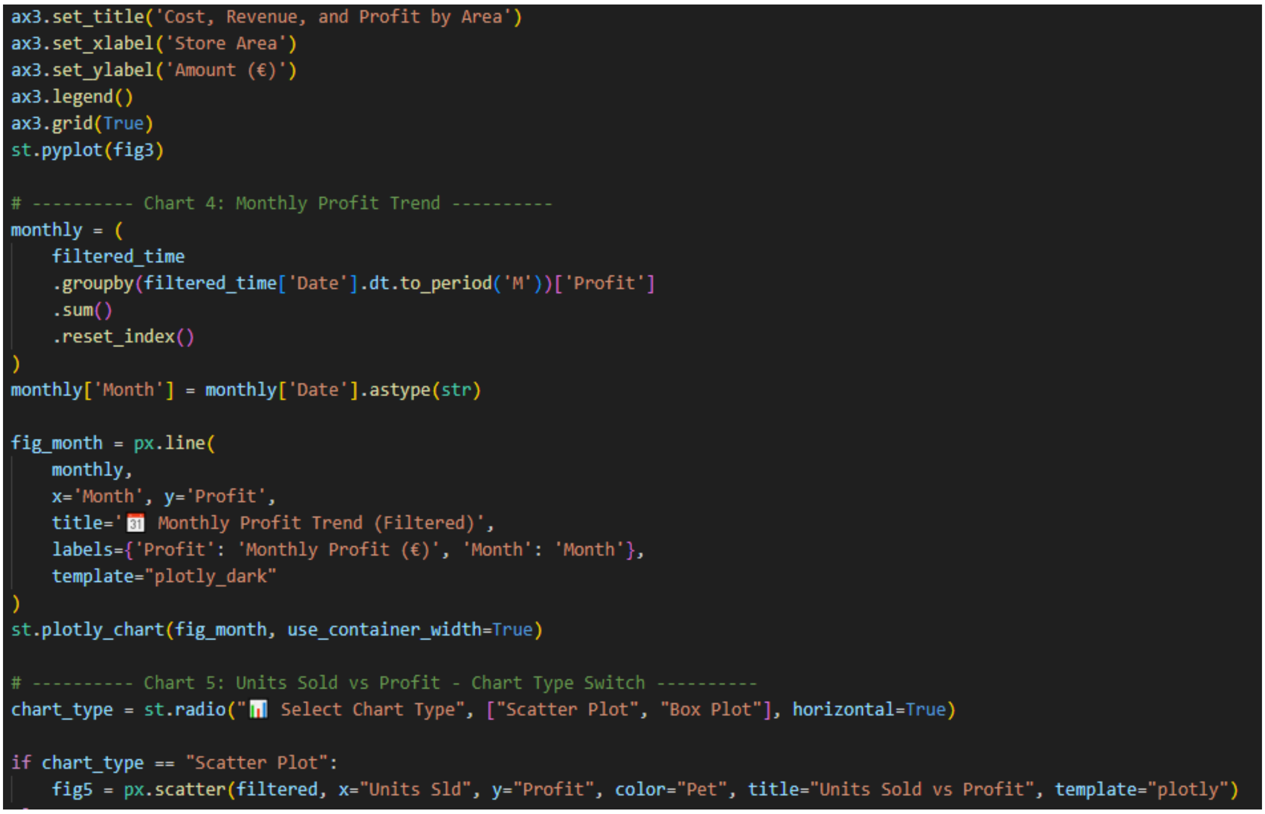
```python
import streamlit as st
import pandas as pd
import plotly.express as px
import plotly.graph_objects as go
import seaborn as sns
import matplotlib.pyplot as plt

# Load data
df = pd.read_excel('Fury_Friends data set_clean.xlsx', sheet_name='Sheet1')
df['Date'] = pd.to_datetime(df['Date'])  # Ensure 'Date' is datetime

st.set_page_config(page_title="Fury Friends Dashboard", layout="wide")

# Title
st.title("🐾 Fury Friends UK - Pet Store Profit Dashboard")
st.markdown("Analysis of profitability by pet type, store location, and sales performance across the UK.")

# ---------- KPI Cards ----------
total_profit = df['Profit'].sum()
total_revenue = df['Revenue'].sum()
total_cost = df['Cost'].sum()
total_units = df['Units Sld'].sum()

col1, col2, col3, col4 = st.columns(4)
col1.metric("💸 Total Profit", f"€{int(total_profit):,}")
col2.metric("📈 Total Revenue", f"€{int(total_revenue):,}")
col3.metric("💰 Total Cost", f"€{int(total_cost):,}")
col4.metric("📦 Units Sold", f"{int(total_units):,}")

st.markdown("---")
```



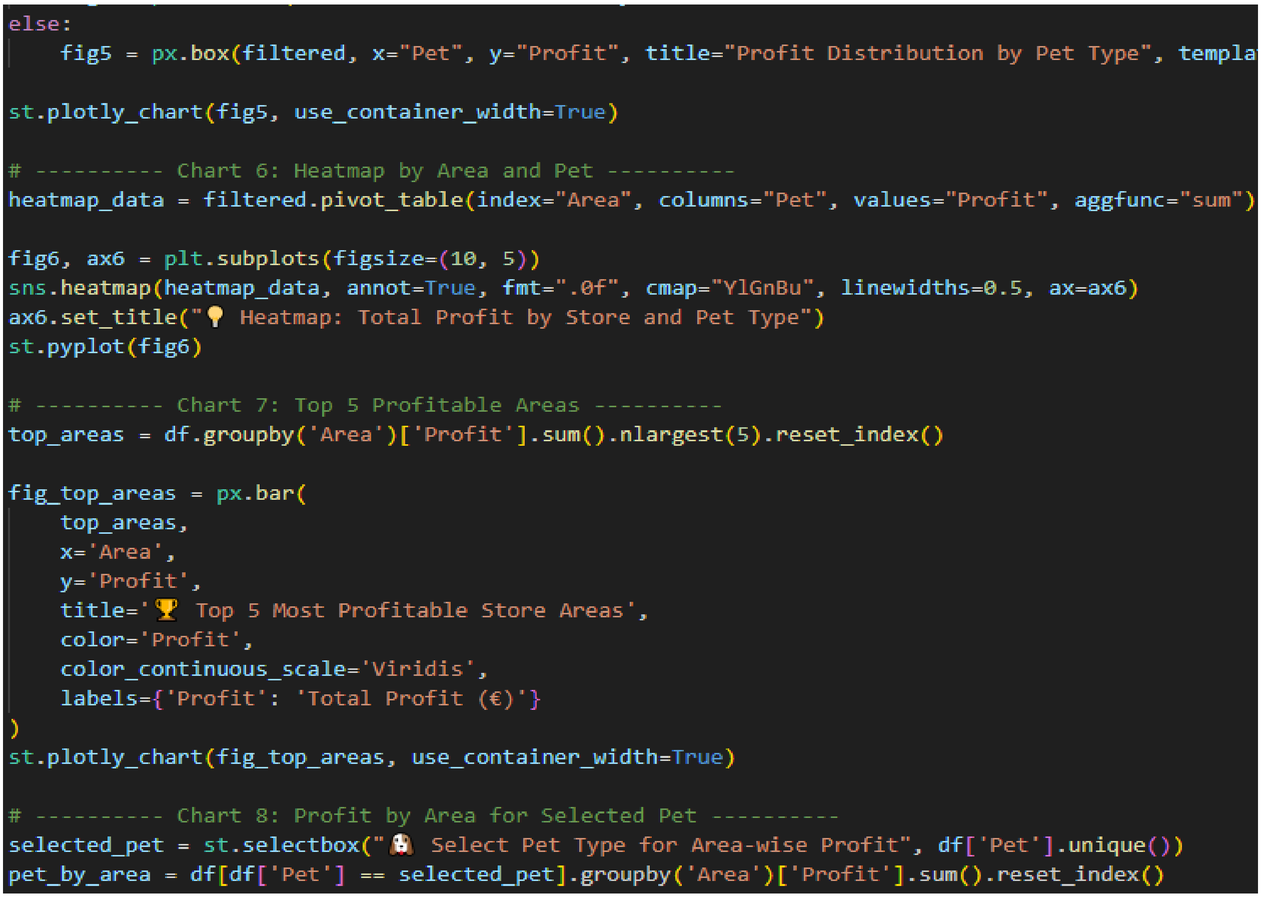
```python
# ---------- View Option ----------
view_option = st.radio("🔍 Select View Mode", ("Overview", "Filtered View"), horizontal=True)

if view_option == "Filtered View":
    selected_area = st.selectbox("🏬 Select Store Area", df['Area'].unique())
    st.markdown(f"**Showing data for:** {selected_area}")
    filtered = df[df['Area'] == selected_area].copy()
else:
    filtered = df.copy()

# ---------- Date Filter ----------
min_date = filtered['Date'].min().date()
max_date = filtered['Date'].max().date()

col5, col6 = st.columns(2)
start_date = col5.date_input("Start Date", min_value=min_date, max_value=max_date, value=min_date)
end_date   = col6.date_input("End Date", min_value=min_date, max_value=max_date, value=max_date)

filtered_time = filtered[
    (filtered['Date'].dt.date >= start_date) &
    (filtered['Date'].dt.date <= end_date)
].copy()

# ---------- Chart 1: Profit by Area and Pet ----------
profit_by_area_pet = filtered.groupby(['Area', 'Pet'])['Profit'].sum().unstack()
custom_colors = ['#66C2A5', '#FC8D62', '#8DA0CB', '#E78AC3', '#A6D854', '#FFD92F']

fig1 = go.Figure()
for pet, color in zip(profit_by_area_pet.columns, custom_colors):
    fig1.add_trace(go.Bar(x=profit_by_area_pet.index, y=profit_by_area_pet[pet], name=pet, marker_color=color))
```



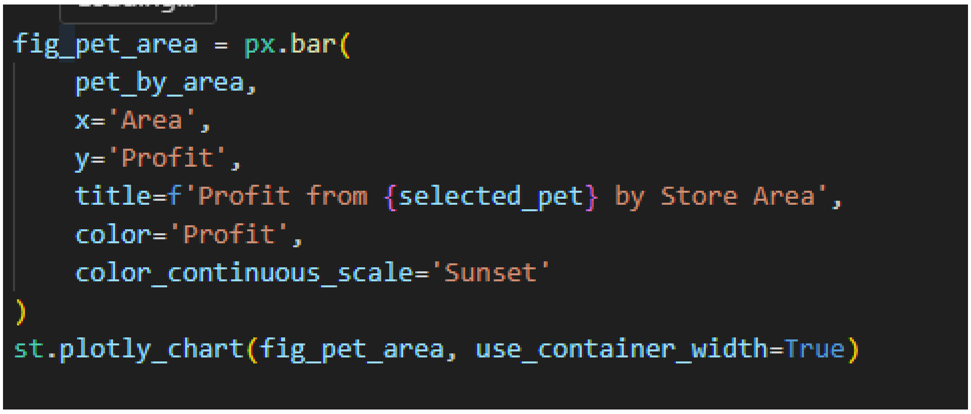
```python
fig1.update_layout(
    title='Profit by Store Location and Pet Type',
    xaxis_title='Store Area',
    yaxis_title='Total Profit (€)',
    barmode='stack',
    legend_title='Pet Type',
    template="plotly_dark"
)
st.plotly_chart(fig1, use_container_width=True)

# ---------- Chart 2: Pie Chart - Total Profit by Pet ----------
pet_profit = filtered.groupby('Pet')['Profit'].sum().sort_values(ascending=False)
fig2 = px.pie(
    pet_profit,
    names=pet_profit.index,
    values=pet_profit,
    title='💰 Total Profit Distribution by Pet Type',
    hole=0.35,
    color_discrete_sequence=custom_colors
)
fig2.update_traces(textinfo='label+percent+value', pull=[0.1]*len(pet_profit))
st.plotly_chart(fig2, use_container_width=True)

# ---------- Chart 3: Cost, Revenue, Profit Line Chart ----------
store_metrics = filtered.groupby('Area')[['Cost', 'Revenue', 'Profit']].sum().reset_index()
store_metrics.set_index('Area', inplace=True)

fig3, ax3 = plt.subplots(figsize=(12, 5))
ax3.plot(store_metrics.index, store_metrics['Cost'], marker='o', label='Cost', color='#FF6666')
ax3.plot(store_metrics.index, store_metrics['Revenue'], marker='s', label='Revenue', color='#66B2FF')
ax3.plot(store_metrics.index, store_metrics['Profit'], marker='^', label='Profit', color='#66FF66')
```



```
ax3.set_title('Cost, Revenue, and Profit by Area')
ax3.set_xlabel('Store Area')
ax3.set_ylabel('Amount (€)')
ax3.legend()
ax3.grid(True)
st.pyplot(fig3)

# ---------- Chart 4: Monthly Profit Trend ----------
monthly = (
    filtered_time
    .groupby(filtered_time['Date'].dt.to_period('M'))['Profit']
    .sum()
    .reset_index()
)
monthly['Month'] = monthly['Date'].astype(str)

fig_month = px.line(
    monthly,
    x='Month', y='Profit',
    title='📅 Monthly Profit Trend (Filtered)',
    labels={'Profit': 'Monthly Profit (€)', 'Month': 'Month'},
    template="plotly_dark"
)
st.plotly_chart(fig_month, use_container_width=True)

# ---------- Chart 5: Units Sold vs Profit - Chart Type Switch ----------
chart_type = st.radio("📊 Select Chart Type", ["Scatter Plot", "Box Plot"], horizontal=True)

if chart_type == "Scatter Plot":
    fig5 = px.scatter(filtered, x="Units Sld", y="Profit", color="Pet", title="Units Sold vs Profit", template="plotly")
```



```
else:
    fig5 = px.box(filtered, x="Pet", y="Profit", title="Profit Distribution by Pet Type", templa

st.plotly_chart(fig5, use_container_width=True)

# ---------- Chart 6: Heatmap by Area and Pet ----------
heatmap_data = filtered.pivot_table(index="Area", columns="Pet", values="Profit", aggfunc="sum")

fig6, ax6 = plt.subplots(figsize=(10, 5))
sns.heatmap(heatmap_data, annot=True, fmt=".0f", cmap="YlGnBu", linewidths=0.5, ax=ax6)
ax6.set_title("💡 Heatmap: Total Profit by Store and Pet Type")
st.pyplot(fig6)

# ---------- Chart 7: Top 5 Profitable Areas ----------
top_areas = df.groupby('Area')['Profit'].sum().nlargest(5).reset_index()

fig_top_areas = px.bar(
    top_areas,
    x='Area',
    y='Profit',
    title='🏆 Top 5 Most Profitable Store Areas',
    color='Profit',
    color_continuous_scale='Viridis',
    labels={'Profit': 'Total Profit (€)'}
)
st.plotly_chart(fig_top_areas, use_container_width=True)

# ---------- Chart 8: Profit by Area for Selected Pet ----------
selected_pet = st.selectbox("🐶 Select Pet Type for Area-wise Profit", df['Pet'].unique())
pet_by_area = df[df['Pet'] == selected_pet].groupby('Area')['Profit'].sum().reset_index()
```

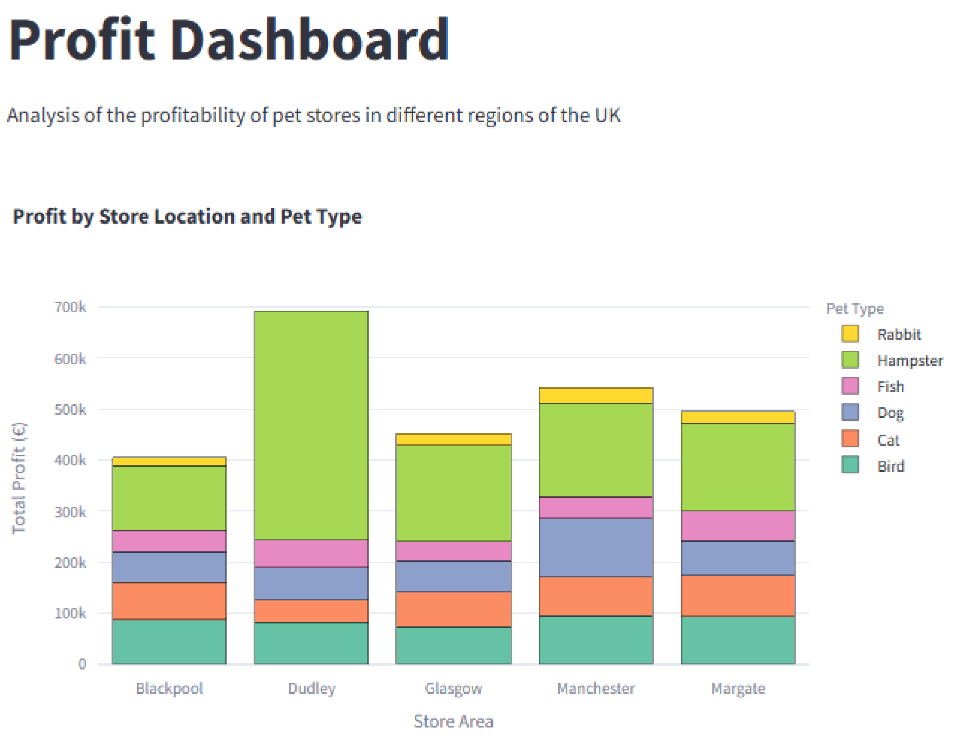


```python
fig_pet_area = px.bar(
    pet_by_area,
    x='Area',
    y='Profit',
    title=f'Profit from {selected_pet} by Store Area',
    color='Profit',
    color_continuous_scale='Sunset'
)
st.plotly_chart(fig_pet_area, use_container_width=True)
```

Figure 26- Python Codes for Implementing Dashboard

Reasons for choosing Stream Light charts according to classic charts:

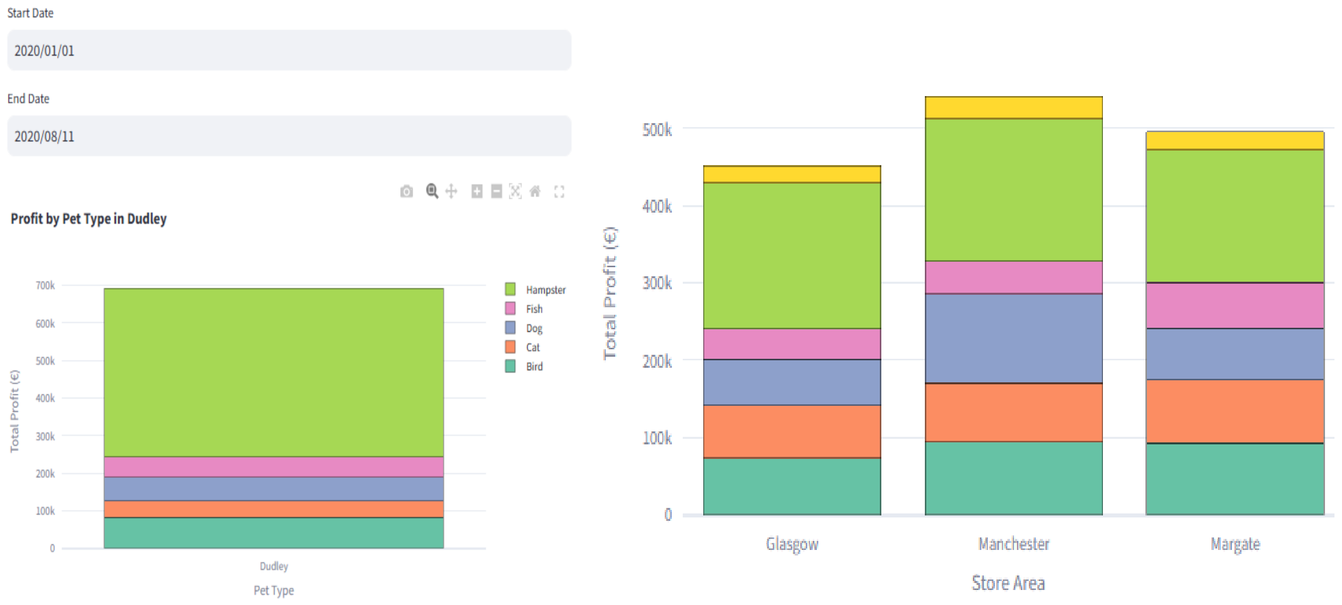
- Control over the chart
- High compatibility with the main body code
- Greater resolution of output and simplicity of code storage
- Simplicity of use



Profit Dashboard

Analysis of the profitability of pet stores in different regions of the UK

Profit by Store Location and Pet Type



Start Date

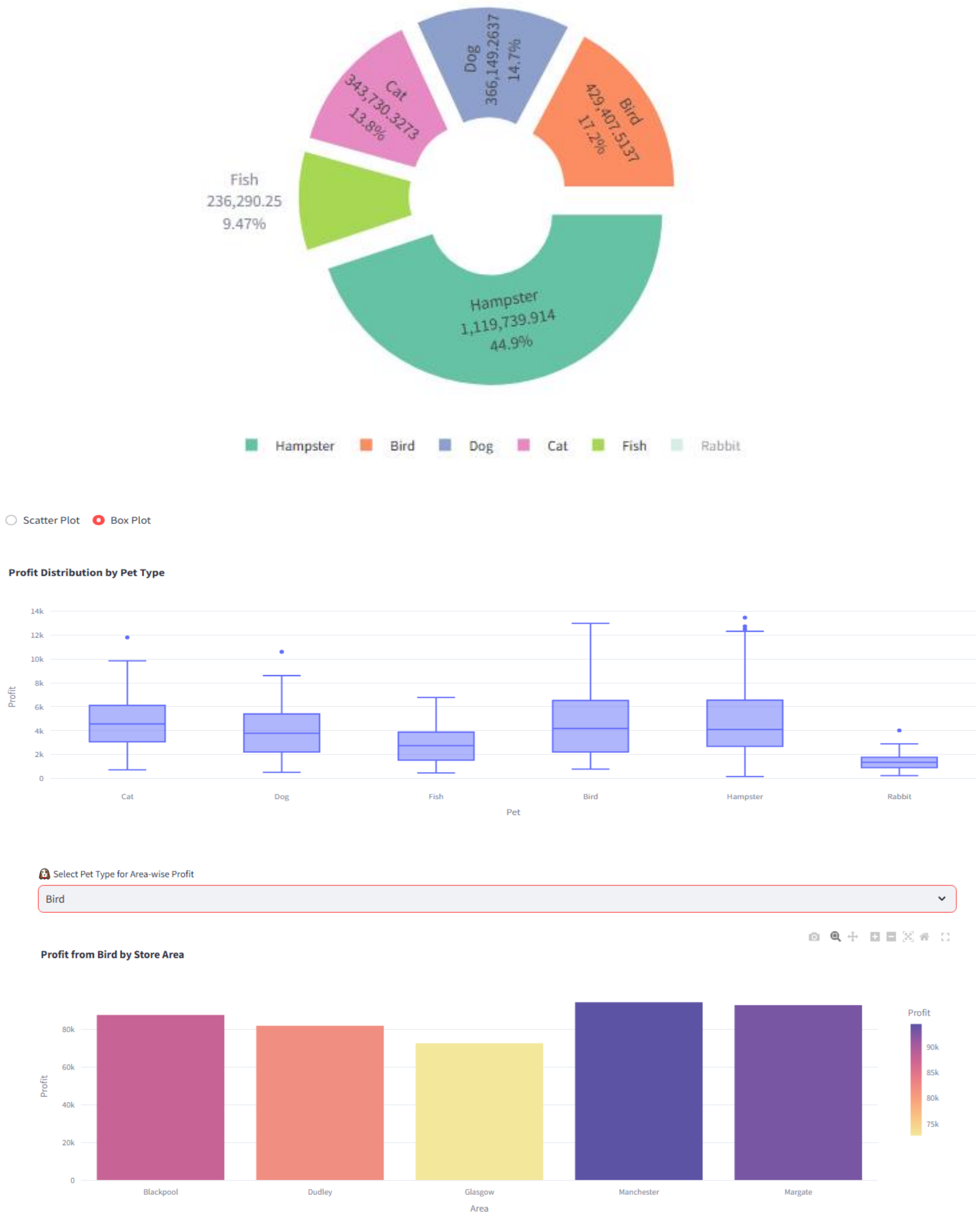
2020/01/01

End Date

2020/08/11

Profit by Pet Type in Dudley

A view of bar chart with time and region filtering

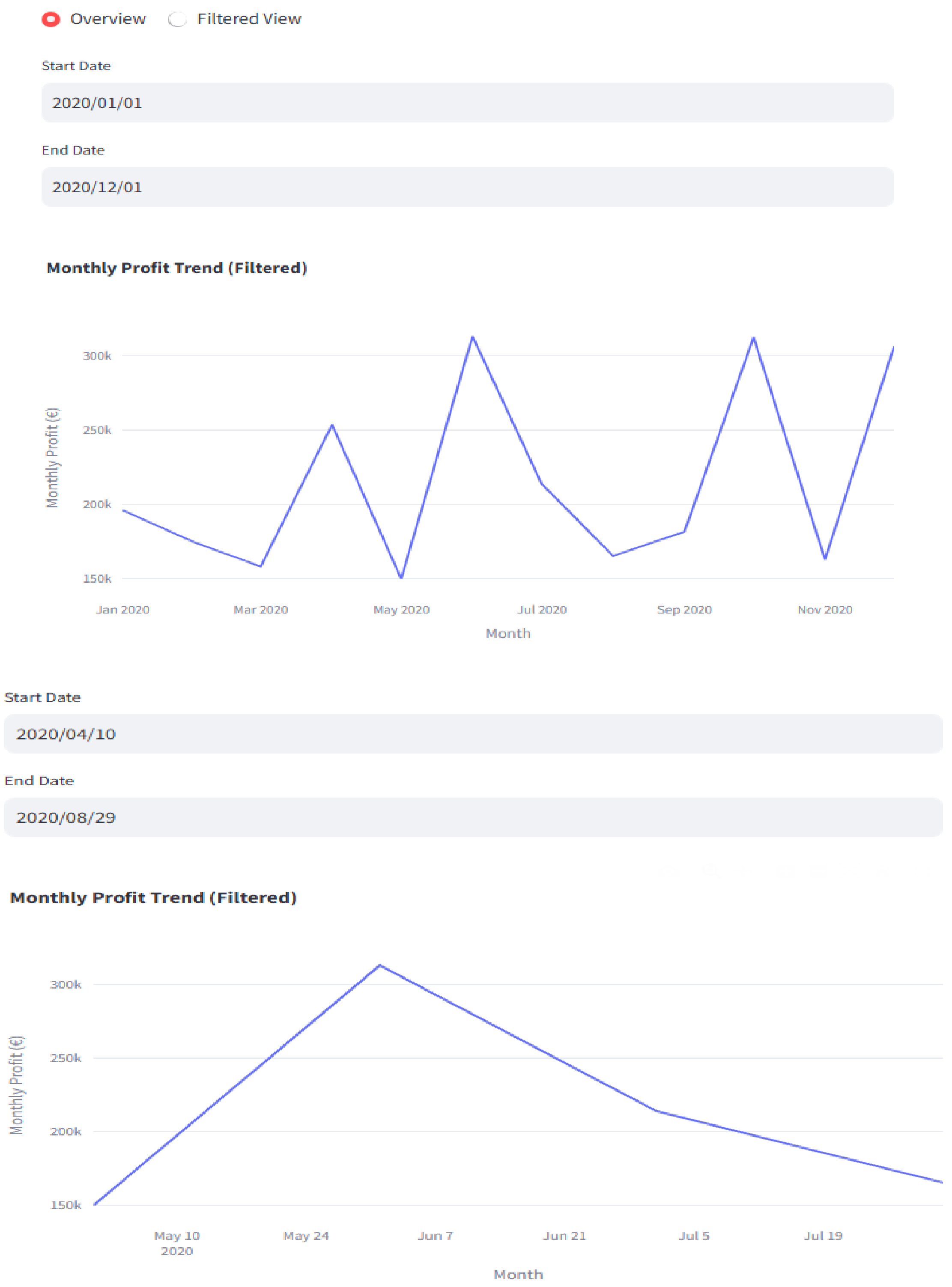


○ Scatter Plot ● Box Plot

Select Pet Type for Area-wise Profit

Bird

Filtering on pet types



● Overview ○ Filtered View

Start Date

2020/01/01

End Date

2020/12/01

Monthly Profit Trend (Filtered)

Start Date

2020/04/10

End Date

2020/08/29

Monthly Profit Trend (Filtered)

Figure 27- Preview of Streamlit Dashboard

Conclusion of Task 1:

Based on visual analysis, urban stores typically have a higher net profit than rural stores. This shows that the location of the stores has a significant impact on profits. The type of animals also has an impact on net profits. For example, stores with a high demand for cats and dogs have higher average profits than stores with special products such as exotic birds and reptiles, and profitability is also much higher in the last months of the year. In general, it can be assumed that the effects of the type of animals are greater than the location of the store.

TASK 2: Analysing the Performance of implementing and Visualization – Fury Friends

I recently worked as a data analyst intern at a pet food and care company called Lovely Pets. The company is one of the most well-known companies in the UK and has 20 years of experience and 5 branches across the UK, their products range from animal feeds, seeds for birds, and even their care equipment, as well as a veterinarian stationed in the branches to prescribe the right medicines. During these 20 years, the company has always had an acceptable level of profitability and close to each other in all branches, but the sales and the financial department have recently noticed some stark differences in the profitability of stores. For example, some stores in certain areas have higher profits than other stores selling products for a particular pet. After the initial investigations, I realized that factors such as the geographical location of the store, the type of products, and even the type of animals have a significant impact on profitability. Stores located in urban areas make more profit than stores in sparsely populated areas. For example, stores that sell dog and cat products are more profitable than stores that sell certain animals. During the study of store data, I discovered the linear and reciprocal relationships of data to each other using the Python programming language, and then based on data visualization techniques, I conducted an exploratory and critical evaluation of the dataset. Finally, by using the interactive dashboard of Streamlit, i tried to interact as much as possible with user so that they can access accurate information about a specific date or store by applying filters. Our goal is to try to find the factors that affect profitability and/or losses, as well as try to convey visual insights to the board.

The reasons for choosing charts and the structure of the dashboard are explained below, and evidence-based recommendations are provided to support strategic business decisions.

Step 1: Data Preparation and Cleansing

These steps made the data more accurately represent the realities in stores and helped to analyse more accurately and credibly. Data Cleansing operations such as **eliminating duplicate** and **missing values**, **replacement of incorrect data**, and **completion of incomplete values**, as well as investigation and **classification** of variables to improve the quality of the data, were performed.

Step2: Discovery and Analysis of Relationships between Factors (EDA)

In this stage, the factors affecting profit, such as cost, income, store location, and the type of animals are examined and visualize. The following is an analytical report:

- **Linear relationship between sales, profits, costs, and stores**

  There is a linear and positive relationship between profit and income. The highest **Revenue, cost,** and profit (692,497) among all stores belongs to the **Dudley** branch. The store is the main hub of profitability. **Manchester** and **Margate** are in the second and Third ranks. Aalthough **Blackpool** has a low income and cost rather than **Glasgow**, it is more profitable because of its costs. With this analysis, **Glasgow** needs to rethink its cost reduction or sales strategy.

- **Total profit by branch and type of animal**

  According to the bar chart, heat map, and pie chart, hamsters were in high demand at 43.3% (£1.5 million), particularly in **Dudley**, a profit greater than the cat and dog profit collection. In terms of profitability, the **Glasgow**, **Manchester**, and **Margate** branches have made almost equal profits from Hamster-**related** sales. Other types of pets show significant variation in sales rankings across branches. The **rabbits** have the lowest market shares at **£140,000**. Given their performance. In general, animals such as dogs, cats, and birds are much more popular than other specific animals. The purpose of visualizing this analysis with 3 types of graphs is to **emphasize** the concentration of the importance of these factors. In order to give this insight to the board of directors to become more familiar with the tastes and interests of the buyers of each city, which will undoubtedly be effective in increasing profitability.

- **Relationship between profit, unit sales, and pet:**

  There is a positive linear relationship between **profits** and **sales**. **Birds**, **cats,** and **hamsters** are the **top-performing** pet categories in terms of profitability, respectively. On the other hand, **rabbits** generate **low** profit despite relatively high sales, indicating a possible imbalance between cost and pricing. **Fish** have the **lowest** and display the frequency, upward trend, and order of type of animals in terms of profitability. In general, all animals are profitable, but the policy of choosing the store that provides them needs to be reviewed.

- **Survey the Monthly Profits:**

  Peak profits usually occur in the summer (**June to August**) at over **300,000£**—mainly due to increased demand during the holiday season. After August, there is a slight decline, but again there is a secondary peak in **September** and **October**. These fluctuations after each peak indicate the lack of a profitable and flexible strategy suitable for each season. The line chart was able to depict this fluctuation clearly.

Step 3: Streamlit Interactive Dashboard

An interactive dashboard was designed using Streamlit. This dashboard allows users to filter data based on location and animal type and view dynamic visualizations of revenue and profits.
Features:
Drop-down menus to select the location and type of animal, time frame. This dashboard provides a user-friendly tool for data discovery. Store managers and board members can easily inspect specific areas or types of animals and identify opportunities for improvement.

Step 4: Results and Recommendations

Focus on high-demand products such as hamsters, birds, cats, and dogs. For example, increasing inventory or replacing them with low-demand products. It also provides special policies for advertising low-demand products.

- Focus on sales strategy in profitable stores to repeat and implement in low-profit stores.
- Strengthen marketing strategies in the summer and increase ad campaigns in the months when profitability is low.
- A weak correlation between income and profit suggests that costs are significantly variable. Optimize costs in stores with high sales and low profits, and Detailed cost analysis to identify areas for cost reduction, such as: negotiating better contracts with suppliers, optimizing the workforce, or Streamlining operations can be effective.
- No store deserves to be closed because they are all profitable with different percentages. It is only by applying a series of reforms that this percentage can be increased. Finally, it is recommended to stock products such as dogs and cats, which are popular in **Blackpool** or merge the **Blackpool** and **Glasgow** branches.
- Having more detailed information about the stores, such as the size of the store, the number of staff, helps in a more accurate analysis.

Step 5: Conclusion

Based on the analysis conducted, significant differences in the financial performance and profitability of various branches were identified. For example, Dudley and Manchester emerged as the most profitable stores, while branches such as Glasgow and Blackpool showed relatively lower profitability and were recommended for either consolidation or strategic review. It was also observed that while store location plays a role, the type of animals sold has an even greater impact on profitability. Furthermore, it was suggested that the company adopt best practices from high-performing stores as a benchmark. Therefore, it is recommended that the company strategically reassess its sales policies, product distribution, and the management of underperforming branches in order to optimize overall profitability across the retail network.

References:

- Cody, P. (2020) *Streamlit for Data Science*. Birmingham. Packt Publishing, UK.

- Müller, A. and Guido. (2016) Introduction to machine learning with Python: A guide for data scientists. Firth Edition. O'Reilly Media, Inc.

- Tufte, E.R.(2001). *The visual display of quantitative information*. 2nd ed. Cheshire, CT: Graphics Press, USA.

#Appendix: Python code

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
data = pd.read_excel('Fury_Friends data set_4376.xlsx')
data
print(data.shape)
print(data.info())
print(data.describe())
print("Location:", data['Area'].unique())
print("Type of Pet:", data['Pet'].unique())
print(data.dtypes)
print("Number of Null Values:",data.isnull().sum())
data["Units Sld"].fillna(data["Units Sld"].mean(), inplace=True)
data["Revenue"].fillna(data["Revenue"].mean(), inplace=True)
data["Cost"].fillna(data["Cost"].mean(), inplace=True)
data["Profit"].fillna(data["Profit"].mean(), inplace=True)
print("Number of Duplicated Values:",data.duplicated().sum())
data = data.drop_duplicates()

data.to_excel("Fury_Friends data set_clean.xlsx", index=False)
data['Pet'] = data['Pet'].astype('category')
data['Area'] = data['Area'].astype('category')
data.to_excel("Fury_Friends data set_clean.xlsx", index=False)
```

```
profit_by_area_pet = data.groupby(['Area', 'Pet'])['Profit'].sum().unstack()
custom_colors = ['#66C2A5',
          '#FC8D62',
          '#8DA0CB',
          '#E78AC3',
          '#A6D854',
          '#FFD92F']

profit_by_area_pet.plot(kind='bar', figsize=(12, 6),
              color=custom_colors[:len(profit_by_area_pet.columns)])

plt.title('Profit by Store Location and Pet Type')
plt.xlabel('Store Area')
plt.ylabel('Total Profit (€)')
plt.legend(title='Pet Type')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
best = (
  data
  .groupby('Area')['Profit']
  .sum()
  .sort_values(ascending=False)
)

# the most Profitable Stores
top_store = best.head(1)
print("Most profitable store:\n", top_store)
```

```
plt.figure(figsize=(10, 6))
sns.barplot(x=best.index, y=best.values, palette='viridis')
plt.title('Total Profit by Store Area', fontsize=16)
plt.xlabel('Store Area', fontsize=12)
plt.ylabel('Total Profit ', fontsize=12)
plt.xticks(rotation=45)
plt.show()
store_metrics = data.groupby('Area')[['Cost', 'Revenue', 'Profit']].sum().reset_index()
store_metrics.set_index('Area', inplace=True)

plt.figure(figsize=(12, 6))
for column, color, marker in zip(['Cost', 'Revenue', 'Profit'],
                                 ['#FF6666', '#66B2FF', '#66FF66'],
                                 ['o', 's', '^']):
    plt.plot(store_metrics.index, store_metrics[column], marker=marker, label=column, color=color)

    for i, value in enumerate(store_metrics[column]):
        plt.text(x=i, y=value + max(store_metrics[column]) * 0.01,
                                 s=f'{int(value):,}', ha='center', fontsize=9)
plt.title('Cost, Revenue, and Profit by Area')
plt.xlabel('Store Area')
plt.ylabel('Amount (€)')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
df_time = data.dropna(subset=['Date'])
```

```
monthly_profit = df_time.groupby(df_time['Date'].dt.to_period('M'))['Profit'].sum().reset_index()

monthly_profit['Date'] = monthly_profit['Date'].astype(str)  # Convert to String for X-Axis

fig = px.line(

    monthly_profit,

    x='Date',

    y='Profit',

    title='Monthly Profit Trend',

    labels={'Profit': 'Monthly Profit (£)', 'Date': 'Month'}

)

fig.show()

pet_profit = data.groupby('Pet')['Profit'].sum()

plt.figure(figsize=(5, 5))

plt.pie(pet_profit, labels=pet_profit.index, autopct='%1.1f%%', startangle=140, colors=plt.cm.Set3.colors)

plt.title('Total Profit Distribution by Pet Type')

plt.axis('equal')

plt.show()

plt.figure(figsize=(8,6))

sns.scatterplot(data=data, x="Units Sld", y="Profit", hue="Pet", palette="Dark2")

plt.title("Units Sold vs Total Profit")

plt.tight_layout()

plt.show()

heatmap_data = data.pivot_table(index="Area",

                               columns="Pet",

                               values="Profit",

                               aggfunc="sum")


plt.figure(figsize=(10, 6))

sns.heatmap(heatmap_data, annot=True, fmt=".0f", cmap="YlGnBu", linewidths=0.5)
```

```
plt.title("Total Profit by Store and Pet Type")
plt.xlabel("Pet Type")
plt.ylabel("Store Location")
plt.tight_layout()
plt.show()
```

#Appendix: Streamlit Dashboard Code

```
import streamlit as st
import pandas as pd
import plotly.express as px
import plotly.graph_objects as go
import seaborn as sns
import matplotlib.pyplot as plt
df = pd.read_excel('Fury_Friends data set_clean.xlsx', sheet_name='Sheet1')
df['Date'] = pd.to_datetime(df['Date'])  # Ensure 'Date' is datetime

st.set_page_config(page_title="Fury Friends Dashboard", layout="wide")
st.title("🐾 Fury Friends UK - Pet Store Profit Dashboard")
st.markdown("Analysis of profitability by pet type, store location, and sales performance across the UK.")
total_profit = df['Profit'].sum()
total_revenue = df['Revenue'].sum()
total_cost = df['Cost'].sum()
total_units = df['Units Sld'].sum()
col1, col2, col3, col4 = st.columns(4)
col1.metric("💸 Total Profit", f"€{int(total_profit):,}")
col2.metric("📈 Total Revenue", f"€{int(total_revenue):,}")
col3.metric("💰 Total Cost", f"€{int(total_cost):,}")
```

```
col4.metric("🎁 Units Sold", f"{int(total_units):,}")
st.markdown("---")
view_option = st.radio("🔍 Select View Mode", ("Overview", "Filtered View"), horizontal=True)
if view_option == "Filtered View":
    selected_area = st.selectbox("🏪 Select Store Area", df['Area'].unique())
    st.markdown(f"**Showing data for:** {selected_area}")
    filtered = df[df['Area'] == selected_area].copy()
else:
    filtered = df.copy()
min_date = filtered['Date'].min().date()
max_date = filtered['Date'].max().date()
col5, col6 = st.columns(2)
start_date = col5.date_input("Start Date", min_value=min_date, max_value=max_date, value=min_date)
end_date   = col6.date_input("End Date", min_value=min_date, max_value=max_date, value=max_date)
filtered_time = filtered[
    (filtered['Date'].dt.date >= start_date) &
    (filtered['Date'].dt.date <= end_date)
].copy()

profit_by_area_pet = filtered.groupby(['Area', 'Pet'])['Profit'].sum().unstack()
custom_colors = ['#66C2A5', '#FC8D62', '#8DA0CB', '#E78AC3', '#A6D854', '#FFD92F']

fig1 = go.Figure()
for pet, color in zip(profit_by_area_pet.columns, custom_colors):
    fig1.add_trace(go.Bar(x=profit_by_area_pet.index, y=profit_by_area_pet[pet], name=pet, marker_color=color))

fig1.update_layout(
    title='Profit by Store Location and Pet Type',
    xaxis_title='Store Area',
    yaxis_title='Total Profit (€)',
    barmode='stack',
    legend_title='Pet Type',
    template="plotly_dark"
)
st.plotly_chart(fig1, use_container_width=True)

pet_profit = filtered.groupby('Pet')['Profit'].sum().sort_values(ascending=False)
fig2 = px.pie(
    pet_profit,
    names=pet_profit.index,
    values=pet_profit,
    title='💰 Total Profit Distribution by Pet Type',
    hole=0.35,
    color_discrete_sequence=custom_colors
)
fig2.update_traces(textinfo='label+percent+value', pull=[0.1]*len(pet_profit))
st.plotly_chart(fig2, use_container_width=True)

store_metrics = filtered.groupby('Area')[['Cost', 'Revenue', 'Profit']].sum().reset_index()
store_metrics.set_index('Area', inplace=True)
fig3, ax3 = plt.subplots(figsize=(12, 5))
ax3.plot(store_metrics.index, store_metrics['Cost'], marker='o', label='Cost', color='#FF6666')
ax3.plot(store_metrics.index, store_metrics['Revenue'], marker='s', label='Revenue', color='#66B2FF')
ax3.plot(store_metrics.index, store_metrics['Profit'], marker='^', label='Profit', color='#66FF66')
ax3.set_title('Cost, Revenue, and Profit by Area')
ax3.set_xlabel('Store Area')
```

```
ax3.set_ylabel('Amount (€)')
ax3.legend()
ax3.grid(True)
st.pyplot(fig3)
monthly = (
    filtered_time
    .groupby(filtered_time['Date'].dt.to_period('M'))['Profit']
    .sum()
    .reset_index()
)
monthly['Month'] = monthly['Date'].astype(str)

fig_month = px.line(
    monthly,
    x='Month', y='Profit',
    title='📅 Monthly Profit Trend (Filtered)',
    labels={'Profit': 'Monthly Profit (€)', 'Month': 'Month'},
    template="plotly_dark"
)
st.plotly_chart(fig_month, use_container_width=True)
chart_type = st.radio("📊 Select Chart Type", ["Scatter Plot", "Box Plot"], horizontal=True)
if chart_type == "Scatter Plot":
    fig5 = px.scatter(filtered, x="Units Sld", y="Profit", color="Pet", title="Units Sold vs Profit", template="plotly")
else:
    fig5 = px.box(filtered, x="Pet", y="Profit", title="Profit Distribution by Pet Type", template="plotly_dark")

st.plotly_chart(fig5, use_container_width=True)
heatmap_data = filtered.pivot_table(index="Area", columns="Pet", values="Profit", aggfunc="sum")
```

```
fig6, ax6 = plt.subplots(figsize=(10, 5))

sns.heatmap(heatmap_data, annot=True, fmt=".0f", cmap="YlGnBu", linewidths=0.5, ax=ax6)

ax6.set_title("💡 Heatmap: Total Profit by Store and Pet Type")

st.pyplot(fig6)

top_areas = df.groupby('Area')['Profit'].sum().nlargest(5).reset_index()

fig_top_areas = px.bar(

    top_areas,

    x='Area',

    y='Profit',

    title='🏆 Top 5 Most Profitable Store Areas',

    color='Profit',

    color_continuous_scale='Viridis',

    labels={'Profit': 'Total Profit (€)'}

)

st.plotly_chart(fig_top_areas, use_container_width=True)

selected_pet = st.selectbox("🐶 Select Pet Type for Area-wise Profit", df['Pet'].unique())

pet_by_area = df[df['Pet'] == selected_pet].groupby('Area')['Profit'].sum().reset_index()

fig_pet_area = px.bar(

    pet_by_area,

    x='Area',

    y='Profit',

    title=f'Profit from {selected_pet} by Store Area',

    color='Profit',

    color_continuous_scale='Sunset'

)

st.plotly_chart(fig_pet_area, use_container_width=True)
```