Understanding the Dynamics of Dietary Restaurant Popularity: Insights from Data Mining in East Java Restaurants

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ABSTRACT
In recent years, there has been a noticeable surge in public interest in maintaining healthy lifestyles. This trend reflects broader shifts towards health-oriented dietary choices, including the preference for plant-based foods. This study investigates the popularity of dietary restaurants by employing data mining techniques and multiple regression analysis. Through systematic data collection and analysis, it identifies key factors shaping consumer behavior, including the presence of dietary options, pricing perceptions, and online reviews. Results indicate that dietary options significantly impact restaurant popularity, attracting a diverse customer base. However, the perception of higher prices for dietary options poses a potential barrier to consumer adoption. Furthermore, online reviews play a crucial role in shaping restaurant reputations, with enduring effects on consumer behavior. This research contributes to our understanding of consumer behavior in the context of dietary preferences, offering practical implications for enhancing the popularity and success of dietary restaurants in an evolving market landscape.

Keywords: *Popularity, Dietary, Data Mining, Restaurant.*

1. INTRODUCTION

In recent years, there has been a noticeable increase in public awareness regarding the significance of maintaining a healthy lifestyle (Bolton et al., 2008; Divine and Lepisto, 2005; Rajamma and Pelton, 2010). This heightened consciousness has prompted individuals of all age groups to explore Complementary and Alternative Medicines (CAMs), with dietary supplements emerging as one of the fastest-growing categories within this domain (Royne et al., 2014). Particularly, the use of dietary supplements has seen a substantial rise, with a remarkable 68 percent of American adults now integrating them into their daily routines (Council for Responsible Nutrition, 2023). The economic magnitude of this trend is equally noteworthy, as evidenced by the $38.8 billion in consumer sales of dietary supplements recorded in the US through various channels in 2015 (Nutrition Business Journal, 2016). Economic factors have played a crucial role in this surge, as individuals seek to manage healthcare costs by resorting to alternative remedies to avoid expensive doctor visits and prescription medications (Federal Trade Commission, 2010).

Furthermore, recent research has highlighted the increasing preference for plant-based and dietary foods, with significant implications for consumer behavior and public health. Studies indicate a growing global concern regarding the sustainability of food systems and the impact of dietary choices on climate change, leading to a shift towards plant-based diets (Wirnitzer et al., 2022). This transition is accompanied by an abundance of plant-based products in the market, reflecting evolving consumer preferences. However, while plant-based alternatives show promise for dietary reform, there is a need for optimization to ensure alignment with nutritional guidelines (Wirnitzer et al., 2022). Further exploration into the dietary habits of specific populations, such as vegan and vegetarian athletes, underscores a broader trend towards health-oriented dietary choices among certain demographics (Huybers & Roodenburg, 2023; Tanous et al., 2022).

Moreover, the marketing strategies employed by food companies significantly influence consumer dietary preferences and behaviors, particularly among vulnerable populations. Studies investigating the dietary habits of military cadets in Bulgaria highlight the profound impact of marketing tactics and economic factors on nutrition habits,

emphasizing the necessity for targeted interventions to promote healthier choices (Glushkov, 2018). Similarly, the proliferation of unhealthy food products driven by aggressive marketing campaigns poses a significant public health challenge, necessitating concerted efforts to reduce consumption through regulatory measures and health education initiatives (Neupane, 2014). Some researchers have applied process mining techniques to analyze food purchase behavior and its relationship to children's weight status, using data from food digital cards. This allows schools to provide personalized dietary recommendations and adjust meal plans to improve student nutrition (Matthanawongsakorn, 2019).

Given these developments, this research aims to comprehensively examine the marketing and popularity of dietary food products, elucidating their implications for consumer choices and public health. By applying data mining techniques to analyze food purchase behavior, this study seeks to provide a holistic understanding of the factors shaping contemporary dietary trends and to inform strategies for promoting healthier lifestyles. Such research could provide valuable insights for policymakers, healthcare professionals, and consumers to make informed decisions regarding dietary choices and supplementation practices, ultimately contributing to the promotion of optimal health and well-being.

1.1. Dietary Food

Dietary food refers to the foods and nutrients that make up a person's diet and have an impact on their health and well-being (Lujan et al., 2021; Szewczyk, Chojnacka & Górnicka, 2021; Ter Borg et al., 2021). Unhealthy dietary patterns high in calories, sugars, and saturated fats, and low in healthy nutrients like fiber and polyunsaturated fatty acids, play a critical role in the development and progression of non-alcoholic fatty liver disease (NAFLD) (Lujan et al., 2021). Dietary interventions focused on low-calorie, plant-based diets like the Mediterranean diet are recommended as effective treatments for NAFLD (Lujan et al., 2021).

Certain nutrients like tocopherols and tocotrienols (forms of vitamin E) have demonstrated antioxidant and other beneficial health effects, though their exact biological roles are still under investigation (Szewczyk et al., 2021). The main dietary sources of these nutrients are vegetable oils, oilseeds, and nuts (Szewczyk et al., 2021). The Nutri-Score front-of-pack nutrition label can help guide consumers towards healthier dietary choices by aligning with recommendations to increase intake of fruits, vegetables, pulses, and nuts, and decrease intake of sugary drinks and refined grains (Ter Borg et al., 2021). Reformulating food products to reduce sodium, saturated fat, and sugars can also improve their Nutri-Score (Ter Borg et al., 2021).

1.2. Marketing on Unhealthy Food

Marketing of unhealthy foods and beverages, including through social media, television, and the use of celebrities and influencers, can negatively impact the dietary intake and preferences of children and adolescents. Several studies have found that exposure to marketing of foods and drinks high in fat, sugar, and salt leads to increased consumption of these unhealthy products (Sadeghirad et al., 2016; Packer et al., 2022). A meta-analysis showed that the use of celebrities in marketing unhealthy foods resulted in a significant increase in consumption of the marketed product by 56. calories under experimental conditions (Packer et al., 2022).

Additionally, research has suggested that food and beverage marketing on social media (Gascoyne et al., 2021) as well as television advertising (Jensen, et al., 2021), can contribute to poor dietary behaviors in young people. A qualitative study in Chile found that the country's food labeling and advertising law had a positive influence on the dietary and physical activity habits of elementary school students (Pfister & Pozas, 2023). In summary, the evidence indicates that marketing of unhealthy foods and beverages, particularly when using celebrities and influencers, has a detrimental impact on the dietary intake and preferences of children and adolescents.

2. RESEARCH METHOD

The study employs a systematic approach consisting of three primary steps: data preparation, data collection, and data analysis. These stages are detailed below. Data collection serves as the initial step in the process. Here, the focus lies on selecting restaurants that offer diets suitable for research purposes. The author utilizes Google Maps to search for restaurants in Surabaya, Sidoarjo, Malang, and Jember, four of East Java's most populous cities. By employing the search term "dietary restaurant [city name]," the author aims to gather all pertinent information. The search process is facilitated through the use of the Google Maps API and Python scripts, resulting in the identification of 1,098 eateries from the initial list.

Following this, in December 2023, a total of 369 restaurants undergo data sampling after undergoing further filtering and selection. Reviews are filtered based on two criteria: having fewer than 100 reviews or being blank. Setting a threshold of 100 reviews for retail establishments serves two purposes: firstly, to ensure a robust representation of retail stores, and secondly, to streamline the dataset by excluding irrelevant reviews. The study utilizes multiple regression analysis to address research question. By examining the relationship between features of retail shop services (as continuous predictor variables) and customer reviews, multiple regression modeling offers a solution. The author utilizes SPSS for conducting multiple regression analyses.

This study employs two distinct multiple regression approaches to examine the factors influencing the popularity of dietary foods. One method involves predicting the popularity of a diet food by assessing its star ratings. Specifically, the star ratings of dietary foods serve as the dependent variable in the second multiple regression technique. In both methodologies, the number of reviews, alongside the dietary attributes of the food, is considered as predictive variables. Previous scholarly works, such as those by Izharuddin & Chen (2023), have similarly utilized review volume to forecast star ratings. Adopting these methodologies enables diet food establishments to discern how various nutritional characteristics impact customers across different levels of expertise.

2.1. Model Specifications

Relevant econometric models must be used to compensate for individual heterogeneity using this data structure. In order to assess the data and account for non-observable characteristics among hotels, we employed two models (reviews and ratings). The models that arise are shown in Equation 1 and Equation 2:

$$\text{REVIEWS} = \beta 0 + \beta 1\ \text{PRICE} + \beta 2\ \text{DIETARY OPTION} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\text{RATINGS} = \beta 0 + \beta 1\ \text{PRICE} + \beta 2\ \text{DIETARY OPTION} + \beta 3\ \text{REVIEWS} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where REVIEWS is the number of reviews on the restaurant. RATING is the average rating that customers give on the platform. PRICE is the average price for the restaurant service. DIETARY OPTION is option for dietary food in the restaurant. Table 1 shows the regression test results of this study.

Table 1. Regression results

	Model 1: Reviews		Model 2: Ratings	
	Standardized Beta	t	Standardized Beta	t
Dietary options	0.254***	5.033	0.253***	-7.361
Price	0.269***	5.338	-0.623***	18.036
Reviews			0.434	12.577
R^2	0.431		0.493	
Durbin-Watson	1.6053449		1.611364	

3. RESULTS AND DISCUSSIONS

Our analysis shows that option for dietary food in a restaurant, price and restaurant reviews , would impact popularity of dietary restaurant. The presence of dietary food options in a restaurant significantly affects its popularity. This indicates that consumers are increasingly looking for restaurants that cater to their dietary needs, whether it be vegetarian, vegan, gluten-free, etc. Having a variety of dietary options can attract a broader customer base and enhance the restaurant's appeal.

Interestingly, the study suggests that while dietary options may attract customers, the perception that such options are pricier than non-dietary options could have a negative impact on popularity. This implies that consumers might be hesitant to choose dietary restaurants if they anticipate higher prices. This finding highlights a potential barrier that dietary restaurants need to address in order to improve their attractiveness to customers. The research underscores the significant influence of online reviews on the popularity of dietary restaurants. Positive reviews can boost the restaurant's reputation and attract more customers, while negative reviews can have the opposite effect. Importantly, the study indicates that the impact of online reviews can be long-lasting, extending for at least two quarters. This suggests that a positive or negative reputation established through online reviews can have a sustained effect on consumer behavior.

The findings of this research have significant implications for both theory development and managerial practices. The study contributes to our understanding of consumer behavior by highlighting the importance of dietary options, pricing perceptions, and online reviews in shaping restaurant popularity. Insights from this research can inform service marketing theories, particularly regarding how restaurants can effectively position themselves in the market by catering to dietary preferences, managing pricing strategies, and leveraging online reputation management techniques.

For managerial implications, restaurant managers can use the findings to strategically design menus that offer a variety of dietary options to appeal to a broader customer base. This may involve collaborating with chefs and nutritionists to create innovative and appealing dishes that meet diverse dietary needs.

Recognizing the potential perception that dietary options are more expensive, managers can implement transparent pricing strategies to address customer concerns. This might involve clearly communicating the value proposition of dietary offerings and ensuring competitive pricing relative to non-dietary alternatives. Given the enduring impact of online reviews, managers should actively monitor and respond to feedback on review platforms. Implementing strategies to enhance positive reviews and address negative feedback can help maintain and improve the restaurant's reputation over time.

4. LIMITATIONS AND FUTURE STUDIES

While this research provides valuable insights into the factors influencing the popularity of dietary restaurants, it's important to acknowledge its limitations and identify avenues for future studies. The findings of this research may be context-specific and might not fully capture the dynamics of different markets or cultural contexts. Future studies could explore how these factors vary across different geographical regions, demographic groups, or cultural settings. The research appears to have focused on a simplified model that considers only a few factors influencing restaurant popularity. Future studies could adopt a more comprehensive approach by incorporating additional variables such as restaurant ambiance, service quality, location, and social media presence to provide a more nuanced understanding of consumer behavior in the restaurant industry.

While the study suggests that the influence of online reviews can last for at least two quarters, it's unclear how enduring these effects are in the long term. Future studies could investigate the long-term sustainability of positive or negative reputation effects on restaurant popularity. The restaurant industry is subject to rapid changes in consumer preferences, technology, and market trends. Future studies could examine how emerging trends such as plant-based diets, sustainability concerns, and delivery services impact the factors influencing restaurant popularity.

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