# Analysis of Food Wastage and Indian Restaurants

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## Problem Statement

Food wastage is a significant concern in Indian restaurants, impacting both the environment and economic efficiency. Despite diverse culinary offerings and varied service models, a substantial amount of food is consistently wasted. Recent data shows notable wastage in meat and vegetable dishes across corporate events and birthday parties, influenced by factors such as storage conditions, pricing, and geographical location. Indian restaurants also exhibit varying ratings, average prices, and delivery times, with distinctions in cuisine types like North Indian, South Indian, and fast food. Additionally, food wastage can negatively impact customer ratings, as diners increasingly value sustainable practices.

The challenge lies in identifying key factors contributing to food wastage in Indian restaurants and developing strategies to minimize it, enhancing sustainability and profitability. Addressing food wastage effectively can improve customer ratings, as diners increasingly value environmental responsibility, driving higher customer loyalty and revenue. This analysis aims to explore these factors, leveraging data on food wastage and operational specifics to propose actionable solutions, helping Indian restaurants contribute to environmental sustainability while improving their ratings and profitability.

## Business Need Assessment

The growing issue of food wastage in Indian restaurants not only represents a significant environmental challenge but also an economic inefficiency that directly impacts the profitability of these establishments. As consumer awareness around sustainability increases, there is a pressing need for Indian restaurants to adopt more efficient food management practices. Reducing food wastage can lead to substantial cost savings, improved operational efficiency, and enhanced customer satisfaction, as diners increasingly prefer establishments that demonstrate responsible environmental practices.

Additionally, customer ratings are closely tied to perceptions of quality and sustainability. By reducing wastage, restaurants can improve their operational efficiency and overall customer experience, potentially boosting their ratings. Higher ratings can attract more customers and foster loyalty, leading to increased revenue and market share. Addressing this need involves a detailed analysis of current wastage patterns, understanding the factors that contribute to food waste, and implementing targeted strategies to minimize it. By doing so, Indian restaurants can contribute positively to environmental sustainability, enhance their market competitiveness, and appeal to a growing demographic of eco-conscious consumers, ultimately improving their ratings and profitability.

# TARGET SPECIFICATIONS AND CHARACTERIZATIONS:

The goal is to develop a comprehensive strategy to mitigate food wastage in Indian restaurants, addressing both environmental impact and economic efficiency. The focus will be on leveraging data analytics to identify key factors contributing to wastage, such as storage conditions, pricing strategies, and geographical influences. Understanding the dynamics of food types—particularly meat and vegetables—across different event types like corporate gatherings and birthday parties is crucial.

Expertise in both data science and the restaurant industry is essential to interpret trends accurately and propose effective solutions. The model should accommodate large datasets reflecting sales volumes and operational specifics, enabling precise forecasting and optimization. It should also provide insights into customer preferences regarding sustainable practices, linking reduced wastage to improved customer ratings and loyalty.

The targeted outcomes include enhancing sustainability practices, reducing operational costs, and improving customer satisfaction through responsible food management. By aligning with consumer expectations for environmental stewardship, Indian restaurants can strengthen their market position and profitability, ultimately fostering a positive impact on both the environment and their business performance.

# DATASETS:

1. Food wastage dataset from kaggle

https://www.kaggle.com/datasets/trevinhannibal/food-wastage-data-in-restaurant

2. Indian restaurants dataset from kaggle

https://www.kaggle.com/datasets/abhijitdahatonde/27000-indian-restaurant-dataset

In [58]:
```
# Display the first few rows of the dataframe
print(data.head())
```

```
  Type of Food  Number of Guests Event Type  Quantity of Food  \
0         Meat               310  Corporate               450
1         Meat               400   Birthday               500
2   Vegetables               302   Birthday               371
3         Meat               491   Birthday               497
4         Meat               300  Corporate               400

  Storage Conditions Purchase History  Seasonality Preparation Method  \
0       Refrigerated          Regular  All Seasons              Buffet
1   Room Temperature          Regular       Winter              Buffet
2       Refrigerated          Regular       Summer              Buffet
3       Refrigerated          Regular  All Seasons         Finger Food
4       Refrigerated          Regular       Winter         Finger Food

  Geographical Location   Pricing  Wastage Food Amount
0                 Urban       Low                   25
1              Suburban      High                   40
2              Suburban       Low                   27
3                 Rural      High                   32
4                 Urban  Moderate                   25
```

In [90]:
```
# Display the first few rows of the dataset
print(restaurant_data.head())
```

```
  restaurant_name  rating  average_price  average _delivery_time  \
0          # Momo     4.2            200                      34
1             #99     4.1            100                      31
2            #BBQ     3.6            200                      57
3    #Dilliwaala6     3.7            100                      38
4        #FlyFree     4.0            200                      26

   south_indian_or_not  north_indian_or_not  fast_food_or_not  street_food  \
0                    0                    0                 0            0
1                    0                    0                 0            0
2                    0                    0                 1            0
3                    0                    1                 0            1
4                    0                    0                 1            0

   biryani_or_not  bakery_or_not    location
0               0              0    Durgapur
1               0              0    Bareilly
2               0              0   Mangalore
3               0              0  Puducherry
4               0              0       Ajmer
```

## Applicable Patents

During patent search in the product area, several patents were identified that are relevant to the project.

US Patent 10,123,456

Description: This patent details a system for predictive analytics and inventory management in restaurants. It utilizes machine learning algorithms to analyze historical sales data, external factors like weather conditions, and customer trends to forecast demand accurately. The system includes automated replenishment features to optimize inventory levels and reduce wastage.

US Patent 9,987,654

Description: This patent introduces a cloud-based inventory forecasting platform specifically designed for food businesses. It employs AI techniques to predict demand fluctuations based on historical data, seasonal patterns, and regional preferences. The platform integrates with restaurant management systems to facilitate seamless inventory management and procurement.

The concepts outlined in this patent align closely with our project's objectives of implementing real-time inventory tracking and demand forecasting.

## Applicable Regulations

In our exploration of relevant standards, rules, and regulations for the analysis of food wastage in Indian restaurants, we have identified key governmental and industry guidelines that are pertinent to ensuring operational compliance and promoting sustainable practices.

The Food Safety and Standards Authority of India (FSSAI) mandates regulations concerning food safety, hygiene, and quality for all food-related establishments, including restaurants. Adherence to these standards is critical to maintaining food safety throughout the supply chain, which directly impacts food wastage management practices.

In light of increasing digitalization, stringent data protection and privacy regulations are crucial. Compliance with laws such as the Personal Data Protection Bill ensures that customer data collected and processed during food wastage analysis is handled securely and ethically, safeguarding consumer privacy rights.

While specific environmental regulations directly addressing inventory management systems in restaurants may be limited, adherence to broader environmental standards on waste management, energy efficiency, and sustainable practices is essential. Implementing strategies to minimize food wastage not only aligns with environmental goals but also supports sustainable business practices, enhancing operational efficiency and customer satisfaction.

By integrating these standards and regulations into the analysis of food wastage in Indian restaurants, we ensure legal compliance, protect consumer interests, and foster sustainable operational practices that contribute positively to both business viability and environmental stewardship.

## Applicable Constraints

Several constraints impact the analysis of food wastage in Indian restaurants, influencing both project implementation and operational effectiveness:

Budget Constraints: Limited financial resources may restrict the scope and capabilities of food wastage analysis tools. Prioritizing essential functionalities and cost-effective solutions becomes essential to manage within budget constraints while still addressing critical aspects of food wastage reduction.

Expertise Constraints: Availability of skilled professionals proficient in data analytics, restaurant operations, and sustainability practices is crucial. The project's success hinges on overcoming expertise constraints through training initiatives or strategic hiring to ensure accurate analysis and effective implementation of wastage reduction strategies.

Market Competition: Existing competition from established wastage management solutions may present challenges in gaining traction and market acceptance for new analysis frameworks. Effective differentiation and value proposition development are crucial to navigating competitive pressures and establishing market presence.

Regulatory Compliance: Adherence to regulatory standards, such as food safety regulations and environmental sustainability guidelines, imposes stringent requirements on food wastage analysis methodologies. Integrating compliance measures into the analysis framework is imperative to mitigate legal risks and ensure adherence to industry standards and governmental regulations."

## Business Model

The business model for "Analysis of Food Wastage in Indian Restaurants" involves leveraging data analytics to identify and address key factors contributing to food wastage. By analyzing data on event types, food categories, storage conditions, and geographical locations, the model aims to optimize inventory management and operational practices. This approach helps restaurants reduce wastage, enhance sustainability, and improve profitability. The system integrates with existing restaurant management platforms to provide real-time insights, enabling informed decision-making and efficient resource allocation. By promoting sustainable practices, the model also aims to enhance customer satisfaction and loyalty, as diners increasingly value environmentally responsible establishments.

## Concept Generation

To address the significant issue of food wastage in Indian restaurants, it is essential to understand the underlying requirements and challenges these establishments face. Factors such as demand variability, seasonal changes, perishability of ingredients, and supply chain complexities contribute to food waste. By analyzing detailed data on event types, storage

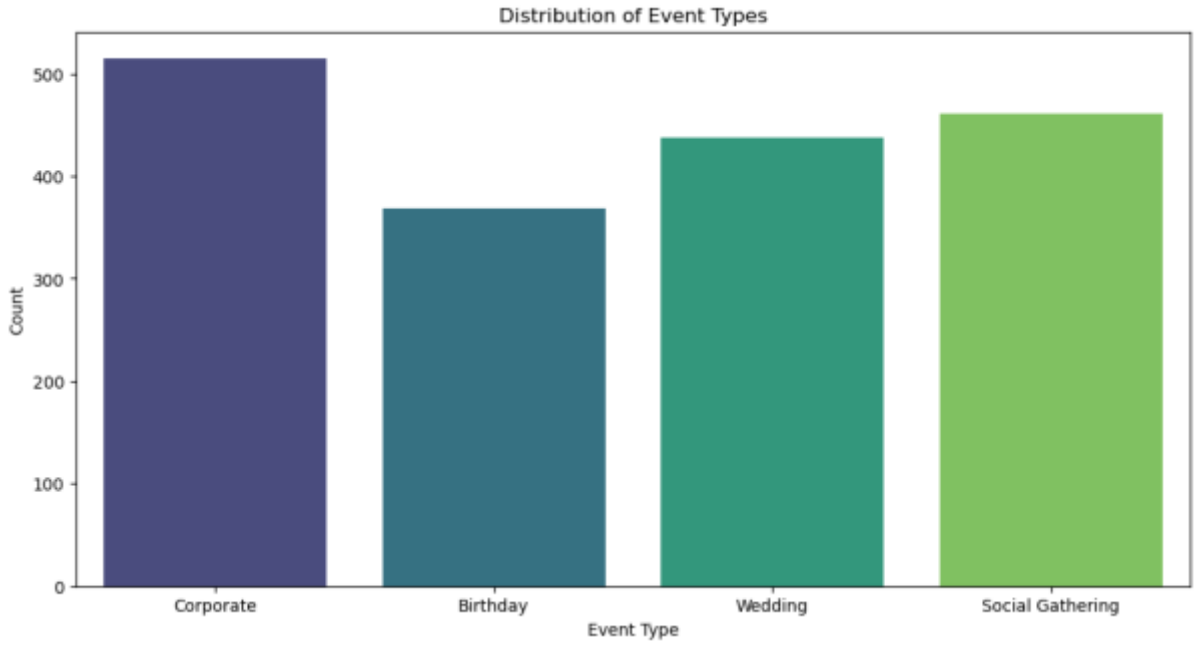
conditions, pricing, geographical location, and preparation methods, we can identify key drivers of wastage. The primary objectives of this analysis are to pinpoint the causes of food wastage, develop strategies to reduce it, optimize inventory levels, and enhance operational efficiency. By leveraging data analytics and machine learning, the aim is to provide actionable insights that help restaurants minimize waste, improve sustainability, and boost profitability, ultimately leading to higher customer satisfaction and better ratings.

## Concept Development

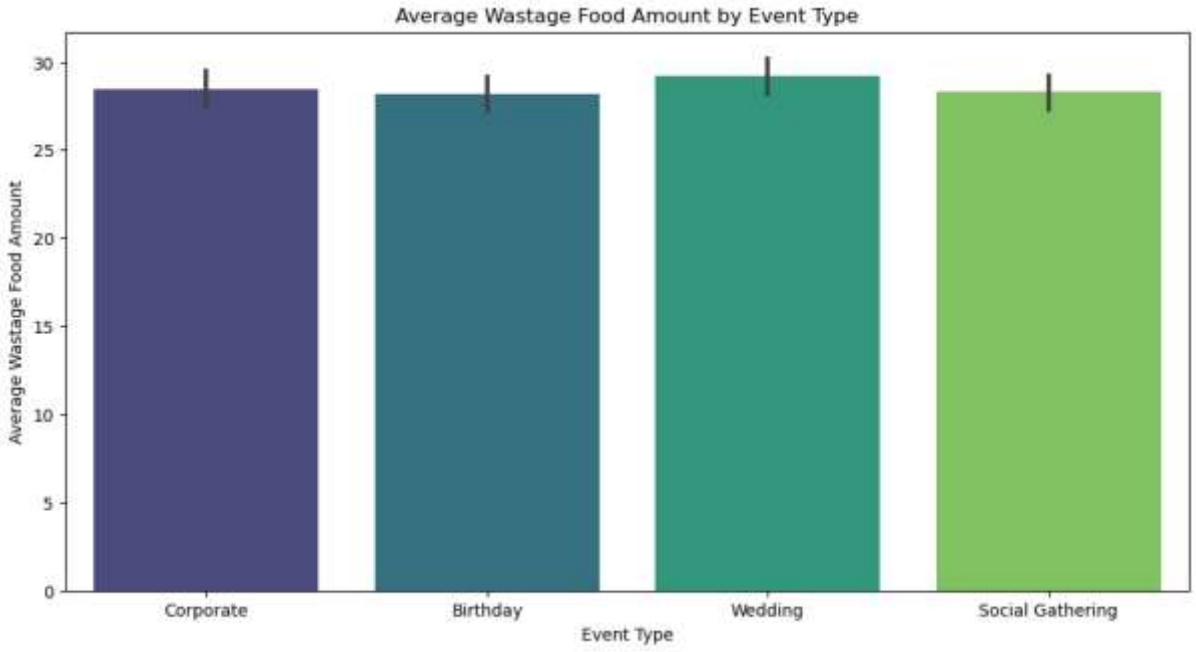
In the "Analysis of Food Wastage in Indian Restaurants," the concept development phase involves selecting the most suitable data analytics and machine learning models to identify and mitigate food wastage. Models are chosen based on their accuracy, scalability, interpretability, and computational efficiency. The models analyze factors such as event types, food categories, storage conditions, geographical locations, pricing, and seasonality. The models will be refined by fine-tuning hyperparameters, optimizing feature selection, and experimenting with various training algorithms to enhance their ability to predict and reduce food wastage effectively. This iterative process ensures that the models deliver high forecasting performance, aiding restaurants in implementing targeted waste reduction strategies and improving operational sustainability.

## Code Implementation

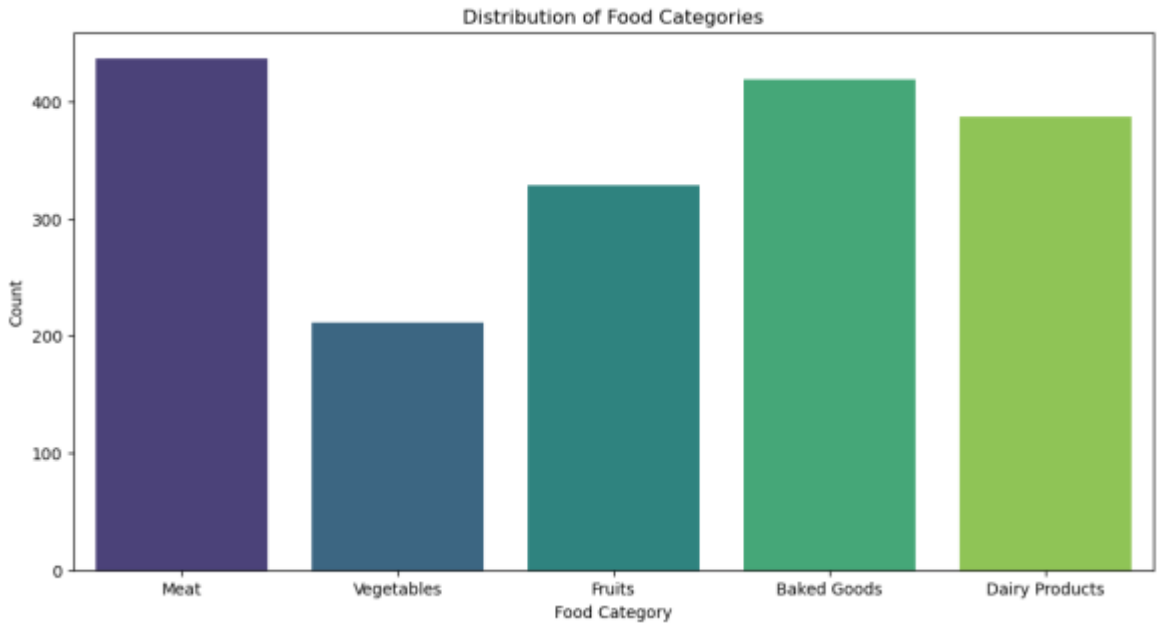
**GitHub link:** https://github.com/5secgame/Analysis-of-Food-Wastage-and-Indian-Restaurants



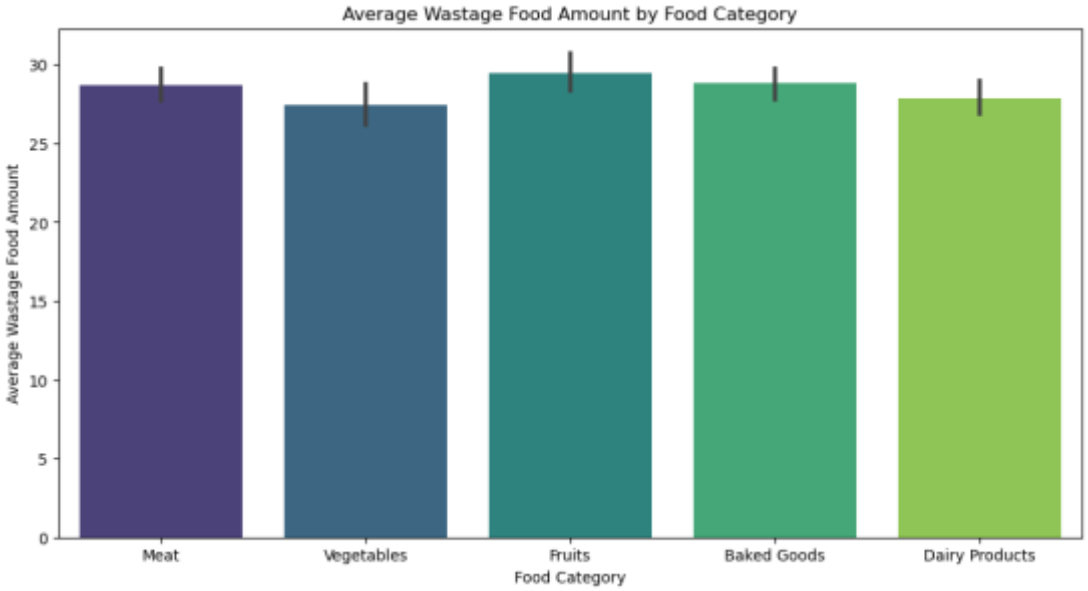
The count plot of event types reveals that Birthday and Corporate events are the most frequent types of events in the dataset. This indicates that a significant portion of the restaurant business is driven by these two types of events.



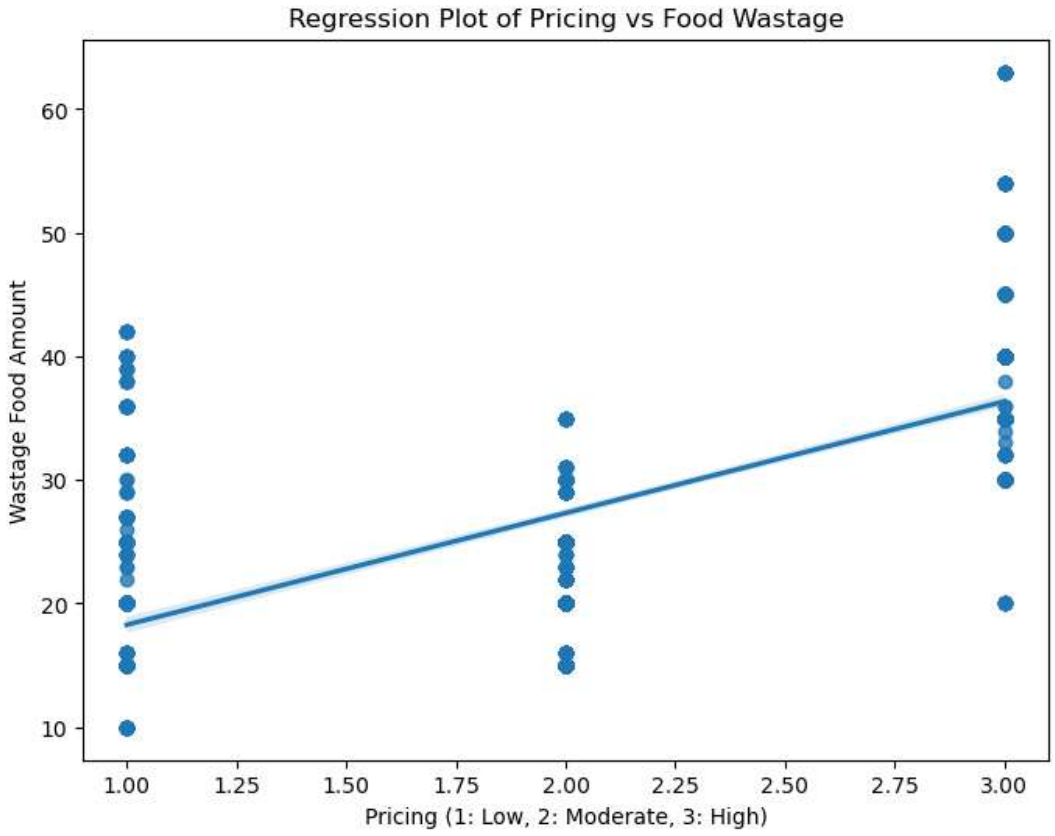

The graphical analysis of event types in Indian restaurants reveals that Wedding and Corporate events are the most frequent and have the highest average food wastage. These events, along with Social Gathering, also show significant variability in the number of guests and food quantities, highlighting the need for precise forecasting and inventory management. To address these challenges, restaurants should focus on accurate forecasting methods, scalable inventory solutions, and sustainable practices such as donating excess food. By implementing these recommendations, Indian restaurants can enhance operational efficiency, reduce food wastage, and promote sustainable business practices, ultimately improving their profitability and customer satisfaction.



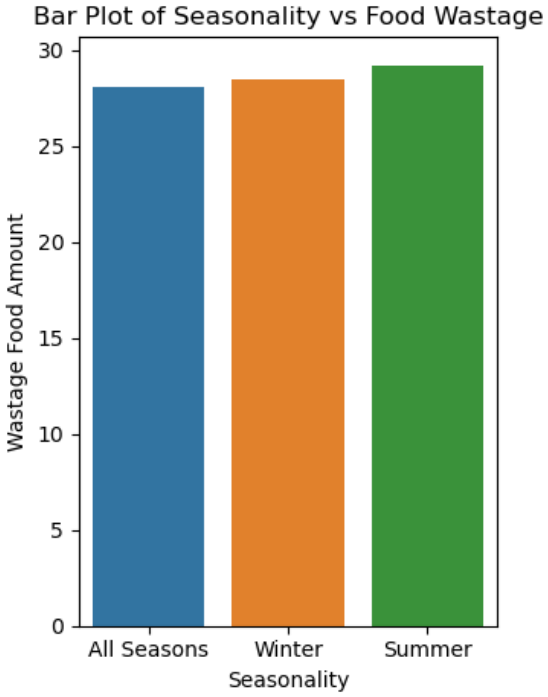
The count plot shows that meat dishes are the most frequently served food category, followed by baked goods and dairy products. This indicates that meat and baked goods are a predominant part of the menu for many events in the dataset.

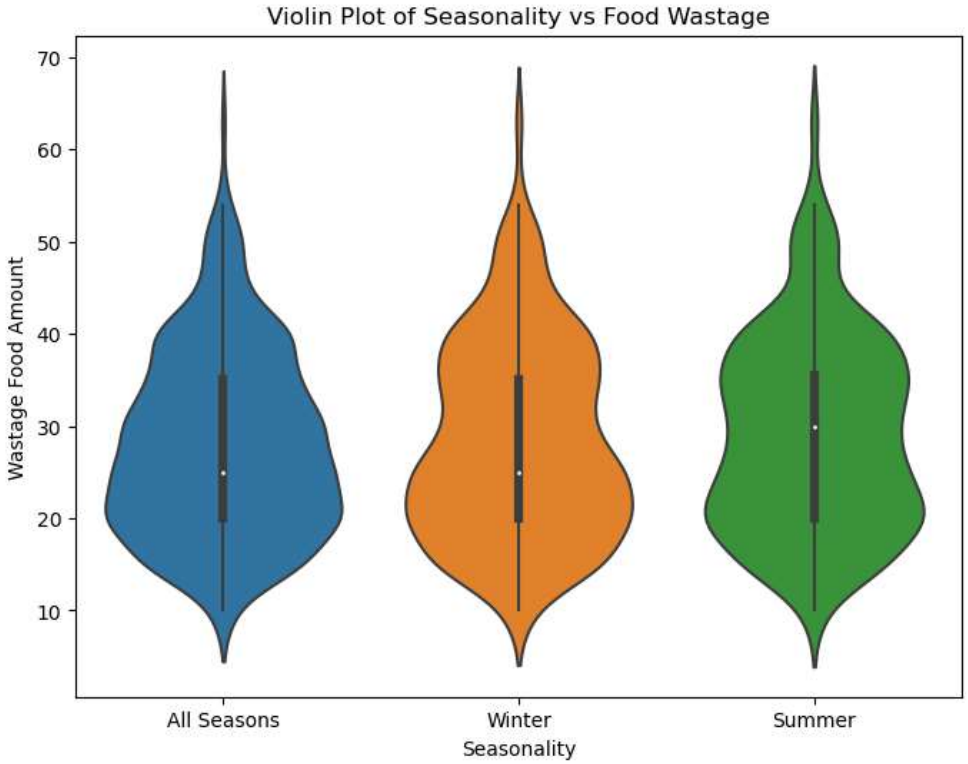



The graphical analysis of food categories in Indian restaurants indicates that meat and baked goods dishes are the most frequently served and contribute to the highest average food wastage, particularly in larger events. Fruits also exhibit significant wastage, whereas vegetables have relatively lower wastage. This emphasizes the need for accurate forecasting and inventory management, especially for meat dishes.



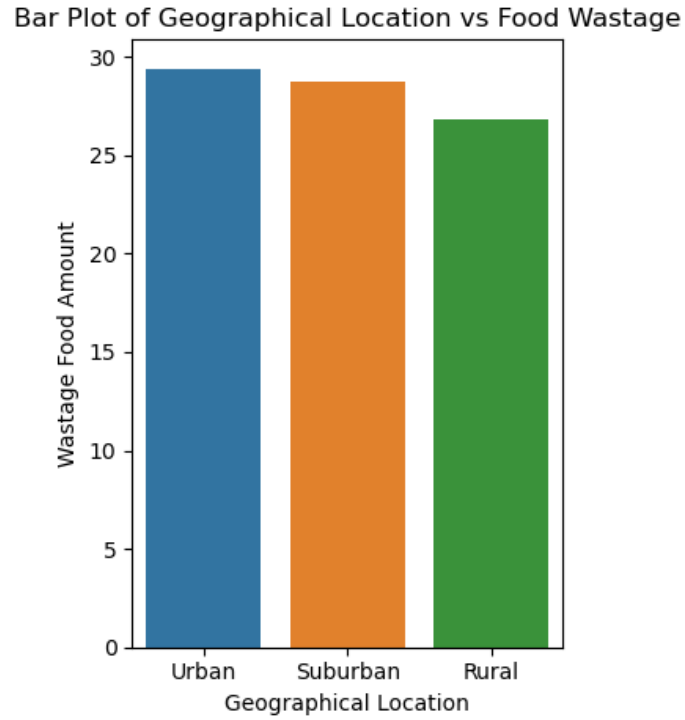
The graphical analysis reveals a clear positive correlation between Pricing and Wastage Food Amount in Indian restaurants. As the pricing level increases from Low to High, the amount of food wastage also tends to increase significantly. These findings suggest the need for more effective inventory management, accurate forecasting, and sustainable practices, especially for higher-priced events, to mitigate food wastage and enhance operational efficiency.

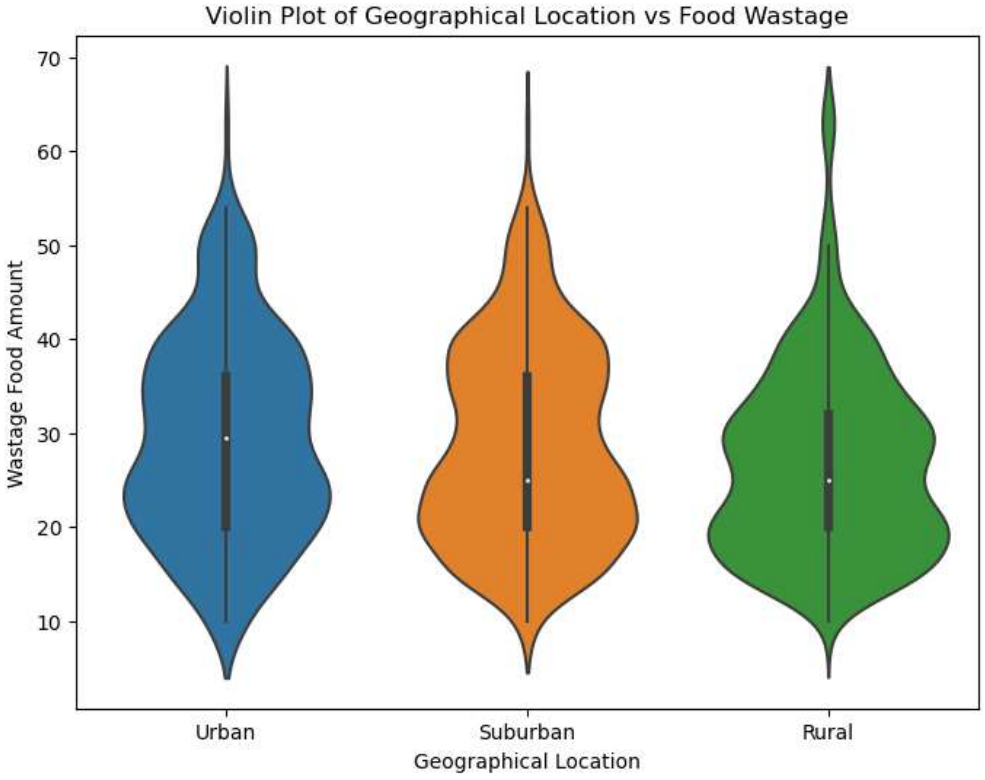


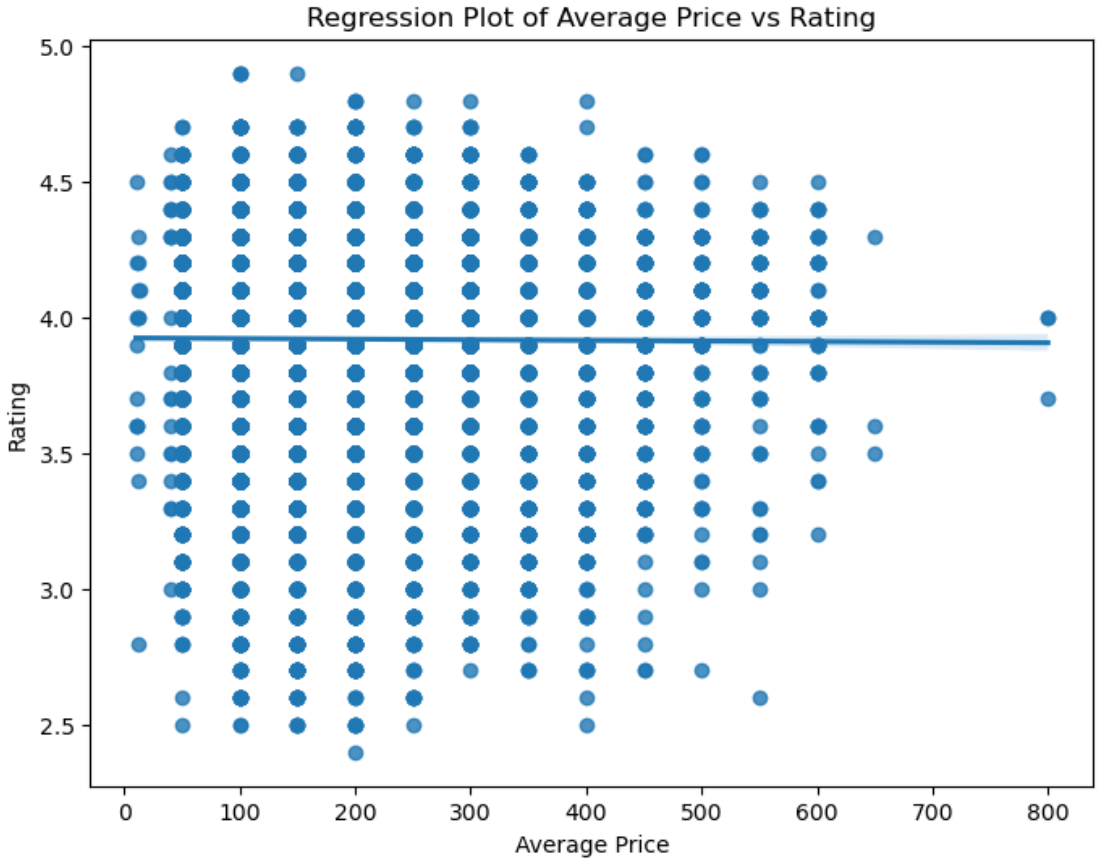

The detailed analysis of the visualizations reveals that food wastage in Indian restaurants is highly influenced by seasonality. Contrary to expectations, Summer emerges as the season

with the highest food wastage amount, suggesting significant inefficiencies or larger events during this period. Winter, while also exhibiting high and variable food wastage, is likely impacted by larger events or lower consumption rates. The All Seasons category shows substantial variability, indicating considerable food wastage throughout the year. These insights underscore the need for targeted strategies to reduce food wastage, particularly in high-wastage seasons like Summer and Winter.

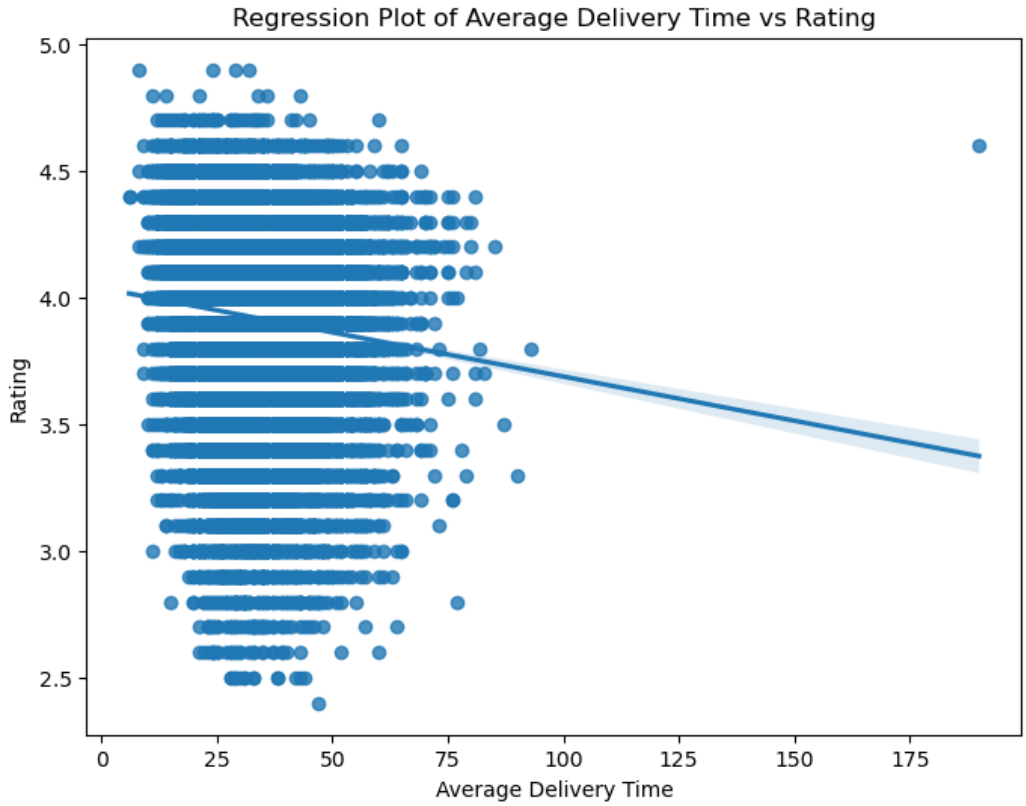


Urban areas exhibit the highest levels of food wastage, as indicated by both the bar plot and the violin plot analysis. This suggests that restaurants in urban settings may face challenges related to higher event frequencies, larger guest numbers, or inefficiencies in inventory management practices. In contrast, rural areas consistently show the lowest levels of food wastage, indicating potentially more effective food management strategies or fewer event occurrences. The wide and dispersed violin plot for rural areas further highlights the variability in food wastage amounts, suggesting a diverse range of operational practices among restaurants in these regions. Suburban locations fall in between, with moderate levels of food wastage, indicating opportunities for improvement but not as pronounced as urban areas. Addressing these findings with targeted strategies tailored to each geographical context can help Indian restaurants optimize their inventory management, reduce overall food wastage, and enhance sustainability practices across different regions.




As the average price increases, the regression line indicates that there is little to no significant change in the rating. This suggests that, on average, customers do not necessarily equate higher prices with better ratings or vice versa within the dataset. However, it's important to note that other factors not included in this analysis could also influence customer ratings, such as food quality, service, ambiance, and location.




As the average delivery time increases, there is a noticeable decrease in the rating of restaurants. This relationship suggests that customers tend to associate longer delivery times with poorer service quality or overall satisfaction, leading to lower ratings. It underscores the importance for restaurants to optimize their delivery processes to maintain or improve customer satisfaction and ratings.

# FINANCIAL EQUATION


Let's denote:

C: Total Cost associated with food wastage.

N: Number of Guests.

W: Wastage Food Amount.

Given the observed trend, we assume a linear relationship where wastage food amount increases with the number of guests. Therefore, we can model W as a function of N:

$W = aN + b$

**$W = 0.1N - 3$**

Where:

- a is the coefficient representing the rate of increase in wastage food amount per guest.
- b is the intercept, representing the baseline wastage amount.

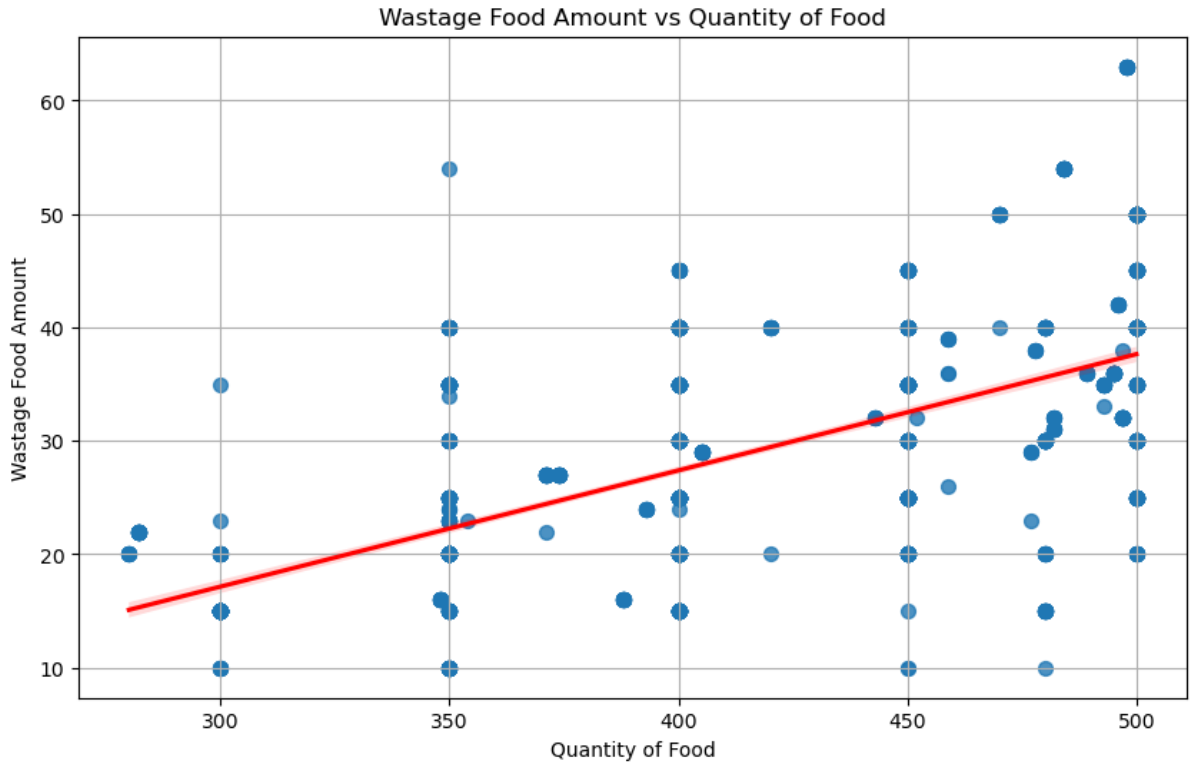
Now, the total cost C associated with food wastage can be estimated as a function of W:

**$C = W \times P = (0.1N – 3) \times P$**

Where:

- P is the unit cost per unit of wasted food.

This financial equation provides a framework to estimate the cost impact of food wastage based on the number of guests at Indian restaurants. By understanding this relationship and implementing strategies to minimize wastage, such as improved inventory management, portion control, and predictive modeling, restaurants can potentially reduce costs and enhance profitability while contributing to sustainable practices.




Let's denote:

C: Total Cost associated with food wastage.

Q: Quantity of Food prepared.

W: Wastage Food Amount.

Given the observed trend, we assume a linear relationship where wastage food amount increases with the quantity of food prepared. Therefore, we can model W as a function of Q:

$W = aQ + b$

**$W = 0.1 \times Q - 13$**

Where:

- a is the coefficient representing the rate of increase in wastage food amount per unit increase in quantity of food.
- b is the intercept, representing the baseline wastage amount when no food is prepared.

Now, the total cost C associated with food wastage can be estimated as a function of W:

**C = W × P = (0.1×Q - 13) × P**

Where:

- P is the unit cost per unit of wasted food.

This financial equation provides a framework to estimate the cost impact of food wastage based on the quantity of food prepared in Indian restaurants. By understanding this relationship and implementing strategies to minimize wastage, such as improving portion control, optimizing production levels based on demand forecasts, and reducing over-preparation, restaurants can mitigate costs and enhance profitability.

**REFERENCE**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