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PROJECT REPORT

ON

“Food Delivery Cost and Profitability Analysis using Python”

SUBMITTED BY:

RAHUL GARAI

MD SAHID RAJA

Introduction of the Project:

A Food Delivery Cost and Profitability Analysis is an in-depth assessment designed to evaluate the financial workings of a food delivery service to make it more cost-effective and profitable. This analysis focuses on scrutinizing each element of the operation, from variable costs, such as food ingredients, packaging, and delivery expenses, to fixed costs like labor, technology, and rent. By carefully examining these costs, businesses can pinpoint inefficiencies that lead to overspending, identify areas where adjustments can be made, and develop strategies to manage expenses without compromising service quality. Additionally, the analysis reviews revenue streams, considering how pricing and commission structures impact overall profitability. For example, setting optimal delivery fees, refining commission rates with restaurants, or creating tiered pricing for premium services can increase revenue without alienating customers or partners. This strategic approach enables the business to gain insight into both fixed and flexible factors that influence its bottom line. Ultimately, a well-executed Food Delivery Cost and Profitability Analysis equips businesses with the tools to minimize unnecessary expenses, increase revenue, and establish a sustainable and profitable model in a competitive industry.

Food Delivery Cost and Profitability Analysis Process:

Food Delivery Cost and Profitability Analysis involves examining all the costs associated with delivering food orders, from direct expenses like delivery fees and packaging to indirect expenses like discounts offered to customers and commission fees paid by restaurants. By juxtaposing these costs against the revenue generated (primarily through order values and commission fees), the analysis aims to provide insights into how profitable the food delivery service is on a per-order basis.

Below is the process we can follow for the task of Food Delivery Cost and Profitability Analysis:

1. Start by gathering comprehensive data related to all aspects of food delivery operations.
2. Clean the dataset for inconsistencies, missing values, or irrelevant information.
3. Extract relevant features that could impact cost and profitability.
4. Break down the costs associated with each order, including fixed costs (like packaging) and variable costs (like delivery fees and discounts).
5. Determine the revenue generated from each order, focusing on commission fees and the order value before discounts.

6. For each order, calculate the profit by subtracting the total costs from the revenue. Analyze the distribution of profitability across all orders to identify trends
7. Based on the cost and profitability analysis, develop strategic recommendations aimed at enhancing profitability.
8. Use the data to simulate the financial impact of proposed changes, such as adjusting discount or commission rates.

So, the process starts with collecting a dataset. I found an ideal dataset for this task.

Now, let's get started with the task of Food Delivery Cost and Profitability Analysis by importing the necessary Python libraries and the dataset:

[1]:
```
import pandas as pd

food_orders = pd.read_csv("food_orders_new_delhi.csv")
print(food_orders.head())
```

```
   Order ID Customer ID Restaurant ID  Order Date and Time  \
0         1       C8270         R2924  2024-02-01 01:11:52
1         2       C1860         R2054  2024-02-02 22:11:04
2         3       C6390         R2870  2024-01-31 05:54:35
3         4       C6191         R2642  2024-01-16 22:52:49
4         5       C6734         R2799  2024-01-29 01:19:30

  Delivery Date and Time  Order Value  Delivery Fee    Payment Method  \
0    2024-02-01 02:39:52         1914             0       Credit Card
1    2024-02-02 22:46:04          986            40    Digital Wallet
2    2024-01-31 06:52:35          937            30  Cash on Delivery
3    2024-01-16 23:38:49         1463            50  Cash on Delivery
4    2024-01-29 02:48:30         1992            30  Cash on Delivery

  Discounts and Offers  Commission Fee  Payment Processing Fee  \
0            5% on App             150                      47
1                  10%             198                      23
2        15% New User              195                      45
3                  NaN             146                      27
4        50 off Promo              130                      50

   Refunds/Chargebacks
0                    0
1                    0
2                    0
3                    0
4                    0
```

```
[2]: print(food_orders.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 12 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Order ID                1000 non-null   int64
 1   Customer ID             1000 non-null   object
 2   Restaurant ID           1000 non-null   object
 3   Order Date and Time     1000 non-null   object
 4   Delivery Date and Time  1000 non-null   object
 5   Order Value             1000 non-null   int64
 6   Delivery Fee            1000 non-null   int64
 7   Payment Method          1000 non-null   object
 8   Discounts and Offers    815 non-null    object
 9   Commission Fee          1000 non-null   int64
 10  Payment Processing Fee  1000 non-null   int64
 11  Refunds/Chargebacks     1000 non-null   int64
dtypes: int64(6), object(6)
memory usage: 93.9+ KB
None
```

The dataset contains 1,000 entries and 12 columns, with no missing values in any of the columns. Now, we need to perform some **data cleaning** and preparation. Below are the necessary cleaning steps we need to take:

- Convert “Order Date and Time” and “Delivery Date and Time” to a datetime format.
- Convert “Discounts and Offers” to a consistent numeric value (if applicable) or calculate the discount amounts.
- Ensure all monetary values are in a suitable format for calculations.

Let’s perform these data preparation steps:

[8]:
```
from datetime import datetime

# convert date and time columns to datetime
food_orders['Order Date and Time'] = pd.to_datetime(food_orders['Order Date and Time'])
food_orders['Delivery Date and Time'] = pd.to_datetime(food_orders['Delivery Date and Time'])

# First, let's create a function to extract numeric values from the 'Discounts and Offers' string
def extract_discount(discount_str):
    # Check if discount_str is a string before processing
    if isinstance(discount_str, str):
        if 'off' in discount_str:
            # Fixed amount off
            return float(discount_str.split(' ')[0])
        elif '%' in discount_str:
            # Percentage off
            return float(discount_str.split('%')[0])
    # Return 0.0 for non-string values or no discount
    return 0.0

# Apply the function to create a new 'Discount Percentage' column
food_orders['Discount Percentage'] = food_orders['Discounts and Offers'].apply(lambda x: extract_discount(x))

# For percentage discounts, calculate the discount amount based on the order value
food_orders['Discount Amount'] = food_orders.apply(lambda x: (x['Order Value'] * x['Discount Percentage'] / 100)
                                                   if x['Discount Percentage'] > 1
                                                   else x['Discount Percentage'], axis=1)

# Adjust 'Discount Amount' for fixed discounts directly specified in the 'Discounts and Offers' column
food_orders['Discount Amount'] = food_orders.apply(lambda x: x['Discount Amount'] if x['Discount Percentage'] <= 1
                                                   else x['Order Value'] * x['Discount Percentage'] / 100, axis=1)

print(food_orders[['Order Value', 'Discounts and Offers', 'Discount Percentage', 'Discount Amount']].head(), food_orders.dtypes)
```

```
   Order Value Discounts and Offers  Discount Percentage  Discount Amount
0         1914            5% on App                 5.0            95.70
1          986                  10%                10.0            98.60
2          937         15% New User                15.0           140.55
3         1463                  NaN                 0.0             0.00
4         1992         50 off Promo                50.0           996.00 Order ID
Customer ID                         object
Restaurant ID                       object
Order Date and Time         datetime64[ns]
Delivery Date and Time      datetime64[ns]
Order Value                          int64
Delivery Fee                         int64
Payment Method                      object
Discounts and Offers                object
Commission Fee                       int64
Payment Processing Fee               int64
Refunds/Chargebacks                  int64
Discount Percentage                float64
Discount Amount                    float64
dtype: object
```

The data is now ready with the following adjustments:

- Order Date and Time and Delivery Date and Time columns have been converted to datetime format.
- A new column, Discount Amount, has been calculated based on the Discounts and Offers column. This was achieved by extracting percentage discounts or fixed amounts and applying them to the order value.
- Discount Percentage has been added to represent the discount rate or fixed amount discount directly.

Cost and Profitability Analysis:

For the cost analysis, we'll consider the following costs associated with each order:

- **Delivery Fee**: The fee charged for delivering the order.
- **Payment Processing Fee**: The fee for processing the payment.
- **Discount Amount**: The discount provided on the order.

We'll calculate the total cost for the platform per order and then aggregate this data to understand the overall cost structure.

The revenue for the platform is mainly derived from the **Commission Fee**. We'll calculate the net profit by subtracting the total costs (including discounts) from the revenue generated through commission fees.

Let’s proceed with the cost and profitability analysis:

[9]:
```
# calculate total costs and revenue per order
food_orders['Total Costs'] = food_orders['Delivery Fee'] + food_orders['Payment Processing Fee'] + food_orders['Discount Amount']
food_orders['Revenue'] = food_orders['Commission Fee']
food_orders['Profit'] = food_orders['Revenue'] - food_orders['Total Costs']

# aggregate data to get overall metrics
total_orders = food_orders.shape[0]
total_revenue = food_orders['Revenue'].sum()
total_costs = food_orders['Total Costs'].sum()
total_profit = food_orders['Profit'].sum()

overall_metrics = {
    "Total Orders": total_orders,
    "Total Revenue": total_revenue,
    "Total Costs": total_costs,
    "Total Profit": total_profit
}

print(overall_metrics)
```

```
{'Total Orders': 1000, 'Total Revenue': np.int64(126990), 'Total Costs': np.float64(232709.85), 'Total Profit': np.float64(-105719.85)}
```

Based on the analysis, here are the overall metrics for the food delivery operations:

- Total Orders: 1,000
- Total Revenue (from Commission Fees): 126,990 INR
- Total Costs: 232,709.85 INR (including delivery fees, payment processing fees, and discounts)
- Total Profit: -105,719.85 INR

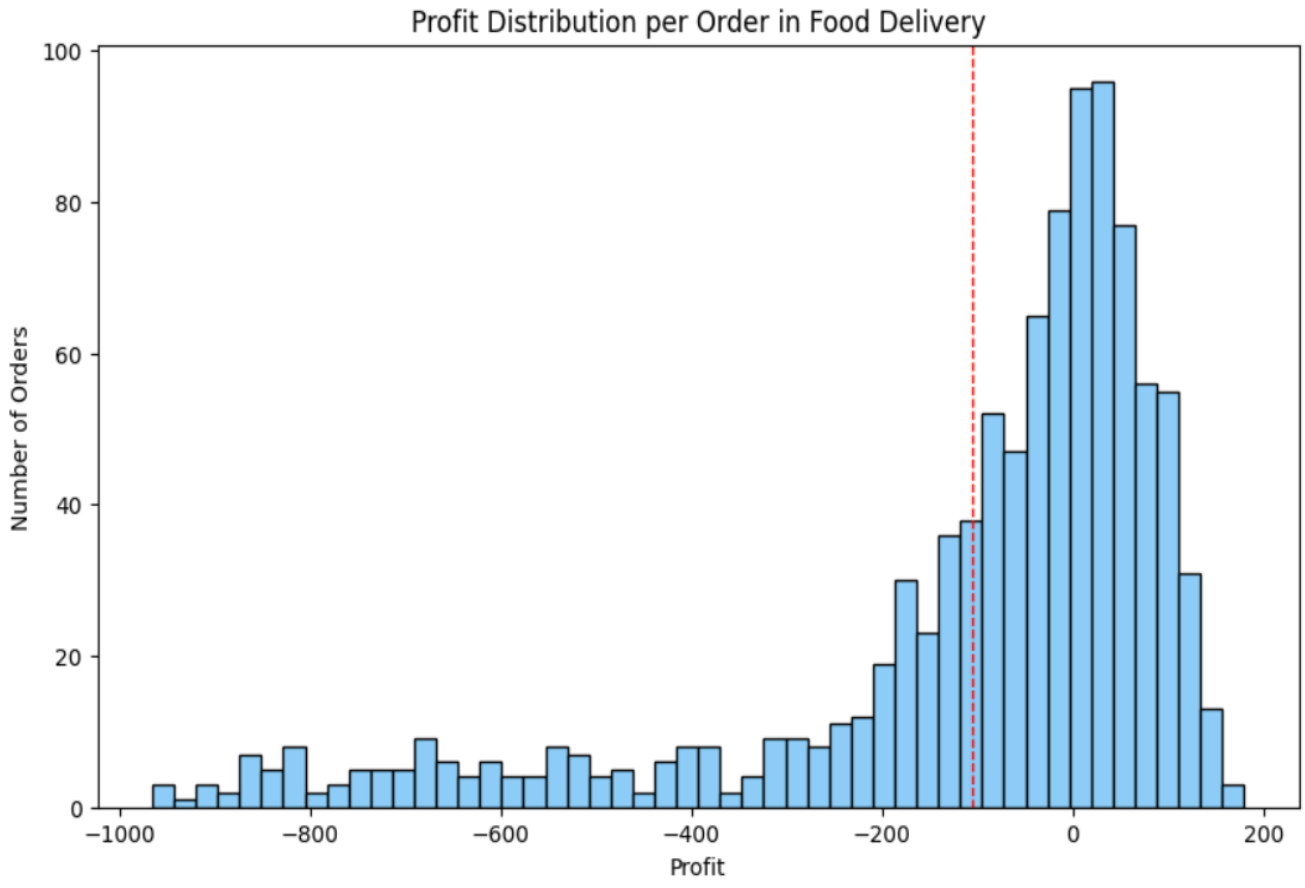
The analysis indicates that the total costs associated with the food delivery operations exceed the total revenue generated from commission fees, resulting in a net loss. It suggests that the current commission rates, delivery fees, and discount strategies might not be sustainable for profitability.

To better understand the distribution of costs, revenue, and profit, let’s plot:

1. A histogram of profits per order to visualize the distribution of profitable and unprofitable orders.
2. A pie chart to visualize the proportion of total costs (delivery fees, payment processing fees, and discounts).
3. A bar chart to compare total revenue, total costs, and total profit

Let's plot the histogram first:

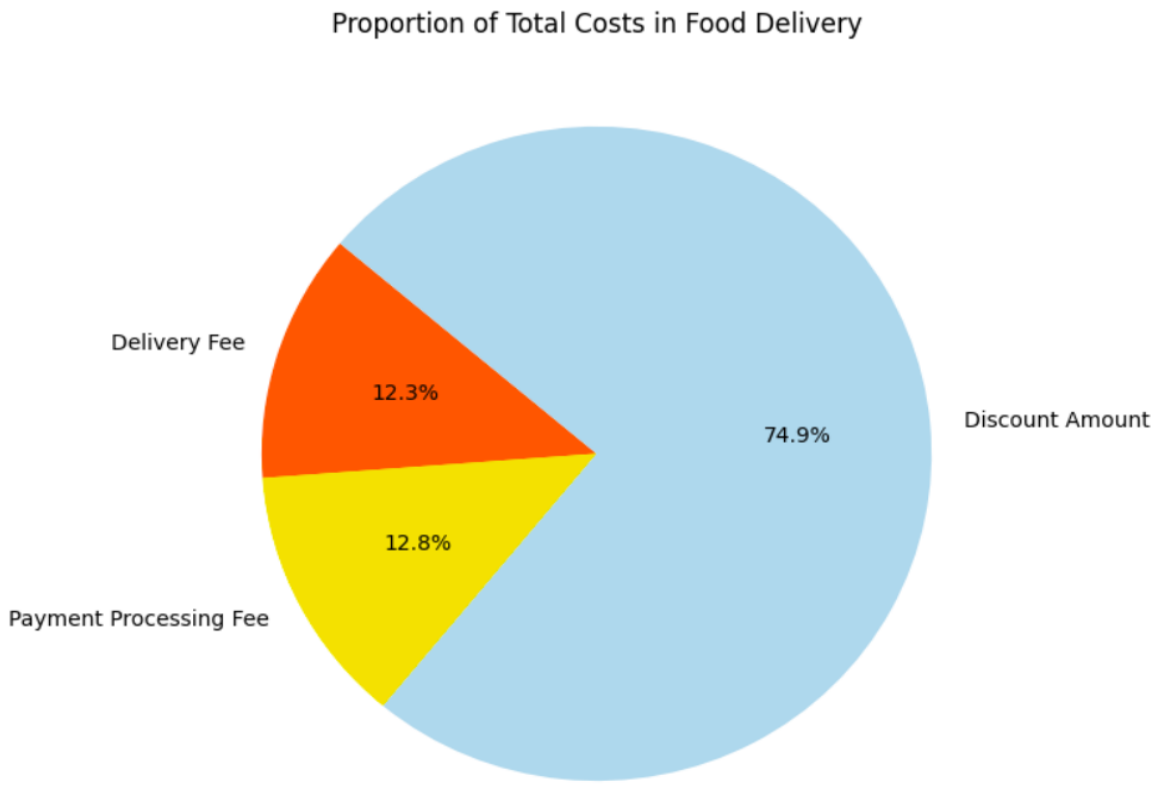
[10]:
```
import matplotlib.pyplot as plt

# histogram of profits per order
plt.figure(figsize=(10, 6))
plt.hist(food_orders['Profit'], bins=50, color='skyblue', edgecolor='black')
plt.title('Profit Distribution per Order in Food Delivery')
plt.xlabel('Profit')
plt.ylabel('Number of Orders')
plt.axvline(food_orders['Profit'].mean(), color='red', linestyle='dashed', linewidth=1)
plt.show()
```



The histogram shows a wide distribution of profit per order, with a noticeable number of orders resulting in a loss (profits below 0). The red dashed line indicates the average profit, which is in the negative territory, highlighting the overall loss-making situation.

Now, let's have a look at the proportion of total costs:

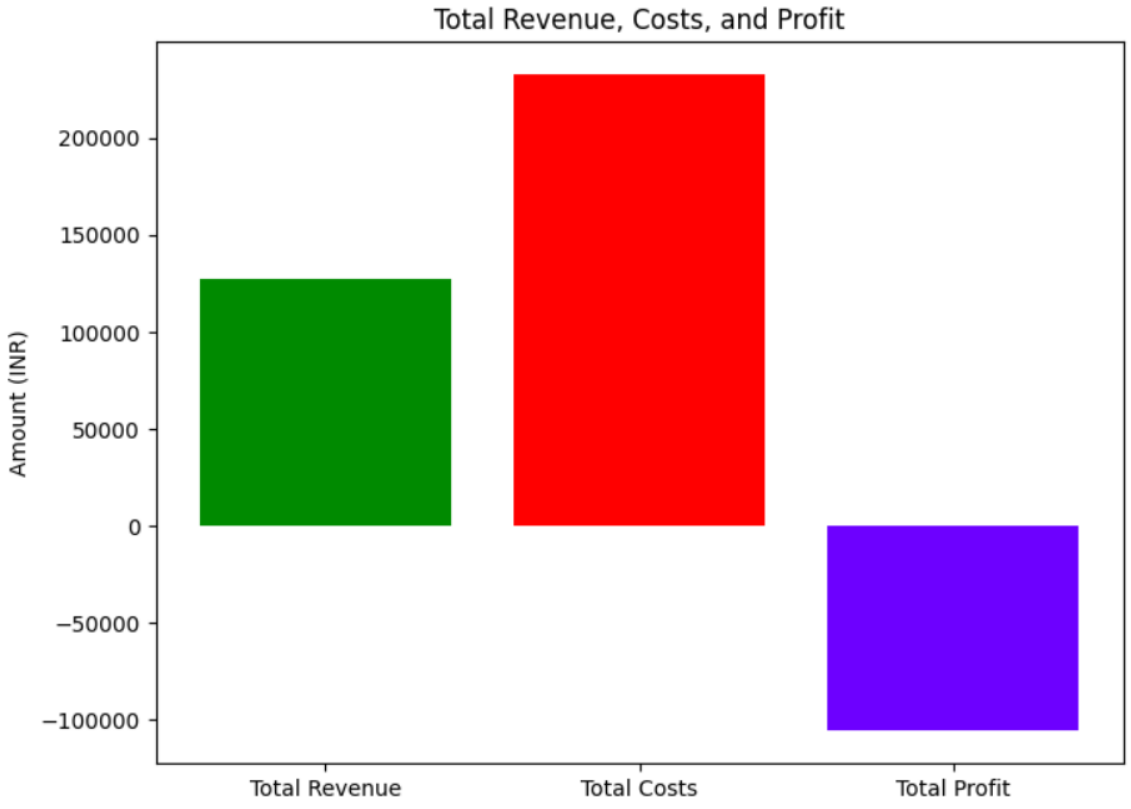
```
[11]: # pie chart for the proportion of total costs
costs_breakdown = food_orders[['Delivery Fee', 'Payment Processing Fee', 'Discount Amount']].sum()
plt.figure(figsize=(7, 7))
plt.pie(costs_breakdown, labels=costs_breakdown.index, autopct='%1.1f%%', startangle=140, colors=['tomato', 'gold', 'lightblue'])
plt.title('Proportion of Total Costs in Food Delivery')
plt.show()
```



The pie chart illustrates the breakdown of total costs into delivery fees, payment processing fees, and discount amounts. Discounts constitute a significant portion of the costs, suggesting that promotional strategies might be heavily impacting overall profitability.

Now, let’s compare total revenue, total costs, and total profit (net loss in our case):

[12]:
```
# bar chart for total revenue, costs, and profit
totals = ['Total Revenue', 'Total Costs', 'Total Profit']
values = [total_revenue, total_costs, total_profit]

plt.figure(figsize=(8, 6))
plt.bar(totals, values, color=['green', 'red', 'blue'])
plt.title('Total Revenue, Costs, and Profit')
plt.ylabel('Amount (INR)')
plt.show()
```



The bar chart compares total revenue, total costs, and total profit. It visually represents the gap between revenue and costs, clearly showing that the costs surpass the revenue, leading to a total loss.

A New Strategy for Profits:

From the analysis so far we understood that the discounts on food orders are resulting in huge losses. Now, we need to find a new strategy for profitability. We need to find a sweet spot for offering discounts and charging commissions. To find a sweet spot for commission and discount percentages, we can analyze the characteristics of profitable orders more deeply. Specifically, we need to look for:

1. A new average commission percentage based on profitable orders.
2. A new average discount percentage for profitable orders, that could serve as a guideline for what level of discount still allows for profitability.

Given these new averages, we can suggest adjustments that might not only make individual orders profitable but also apply broadly across all orders to improve overall profitability. Let's calculate:

- The average commission percentage for profitable orders.
- The average discount percentage for profitable orders.

[16]:
```
# Filter the dataset for profitable orders
profitable_orders = food_orders[food_orders['Profit'] > 0].copy()  # Using .copy() to avoid SettingWithCopyWarning

# Calculate the average commission percentage for profitable orders
profitable_orders.loc[:, 'Commission Percentage'] = (profitable_orders['Commission Fee'] / profitable_orders['Order Value']) * 100

# Calculate the average discount percentage for profitable orders
profitable_orders.loc[:, 'Effective Discount Percentage'] = (profitable_orders['Discount Amount'] / profitable_orders['Order Value']) * 100

# Calculate the new averages
new_avg_commission_percentage = profitable_orders['Commission Percentage'].mean()
new_avg_discount_percentage = profitable_orders['Effective Discount Percentage'].mean()

print(new_avg_commission_percentage, new_avg_discount_percentage)
```

```
30.508436145149435 5.867469879518072
```

Based on the analysis of profitable orders, we find a new set of averages that could represent a “sweet spot” for commission and discount percentages:

- New Average Commission Percentage: 30.51%
- New Average Discount Percentage: 5.87%

The average commission percentage for profitable orders is significantly higher than the overall average across all orders. It suggests that a higher commission rate on orders might be a key factor in achieving profitability. The average discount percentage for profitable orders is notably lower than the overall average, indicating that lower discounts might contribute to profitability without significantly deterring order volume.

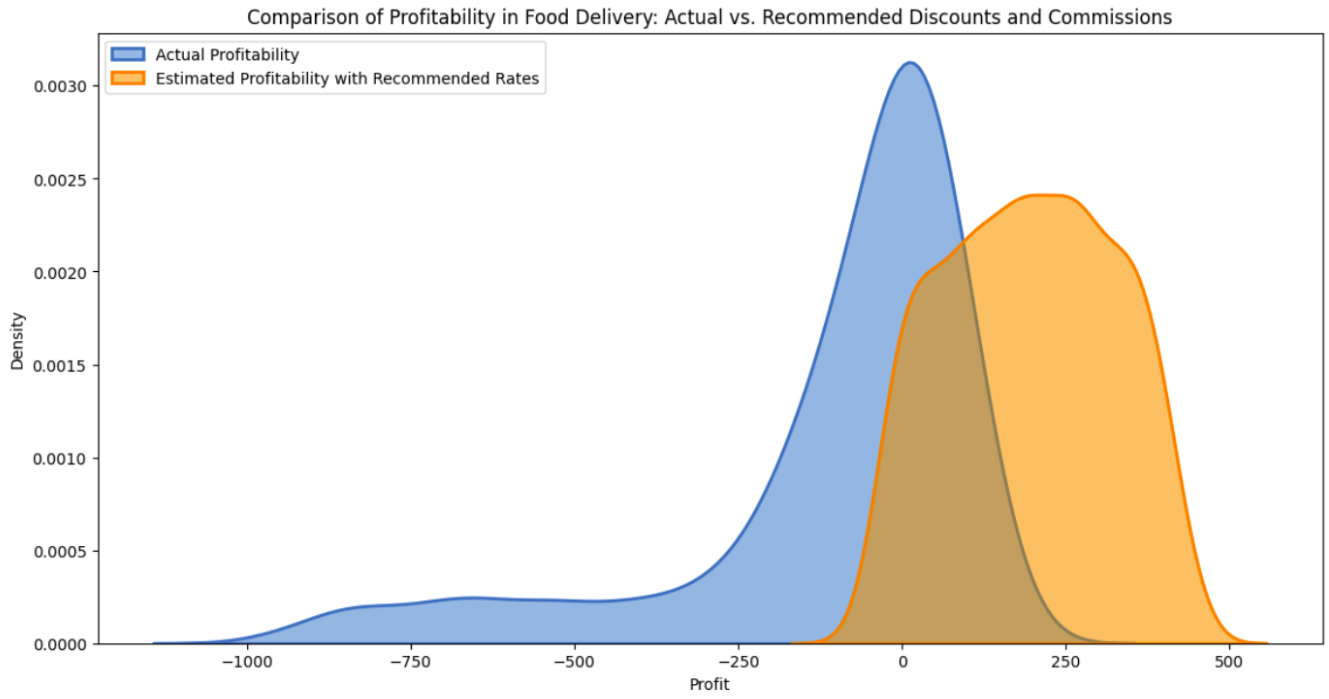
Based on this analysis, a strategy that aims for a commission rate closer to 30% and a discount rate around 6% could potentially improve profitability across the board.

Now, let’s visualize a comparison of profitability using actual versus recommended discounts and commissions across all orders. For this, we need to:

1. Calculate the profitability per order using the actual discounts and commissions already present in the dataset.
2. Simulate profitability per order using the recommended discounts (6%) and commissions (30%) to see the potential impact on profitability.

This comparison will help illustrate the potential impact of adopting the recommended discount and commission rates on the overall profitability of orders. Here's how to visualize this comparison:

[15]:
```python
# simulate profitability with recommended discounts and commissions
recommended_commission_percentage = 30.0  # 30%
recommended_discount_percentage = 6.0    # 6%

# calculate the simulated commission fee and discount amount using recommended percentages
food_orders['Simulated Commission Fee'] = food_orders['Order Value'] * (recommended_commission_percentage / 100)
food_orders['Simulated Discount Amount'] = food_orders['Order Value'] * (recommended_discount_percentage / 100)

# recalculate total costs and profit with simulated values
food_orders['Simulated Total Costs'] = (food_orders['Delivery Fee'] +
                                        food_orders['Payment Processing Fee'] +
                                        food_orders['Simulated Discount Amount'])

food_orders['Simulated Profit'] = (food_orders['Simulated Commission Fee'] -
                                   food_orders['Simulated Total Costs'])

# visualizing the comparison
import seaborn as sns

plt.figure(figsize=(14, 7))

# actual profitability
sns.kdeplot(food_orders['Profit'], label='Actual Profitability', fill=True, alpha=0.5, linewidth=2)

# simulated profitability
sns.kdeplot(food_orders['Simulated Profit'], label='Estimated Profitability with Recommended Rates', fill=True, alpha=0.5, linewidth=2)

plt.title('Comparison of Profitability in Food Delivery: Actual vs. Recommended Discounts and Commissions')
plt.xlabel('Profit')
plt.ylabel('Density')
plt.legend(loc='upper left')
plt.show()
```



The visualization compares the distribution of profitability per order using actual discounts and commissions versus the simulated scenario with recommended discounts (6%) and commissions (30%).

The actual profitability distribution shows a mix, with a significant portion of orders resulting in losses (profit < 0) and a broad spread of profit levels for orders. The simulated scenario suggests a shift towards higher profitability per order. The distribution is more skewed towards positive profit, indicating that the recommended adjustments could lead to a higher proportion of profitable orders.

Summary

To effectively analyze the cost and profitability of a food delivery company, a Food Delivery Cost and Profitability Analysis involves a thorough examination of every expense associated with delivering food orders, paired against the revenue generated. This process starts by identifying direct costs—such as delivery fees, packaging, and logistics costs—which are the immediate expenses incurred for each order. Indirect costs are also reviewed, including discounts offered to customers, promotional deals, and commission fees paid to partner restaurants, as these impact the service's overall profitability. Each of these costs is carefully juxtaposed with revenue sources, which primarily include order values and commission fees that restaurants pay for using the platform. By calculating these financial metrics, the analysis can reveal how much profit (or loss) the business earns on a per-order basis. This insight is critical, as it enables companies to identify trends such as rising operational costs or inefficient pricing structures that may be eroding profits. The analysis can further help businesses explore potential improvements—like refining delivery pricing, adjusting commission fees, or restructuring discounts—ultimately allowing the company to optimize for profitability while maintaining competitive pricing and service standards. By achieving a balanced approach between cost efficiency and revenue generation, food delivery companies can secure a stronger, more sustainable financial standing in a competitive market.