Journal of Information Systems Engineering and Management
2025, 10(19s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Enhancing Operational Efficiency in Restaurants through Menu Analytics

[1]Abheek Pramanick, [2]Dr. Sumant Sharma, [3]Dr. Anish Slath
[1]Research Scholar GNA University, Phagwara, Punjab, India Head of Department, IHM Bathinda
E-mail: abheekpramanick@gmail.com
ORCID iD: 0009-0005-2529-4898
[2]Assistant Professor School of Hospitality GNA University, Phagwara
E-mail: sumant.sharma1@gmail.com
[3]Assistant Professor University Institute of Hotel and Tourism Management Panjab University, Chandigarh
E-mail: anishslath05@gmail.com

ARTICLE INFO

Received: 22 Dec 2024

Revised: 28 Jan 2025

Accepted: 12 Feb 2025

ABSTRACT

The restaurant industry has seen momentous growth and advancement in recent years. This study explores the relationship between menu analysis and operational efficiency across various categories of dining establishments. This research aims to present a comprehensive understanding of the ways in which systematic menu evaluation influences the operational performance of restaurants.

The result of Spearman's rank correlation coefficient is further supported by linear regression analysis, which showed that menu analysis accounts for variance in operational efficiency. The study's implications call attention to the integral role of regular menu analysis in strengthening restaurant operations, providing actionable insights for industry practitioners to attain their objectives. The findings emphasize the importance of integrating menu analysis into strategic planning to accomplish greater operational efficiency and customer loyalty. This research contributes to the conceptual knowledge of menu analysis as an indispensable component of restaurant management and offers constructive recommendations for elevating the productivity of the outlets.

Keywords: Menu Analysis, Operational Efficiency, Restaurant Management

1 INTRODUCTION

The restaurant industry is an important contributor to the global economy, characterized by its constant evolution and rapid growth. The customer base is growing, expanding exponentially with every passing year. Fuelled by urbanisation and changing lifestyles, the restaurant industry is likely to grow at a constant rate of 3% CAGR till 2030 (Grand View Research, 2023). The aggregate food service sector is expected to reach USD 6810.86 billion by 2032, up from USD 4027.61 billion in 2025 (Fortune Business Insights, 2025). Digital advancement in ordering and payment systems is bringing in a revolution in the restaurant business. Old-school food businesses are bowing down to the influx of data management and information technology and the challenges in maintaining margins from food sales. This shift accentuates the need for operational efficiency and customer satisfaction in order to survive in the long term.

1.1 Background of the Study

The highly competitive restaurant industry depends greatly on operational efficiency to sustain profitability along with the delivery of standardized services to its customers (Stamat, 2022). Planning and pricing of menus of the restaurants gain much of the attention as a means of achieving its objectives (Raab et al., 2009). The strategic importance of menu analysis is often overlooked. The resource intensity required in terms of data and time required for such evaluation is a major impediment (Lai et al., 2020). A careful scrutiny of the sale of menu items over a period of time will enable the restaurants to identify high-margin and popular items, cut waste, and optimize

operations (Annaraud, 2007). The study explores the extent to which restaurants embrace menu analysis as a tool to thrive in a dynamic marketplace.

Extensive research has been done in understanding the relationship of the efficiency of restaurants with operational factors like cost control, supply chain management, and customer service (Rodríguez-López et al., 2020). Limited empirical research is available on the correlation of sale data analysis and its contribution to reducing food costs, optimizing manpower, and enhancing overall quality management of the enterprise. Emerging studies underscore the need for concentrated efforts to research the contribution of menu analysis to efficient menu operations (Roy et al., 2022a).

1.2 Research Objectives

The primary objective of the study is to examine the relationship between the focus on menu analysis and the efficiency of restaurant operations. Its aim is to investigate the ways in which regular and methodical restaurant menu evaluations impact different aspects of operational effectiveness. It seeks to offer empirical evidence of the value of menu analysis as a tactical instrument for improving restaurant operations.

This will be achieved by conducting an assessment of the correlation between menu analysis and operational performance indicators. Analysis of the differential impact of menu analysis on restaurant operational efficiency will be also undertaken.

1.3 Research Hypothesis

The research on menu analysis and operational efficiency in restaurants needs a clear hypothesis, which can provide a comprehensive framework for statistical testing. Existing literature indicates that menu analysis is able to identify popular and profitable dishes and suggest phasing out underperforming items. The dependencies between the studied variables are not decisive. Understanding this relationship will allow informed strategic decision-making and optimal resource allocation to enhance overall performance.

Null Hypotheses for the study:

$H0_1$: There is no significant relationship between a restaurant's menu analysis and its menu efficiency.

$H0_2$: There is no significant difference in operational efficiency between restaurants that prioritize menu analysis and those that do not.

The underlying objective of the hypothesis is to test whether there is any appreciable effect of menu analysis on intended operational success. Outcomes of the studies will offer information about the viability of the presumed advantages of menu analysis in the restaurant sector.

1.4 Significance of the Study

The study holds significant importance for various stakeholders within the restaurant industry, academia, and the broader environment of its operation. The insights from the study will contribute to both theoretical knowledge and practical application related to the restaurant industry. It aims to provide restaurant operators with evidence-based strategies to optimize their operations by reducing costs and increasing profitability. It would pave the way for adopting systematic menu analysis to streamline operation and respond effectively to market trends.

Academically, this research adds to the existing body of knowledge on restaurant management. Incorporation of related principles in training curriculum can prepare individuals for successful careers. Restaurants will be better positioned for consistent satisfaction and innovative menu offerings.

2 LITERATURE REVIEW

The literature review synthesizes academic research to explore the relationship between menu analysis and operational efficiency in the restaurant industry.

2.1 Menu Analysis Concepts

The formidable intention of restaurant owners is on the focus on creating new customers and maintaining regular ones, but they often lose customers due to stagnant menus(Park & Jang, 2014). In order to retain customers, they must respond to the variety-seeking behaviour by offering enough options and engaging diners (Hoyer & Ridgway,

1984). Hedonic and social motivations significantly shape the customer variety-seeking behaviour (Kim et al., 2021). Restaurants should strategize to provide a sufficient timing buffer between reintroduction of in-demand items in their menus (Galak et al., 2013). Regular analysis of the menu helps marketers maintain a competitive advantage and foster growth, introducing new items and identifying items which do not substantially contribute to the sale. This translates into better inventory management and financial savings (Tatik Sriwulandari & Ramadhani, 2022). While conventional audits provide general financial information, menu analysis discloses customer-centric data needed for prudent menu development (Fakih et al., 2016).

2.1.1 Concept Inception

Instances of early form menu analysis involved computation of basic food costing and weighing them against sales figures (Taylor & Brown, 2007). Such information was only helpful in gaining a report on the financial status of the outlet, with limited use in menu development. Manual counting of individual items sold was done prior to the introduction of electronic point-of-sale machines (Ramos & Castro, 2017). The Michael Hurst's scoring system worked upon a combined formula of price, volume, and profitability (Allam, 1978). Menu factor analysis identified key variables for forecasting sales. Break-even and subjective techniques were also used to draw conclusions (Doering, 1979a). Time series analysis was applied to determine trend cycles (Fernandes et al., 2021).

Emphasis was also laid on continuous review of menu cost and sales to adapt to market changes (Dyatri Utami Arina Absari, 2023). Scales for calculating food cost percentage, contribution margin and cost volume profit analysis were developed (Pavesic, 1983a). The influence of various non-monetary factors on menu purchases was acknowledged (Lee & Cranage, 2007).

2.1.2 Models on Menu Analysis

Evolution of menu analysis in the restaurant industry got a boost with a shift from rudimentary cost-based models to technology-based data-driven approaches. This allowed the inclusion of varied factors which were earlier neglected to the analysis processes, like, storage cost, transport, etc. The recognition of the deficiencies allowed the development of comprehensive frameworks for capturing the multifaceted nature of the restaurant industry (Kelly et al., 1994). The first matrix based model was developed by Miller, based on sales and food cost (Miller & Pavesic, 1996). Kasavana and Smith's menu engineering model gained popularity and was founded on comparing the contribution margin and sales volume of individual menu items (Kasavana & Smith, 1990). Built on the factors of weighted contribution margin and food cost, Pavesic proposed the cost margin analysis model (Pavesic, 1983b). Lebruto suggested improvement in the menu engineering model by incorporating the labour cost factor into it (Stephen et al., 1995). Hayes and Huffman rebuffed the matrix-based models to propose a data-extensive profit and loss method (Hayes & Huffman, 1985). Break-even analysis allowed the determination of price levels at which menu items could be sold to cover costs over a period of time (Doering, 1979b). Modern methods laid stress on multidimensional, time-based assessment and activity-based costing (*Yang and Chang, 2011*; Ebrahim et al., 2022; Jones & Mifll, 2001; Linassi et al., 2016).

2.1.3 Mechanism for Feedback

Restaurant feedback systems are vital tools for gauging customer acceptance and bringing in improvement in dining experience. Studies have found a direct correlation between customer satisfaction and willingness for repeat visits (Namin, 2017). In-person interaction and comment cards have been traditionally used to gain feedback (Comey & Cummings, 1996). Various factors that influence the guest in making an opinion about the outlet were also identified. Feedback through digital medium like tablets, QR codes, and through social media networks have gained popularity, due to ease of operation (Khan et al., 2023)

2.2 Operational Efficiency in Restaurants

Ascertaining the performance of a restaurant involves a complex framework of multiple parameters that differ from establishment to establishment (Mhlanga, 2018). Beyond the financial metrics of sales and profitability, menus must also be assessed on internal controls and administrative issues (Fang & Hsu, 2012).

2.2.1 Operational Optimization

Thoughtful menu planning serves as the lynchpin of a successful restaurant and extends more than mere dish selection (Mason et al., 2016). A strategically balanced menu spreads out complexity between dishes, helps

streamline kitchen functions, and cultivates efficiency and consistency in food quality. Menu designing supplemented with clear communication and coherent order taking translates into minimizing wait times for consumers (Shimmura et al., 2010). Operational speed is foremost in customer satisfaction, converting into memorable experiences.

2.2.2 Resource Management

Ingredient management is the cornerstone for ensuring cost optimization and profitability. Waste reduction can be achieved by building a menu that shares components across dishes, allows bulk purchasing, and eases inventory control procedures (Dhir et al., 2020). Care should be taken to ensure that multi-application of ingredients does not lead to monotony. Cost-effectiveness can also be promoted through local sourcing of raw materials (Huang & Hall, 2023).

2.2.3 Workforce Management

A well-planned menu not only ensures ingredient availability but also facilitates achieving balanced workload distribution among the staff to prevent overload (Ismail et al., 2020). It prevents kitchen overflow and maintains a consistent flow of ordered food. Creating separate kitchen sections for different product lines will lead to faster preparation of high-quality dishes (Szende, 2017).

2.2.4 Customer Satisfaction

In the fast-paced restaurant landscape, menus should be crafted with the aim to meet customer service time expectations. By capitalizing on data analytics and improving functional issues, restaurants can enhance the overall dining experience. Rapid integration of customer feedback and responding to them promptly exhibit a customer-centric approach (Kyriakidis & Tsafarakis, 2025).

2.2.5 Profitability and Competitive Advantage

Bringing a restaurant menu to profit demands a focus on high-margin dishes and implementing astute selling techniques (Ivanenko et al., 2022). Operational simplicity and the application of yield management methods bolster fiscal discipline (Modica, 2009). Maintaining a balance between expenditures required for distinctive identity and financial gains is required for long-term restaurant business.

2.2.6 Technology Integration

Technology has the power to revolutionize restaurant operation and attain positive customer experience (Cavusoglu, 2019). Adoption of developments in the field of menu ordering and payment systems is extremely necessary. High-end restaurants are using augmented reality and hologram menus to gain attention of customers (Batat, 2021). However, high initial investment and lack of trained manpower are formidable barriers to widespread endorsement of technological innovation.

2.3 Interconnection between Menu Analysis and Operational Efficiency

Transformation of raw sales data through menu analysis, enable restaurant operators to make well-informed decisions. Evaluation of the desirability of menu items, ingredient cost, and diner preferences provided actionable information. Deduction from such insights allows for pinpointed adjustment in the business cycle of the restaurant. A deep understanding of customer preference through meticulous menu analysis fosters customer satisfaction and loyalty (Mohammad Haghighi, 2012). The ultimate aim of data-driven analysis is to ensure the contribution of all the menu items in a streamlined functioning for the overall success of the restaurant's business (Roy et al., 2022b).

3 RESEARCH METHODOLOGY

3.1 Research Design

The thorough investigation of the relationship between menu analysis and operational efficiency in restaurants is achieved by employing a primary data based quantitative research approach. It enables an examination of numerical data facilitating the statistical evaluation and recognition of patterns and association between variables.

3.2 Population and Sample Selection

The diverse culinary landscape of Punjab, India, with a wide spectrum of eateries, was chosen for the study. The food service scenario of Punjab ranges from high-end fine dining restaurants to street stalls and dhabas, which cater to the masses (Kumar & Kumar, 2025). Statistics derived from such varied categories of restaurant models and customer bases will allow a better understanding of the objectives of the study

By collecting numerical data from **425 responses** to structured questionnaires, we can quantify the extent to which menu analysis correlates with operational efficiency indicators like table turnover rates, customer satisfaction scores, and profit margins.

A stratified random sampling method was utilized to ensure representation from each restaurant sub-group (Iliyasu & Etikan, 2021). By segmenting the restaurants into distinct groups based on restaurant type, like fine-dining restaurants, mid-range restaurants, hotel-based restaurants, and small eateries, we improved the precision of our findings and enabled insightful cross-category comparisons. This strengthened the overall validity and reduced sampling bias. .

3.3 Data Collection Methods

The independent variable for the study focused on the extent of menu analysis conducted by restaurants to evaluate and modify their menus. The dependent variable delved into the parameters for measuring the overall effectiveness and smoothness of a restaurant operation. 5-point Likert scale was chosen to measure perceptions and attitudes related to the independent variable (menu analysis) and the dependent variable (operational efficiency).

The questionnaire was scrupulously designed to probe into important aspects of menu analysis and operational efficiency. The literature review related to restaurant management paved the way to identify the key constructs and variables needed to be included in the questionnaire. It encompassed questions on menu analysis strategies, assessment of historical sales data, item-wise contribution to profitability, use of menu analysis matrices, tools used for reviewing menu, and mechanisms for handling customer feedback. Simultaneously, it assessed restaurant operational metrics such as kitchen productivity, utilization of ingredients, distribution of manpower, inventory management, service speed, table turnover rates, and integration of customer preferences.

Experts in the field reviewed the questionnaire prior to the conduct of pilot testing with restaurant managers to identify any contradiction. Internal consistency was assessed using Cronbach's alpha, indicating cohesiveness within the intended constructs (Peterson, 1994).

Questionnaires were distributed to restaurant owners, managers, chefs, and staff members who are closely involved in menu planning and daily operations. The substantial number of responses ensured a reliable dataset that captures the nuances of different restaurant types within the region.

3.4 Data Analysis Techniques

Spearman's correlation coefficient and regression analysis were conducted to test the hypotheses and determine the predictive impact of menu analysis practices on the operational outcomes of any restaurant (De Winter et al., 2016). The data management and analytical tool of the Statistical Package for the Social Sciences (SPSS) was used to perform statistical tests and gain insights into the research questions.

4 RESULTS

4.1 Study Sample

The study was conducted using a sample of 425 responses taken from restaurants. The sample aimed to adequately represent the diversity of the restaurant industry by incorporating outlets from different levels. These comprised of 144 units from fine dining, 137 units from small eateries, 129 units from mid-range restaurants, and 15 restaurants located within hotels. This comprehensive approach makes sure that the result would be representative of the general population and capture the subtleties and viewpoints of various kinds of dining establishments. Combining data from a diverse range of eateries offers an inclusive understanding of the relationship between menu analysis and operational efficiency.

Table 1 Distribution of respondent restaurants

Restaurants	Number of Responses
Restaurants in a Hotel	15
Fine Dining Restaurant	144
QSR / Mid-range Restaurants	129
Small eateries	137

The summary of the frequency with which restaurants conduct menu analysis indicates the level of awareness about its role in enhancing the outcome of a dining establishment. A small proportion of 12.4% of restaurants never conducted menu analysis, indicating a lack of awareness of this practice. 27.9% of units likely reviewed their menu as part of their annual strategic planning. The largest proportion of 46%, finds value in reviewing their menu semi-annually. Out of the restaurants, 11.7% analysed their menu quarterly, 1.2% weekly, and 0.7% daily. This distribution helps in obtaining insights into the practices of menu analysis in their establishments.

Table 2 Frequency of menu analysis done by restaurants

Menu Analysis	Frequency	Percent
Never	53	12.4
Yearly	119	27.9
Half-Yearly	195	46.0
Quarterly	50	11.7
Weekly	5	1.2
Daily	3	0.7
Total	425	100.0

4.2 Reliability Analysis

The coefficient of internal consistency to evaluate the reliability of survey instruments is measured using the Cronbach's Alpha (Adam Bujang et al., 2018). Higher Alpha values denote greater inter-item correlation and, hence, greater reliability. The Alpha values range from 0 to 1, with values closer to 1 indicating the robustness of the instrument construct and items closer to 0 indicating lower internal consistency (Tavakol & Dennick, 2011).

A Cronbach's Alpha value of 0.974 indicates excellent internal consistency for the 12 items measuring menu analysis. The value of 0.973 for 10 items measuring menu efficiency shows excellent internal consistency. The observed high Cronbach's Alpha values provide strong evidence of the internal consistency and reliability of the measurement instrument used in the study for menu analysis and operational efficiency.

Table 3 Cronbach's Alpha results for Sample Study Data

S. No.	Variables	No. of Items	Cronbach's Alpha
1.	Menu Analysis	12	0.974
2.	Operational Efficiency	10	0.973

4.3 Hypothesis Testing

The study on restaurant performance suggests the use of non-parametric tests for further analysis, as the p-values of Kolmogorov-Smirnov and Shapiro-Wilk tests were 0.000 that are significantly lower than the threshold value of 0.05.

4.3.1 $H0_1$: There is no significant relationship between a restaurant's menu analysis and its menu efficiency.

Spearman's rank correlation coefficient

Spearman's rank correlation coefficient (rho) is employed to assess the monotonic association between the means of variables of menu analysis and operational efficiency in restaurants from the collected data (Puth et al., 2015). Given the nature of the collected data, which consisted of ordinal and non-normally distributed continuous variables, Spearman's rho was the most appropriate as it has the potential to provide a robust measure of strength and direction of association for evaluation. Spearman's rho values range from -1 to 1, where 0 indicates no correlation. A value near 1 suggests a strong positive correlation. Values approaching -1 indicate a strong inverse correlation (Pirie, 2005).

The correlation coefficient between Menu Analysis Mean and Menu Efficiency Mean is 0.790. This value reveals a strong positive correlation between the two variables under consideration. A correlation coefficient close to 1 signifies that as the Independent variable increases, the dependent variable tends to increase proportionally. It implies that there is a strong positive relationship between the degree of focus on menu analysis and the efficacy of restaurant operations.

The p-value (Sig.2-tailed) is 0.000, which is less than the common correlation significance level of 0.01 (Cumming, 2009). This confirms that the correlation is significant, making it highly improbable that the relationship occurred by chance. Based on the above findings, we reject the null hypothesis ($H0_1$).

Table 4 Spearman's correlation between Menu Analysis and Operational Efficiency

			Menu Analysis Mean	Menu Efficiency Mean
Spearman's rho	Menu Analysis Mean	Correlation Coefficient	1.000	.790**
		Sig. (2-tailed)	.	.000
		N	425	425
	Operational Efficiency Mean	Correlation Coefficient	.790**	1.000
		Sig. (2-tailed)	.000	.
		N	425	425

**. Correlation is significant at the 0.01 level (2-tailed).

4.3.2 $H0_2$: There is no significant difference in operational efficiency between restaurants that prioritize menu analysis and those that do not.

Linear Regression test for Menu Analysis and Operational Efficiency

Linear regression is a statistical tool that helps us understand and explore the manner in which a change of one or more independent variables predicts its influence on the dependent variable (Mao, 2022). In the present study, it allows to quantify the relationship between menu analysis (independent variable) and operational efficiency (dependent variable). It helps in the understanding of whether prioritizing menu analysis positively or negatively affects operational efficiency.

The scatter plot graph exhibits that there is a direct relationship between menu analysis and the operational efficiency of restaurants. Data points are trending upwards from left to right, suggesting a positive relationship, which means that higher menu analysis scores are associated with higher operational efficiency (Nugroho et al., 2024). The slope of the line of best fit also indicates a positive proportional relationship between the variables.

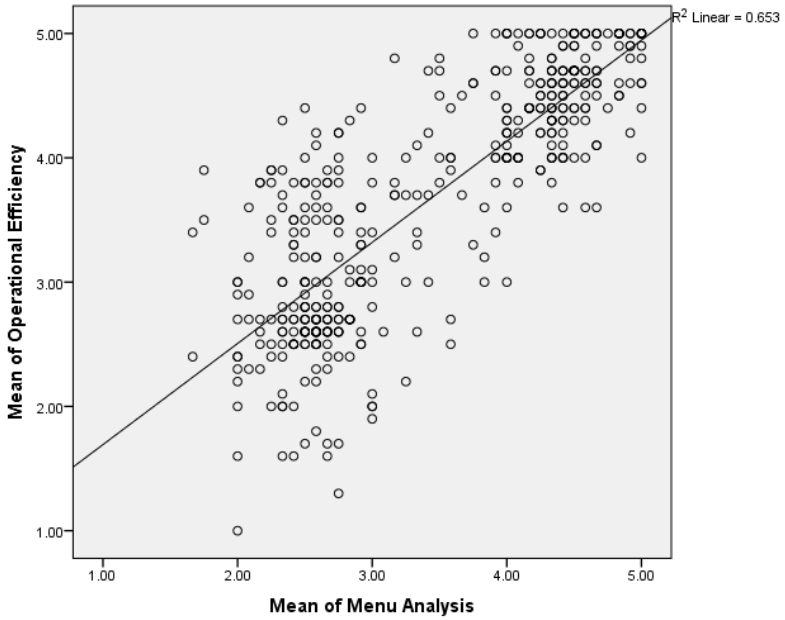

Figure 1 Scatter plot of Linear Regression test for Menu Analysis and Operational Efficiency

Correlation coefficient, R, measures the strength and direction of the linear relationship between the independent variable menu analysis and the independent variable operational efficiency (Senthilnathan, 2019). The value of R ranges from -1 to +1, where a +1 value indicates a perfect positive linear relationship and -1 value signifies perfect negative linear relationship. 0 indicates the absence of any linear relationship. An R value of 0.808 indicates a strong positive relationship.

The coefficient of determination R^2 represents the fraction of the variance in the dependent variable of operational efficiency that is expected from the independent variable menu analysis (Nakagawa et al., 2017). In the absence of any artificial causation and significant multicollinearity among the studied variables, an R-square range between 0.50 to 0.99 is acceptable in social science researches (Ozili, 2023). The result of the regression model shows high explanatory power with menu analysis accounting for 65.2% (R Square of 0.652) of the variance in operational efficiency. The fact that the Adjusted R^2 matches the R^2 lends credibility to the model's ability to explicate the variance. The standard error of estimate (SEE) value of 0.56072 points to a potentially reasonable fit of the model to the data (McAuliffe, 2015). The regression model indicated that performing menu analysis is a significant predictor of the operational efficiency in restaurants.

Table 5 Regression Model Summary for Menu Analysis and Operational Efficiency

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.808[a]	.652	.652	.56072

a. Predictors: (Constant), Menu Analysis Mean

b. Dependent Variable: Operational Efficiency Mean

ANOVA test for Menu Analysis and Operational Efficiency

The statistical significance between menu analysis and operational efficiency can be measured through an ANOVA test (Kozak & Piepho, 2018).

The F-statistic test evaluates the overall regression model to judge the fitness of the data (Sureiman & Mangera, 2020). The F-statistic is calculated by dividing the Regression Mean Square by the Residual Mean Square (249.585 / 0.314). The high F-statistic of 793.815 confirms that the model possesses substantial explanatory power.

The p-value represents the likelihood of getting observed outcome with the assumption that the null hypothesis is valid (Marsman & Wagenmakers, 2017). The validity of assumptions increases if the p-value is close to 1, and the null hypothesis tends to become invalid with the p-value getting closer to 0. In the current study of menu analysis and operational efficiency, the p-value is 0.000, indicating strong evidence against the null hypothesis.

Table 6 ANOVA test results for Menu Analysis and Operational Efficiency

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	249.585	1	249.585	793.815	.000[b]
	Residual	132.996	423	.314		
	Total	382.581	424			

a. Dependent Variable: Menu Efficiency Mean

b. Predictors: (Constant), Operational Analysis Mean

Regression Analysis for Menu Analysis and Operational Efficiency

A regression equation, serving as a regression model, was built to reveal the relationship between menu analysis and operational efficiency.

The standardised coefficients analysis from a regression analysis in the processed database has a mean of zero and a standard deviation of one, obtained through z-score conversion (Dick et al., 2020). The beta coefficients of linear regression range from -1 to +1. A beta value of 0.808 suggests a formidable relationship between the two variables: menu analysis and operation efficiency.

The significance of individual regression coefficients can be determined by the value of t-statistics (Aslam, 2024). The study has an intercept of 8.253 and a menu analysis mean of 28.175. High absolute values show that the intercepts are significantly different from zero, supporting the impact of menu analysis on operational efficiency. The p-value of 0.000 for the intercepts shows high significance, as it is much lower than the accepted 0.05 threshold.

The tolerance measure and variance inflation factor (VIF) measure the proportion of divergence in the independent variables and the quantum of variance of the regression coefficient due to any multicollinearity, respectively (Miles, 2005). The two values of 1 in collinearity statistics indicated the absence of multicollinearity.

Table 7 Regression Analysis results for Menu Analysis and Operational Efficiency

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.854	.104		8.253	.000		
	Menu Analysis Mean	.819	.029	.808	28.175	.000	1.000	1.000

a. Dependent Variable: Operational Efficiency Mean

In simple linear regression, the collinearity diagnostics table demonstrates a very weak form of collinearity with "menu analysis mean" establishing over "operational efficiency mean". The condition index 1.000 and 7.478 is much below the threshold of 15 and are modest despite large differences between Eigenvalues (1.965 and 0.035), suggesting that multicollinearity is not a major issue. The observed weak collinearity is likely attributable to the scaling of the predictor variable (Bobrowski, 2018).

In accordance with the results of the scatter plot, regression model summary, ANOVA test, and regression analysis, we reject the null hypothesis $H0_2$. It indicates that menu analysis significantly boosts the operational efficiency of a restaurant.

Table 8 Collinearity Diagnostics Table

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions	
				(Constant)	Menu Analysis Mean
1	1	1.965	1.000	.02	.02
	2	.035	7.478	.98	.98

a. Dependent Variable: Menu Efficiency Mean

5 DISCUSSION

5.1 Interpretation of Findings

The outcomes of the current study draw attention to the importance of menu analysis in improving operational effectiveness across diverse categories of restaurants. Efforts have been made to make the sample representative of the restaurant business by incorporating data from a wide range of 425 respondents, encompassing fine dining, mid-range restaurants, small eateries, and hotel-based dining venues. The frequency of menu analysis reveals varying levels of awareness and adoption in the majority of restaurants, either annually or semi-annually.

The values of Spearman's correlation coefficient put forward a strong positive relationship between menu analysis and operational efficiency, accentuating the importance of systematic menu appraisals in driving operational success.

The linear regression analysis establishes the strong positive correlation between menu analysis and operational efficiency, expounding 65.2% of the variance. The model's exploratory power is confirmed by a high F-statistic and p-value of 0.000, rejecting the null hypothesis. The absence of multicollinearity enhances the integrity of the findings.

5.2 Theoretical Implications

The research lays stress on the dynamic nature of menu analysis. The theoretical approaches related to restaurant management must incorporate the concepts of persistent adaptation and customer response cycles. The importance of data management of sales and expenditure records on food items needs to be highlighted. The integration of predictive analysis and AI with the financials of restaurants could be explored. Training modules for restaurant staff to identify critical areas for modification and changing market trends should be developed.

5.3 Practical Implications

Prioritizing menu analysis has significant implications for restaurant management. Operators should regularly analyze the popularity and sales contributions of menu items to allow for informed decisions (Senkey & Flavina Osin, 2023). Data management of sales records and customer feedback will help in purpose-built menus to meet demand and increase profitability (Fernandes et al., 2021b). The study suggests that a higher frequency of analysis can lead to greater efficiencies by allowing responding quickly to changing market preferences and market trends. It brings about a holistic improvement in the processes and supervision of the outlets. Involvement of staff in the analysis process provides valuable insights, improves the quality of data, and fosters a culture of continuous improvement. Investment in technology in the form of POS systems and software will provide real-time menu analytics. The use of data analytics and artificial intelligence can bring improvement in various operational areas of a restaurant (Gomiashvili, 2024).

5.4 Limitations

The study was conducted within a specific geographic set-up, the findings of which may not be generalized to restaurants of other regions, as operational environment will vary widely different regions. The menus of different restaurants itself are diverse and face varied challenges and opportunities. Self-reported data by managers or owners can introduce bias, where they might overstate positive actions and trivialise negative ones. Inclusion of greater number of metrics of both the variables studied over a longer time period could have provided deeper causal inferences between menu analysis and operational efficiency

5.5 Recommendations for Future Research

Future research can investigate the magnitude of specific elements of menu analysis that contribute most to attain efficiency in restaurant operations. Prolonged studies will be able to examine the long-term impact of continuous menu analysis on restaurant performance. Study could be undertaken to identify the barriers that prevented a sizeable percentage of restaurants from performing any menu analysis. The effects of different analysis techniques on restaurant performance can be analysed.

6 CONCLUSION

The findings of the research offer compelling indications that menu analysis plays an essential role in determining operational efficiency in the restaurant industry. The study on a wide range of establishments and the use of robust analytical methods lends credence to the conclusion that the extent of priority given to menu analysis will proportionately enhance a restaurant's success. In a highly contentious market, getting or creating a competitive advantage for the restaurant is only possible by faster adaptation to industry changes and meeting the dynamic customer demands.

Menu analytics offers comprehensive information about customers and restaurant operations. It has emerged as a vital tool in restaurant operations. Innovative processes using data envelopment and customer-driven menu analysis have contended to achieve improved outcomes compared to traditional methods (Fang & Hsu, 2014; Nemeschansky et al., 2020). Many functional decision-making aspects of an outlet, like forecasting and sales generation, can be facilitated by embracing current new-age technologies (Roy et al., 2022a). Efficient data management and analytical tools will enable restaurants to attain their objectives. Menu analysis must be incorporated into the strategic planning of a restaurant's business model. Such proactive foresight supports a long-term vision and sustainability for a restaurant.

REFERENCES

[1] Adam Bujang, M., Diana Omar, E., & Baharum, N. A. (2018). A Review on Sample Size Determination for Cronbach's Alpha Test: A Simple Guide for Researchers—PMC. 25(6), 85–99. https://doi.org/doi: 10.21315/mjms2018.25.6.9

[2] Allam, Y. H. (1978). Food and beverage management. FIU Digital Commons.

[3] Annaraud, K. (2007). Restaurant Menu Analysis: Can We Go Further? Journal of Foodservice Business Research, 10(4), 25–37. https://doi.org/10.1300/J369v10n04_03

[4] Aslam, M. (2024). The t-test of a regression coefficient for imprecise data. Hacettepe Journal of Mathematics and Statistics, 53(4), 1130–1140. https://doi.org/10.15672/hujms.1342344

[5] Batat, W. (2021). How augmented reality (AR) is transforming the restaurant sector: Investigating the impact of "Le Petit Chef" on customers' dining experiences. Technological Forecasting and Social Change, 172, 121013. https://doi.org/10.1016/j.techfore.2021.121013

[6] Binomial Real Option Pricing for Restaurant Menu Analysis—Chih-Yun Yang, Te-Yi Chang, 2011. (n.d.). Retrieved February 25, 2025, from https://journals.sagepub.com/doi/abs/10.1177/1938965511410054?journalCode=cqxb

[7] Bobrowski, L. (2018). Collinearity Models in the Eigenvalue Problem. In N. T. Nguyen, D. H. Hoang, T.-P. Hong, H. Pham, & B. Trawiński (Eds.), Intelligent Information and Database Systems (pp. 402–409). Springer International Publishing. https://doi.org/10.1007/978-3-319-75417-8_38

[8] Cavusoglu, M. (2019). An analysis of technology applications in the restaurant industry. Journal of Hospitality and Tourism Technology, 10(1), 45–72. https://doi.org/10.1108/JHTT-12-2017-0141

[9] Comey, W. J., & Cummings, W. T. (1996). Quality Feedback from Patrons in the Fast Food Industry. Journal of Restaurant & Foodservice Marketing, 1(3–4), 73–84. https://doi.org/10.1300/J061v01n03_05

[10] Cumming, G. (2009). Inference by eye: Reading the overlap of independent confidence intervals. Statistics in Medicine, 28(2), 205–220. https://doi.org/10.1002/sim.3471

[11] De Winter, J. C. F., Gosling, S. D., & Potter, J. (2016). Comparing the Pearson and Spearman correlation coefficients across distributions and sample sizes: A tutorial using simulations and empirical data. Psychological Methods, 21(3), 273–290. https://doi.org/10.1037/met0000079

[12] Dhir, A., Talwar, S., Kaur, P., & Malibari, A. (2020). Food waste in hospitality and food services: A systematic literature review and framework development approach. Journal of Cleaner Production, 270, 122861. https://doi.org/10.1016/j.jclepro.2020.122861
[13] Dick, G., Owen, C. A., & Whigham, P. A. (2020). Feature standardisation and coefficient optimisation for effective symbolic regression. Proceedings of the 2020 Genetic and Evolutionary Computation Conference, 306–314. https://doi.org/10.1145/3377930.3390237
[14] Doering, R. D. (1979a). Break-Even Analysis for Restaurant Decision Making. Cornell Hotel and Restaurant Administration Quarterly, 19(4), 7–9. https://doi.org/10.1177/001088047901900404
[15] Doering, R. D. (1979b). Break-Even Analysis for Restaurant Decision Making. Cornell Hotel and Restaurant Administration Quarterly, 19(4), 7–9. https://doi.org/10.1177/001088047901900404
[16] Dyatri Utami Arina Absari. (2023). Analysis Of The Application Of Food Cost Control With Cost Volume Profit Analysis To Optimize The Profit Of Ocean Garden Restaurant. International Journal of Economic Research and Financial Accounting (IJERFA), 1(3). https://doi.org/10.55227/ijerfa.v1i3.36
[17] Ebrahim, K., Gad El Rab, M., & Mauof, M. (2022). The Adoption of Menu Engineering as an Electronic Management System in Cairo Five-Star Hotels. International Journal of Heritage, Tourism and Hospitality, 16(1), 74–82. https://doi.org/10.21608/ijhth.2022.287579
[18] Fakih, K., Assaker, G., Assaf, A. G., & Hallak, R. (2016). Does restaurant menu information affect customer attitudes and behavioral intentions? A cross-segment empirical analysis using PLS-SEM. International Journal of Hospitality Management, 57, 71–83. https://doi.org/10.1016/j.ijhm.2016.06.002
[19] Fang, C.-Y., & Hsu, F.-S. (2012). Meal Category Analysis: An Application of the Metafrontier Approach. Tourism Economics, 18(5), 1083–1095. https://doi.org/10.5367/te.2012.0166
[20] Fang, C.-Y., & Hsu, F.-S. (2014). An Efficiency-Based Metafrontier Approach To Menu Analysis. Journal of Hospitality & Tourism Research, 38(2), 199–221. https://doi.org/10.1177/1096348012451461
[21] Fernandes, E., Moro, S., Cortez, P., Batista, F., & Ribeiro, R. (2021a). A data-driven approach to measure restaurant performance by combining online reviews with historical sales data. International Journal of Hospitality Management, 94, 102830. https://doi.org/10.1016/j.ijhm.2020.102830
[22] Fernandes, E., Moro, S., Cortez, P., Batista, F., & Ribeiro, R. (2021b). A data-driven approach to measure restaurant performance by combining online reviews with historical sales data. International Journal of Hospitality Management, 94, 102830. https://doi.org/10.1016/j.ijhm.2020.102830
[23] Fortune Business Insights. (2025). Food Service Market Size, Share, Growth | Report [2025-2032]. Fortune Business Insights. https://www.fortunebusinessinsights.com/food-service-market-106277
[24] Galak, J., Kruger, J., & Loewenstein, G. (2013). Slow Down! Insensitivity to Rate of Consumption Leads to Avoidable Satiation. Journal of Consumer Research, 39(5), 993–1009. https://doi.org/10.1086/666597
[25] Gomiashvili, T. (2024). Gastronomic optimization: Scientific approaches to enhancing restaurant performance. International Journal of Science and Research Archive, 13(1), 2413–2418. https://doi.org/10.30574/ijsra.2024.13.1.1632
[26] Grand View Research. (2023). Foodservice Market Size, Share And Trends Report, 2030. Grand View Research. https://www.grandviewresearch.com/industry-analysis/foodservice-market-report
[27] Hayes, D. K., & Huffman, L. (1985). Menu Analysis: A Better Way. Cornell Hotel and Restaurant Administration Quarterly, 25(4), 64–70. https://doi.org/10.1177/001088048502500412
[28] Hoyer, W. D., & Ridgway, N. M. (1984). Variety Seeking As an Explanation For Exploratory Purchase Behavior: A Theoretical Model. ACR North American Advances. https://www.semanticscholar.org/paper/Variety-Seeking-As-an-Explanation-For-Exploratory-a-Hoyer-Ridgway/3ed40cdc99f46d298c5bf5e75c19fcf8554bf988
[29] Huang, Y., & Hall, C. M. (2023). Locality in the Promoted Sustainability Practices of Michelin-Starred Restaurants. Sustainability, 15(4), 3672. https://doi.org/10.3390/su15043672
[30] Iliyasu, R., & Etikan, I. (2021). Comparison of quota sampling and stratified random sampling. Biometrics & Biostatistics International Journal, 10(1), 24–27. https://doi.org/10.15406/bbij.2021.10.00326
[31] Ismail, F. H., Osman, S., & Rahman, F. B. A. (2020). Ergonomics Kitchen: A Better Place to Work. International Journal of Academic Research in Business and Social Sciences, 11(13), Pages 43-53. https://doi.org/10.6007/IJARBSS/v11-i13/8501
[32] Ivanenko, V. O., Kaschuck, K. M., Zhytomyr Ivan Franko State University, Botsian, T. V., Zhytomyr Ivan Franko State University, Klimova, I. O., & Zhytomyr Ivan Franko State University. (2022). Menu Analysis as

an Effective Marketing Tool for Increasing the Restaurant Establishments' Profitability. Business Inform, 12(539), 258–263. https://doi.org/10.32983/2222-4459-2022-12-258-263

[33] Jones, P., & Mifll, M. (2001). Menu Development and Analysis in UK Restaurant Chains. Tourism and Hospitality Research, 3(1), 61–71. https://doi.org/10.1177/146735840100300105

[34] Kasavana, M. L., & Smith, D. I. (1990). Menu Engineering: A Practical Guide to Menu Analysis. Hospitality Pub.

[35] Kelly, T. J., Kiefer, N. M., & Burdett, K. (1994). A Demand-Based Approach to Menu Pricing: If menu prices can be increased slightly without reducing sales, restaurant owners can enjoy higher profits. This pilot study indicates that prices can, indeed, be raised. Cornell Hotel and Restaurant Administration Quarterly, 35(1), 48–52. https://doi.org/10.1177/001088049403500106

[36] Khan, F. M., Khan, S. A., Shamim, K., Gupta, Y., & Sherwani, S. I. (2023). Analysing customers' reviews and ratings for online food deliveries: A text mining approach. International Journal of Consumer Studies, 47(3), 953–976. https://doi.org/10.1111/ijcs.12877

[37] Kim, Y. H., Sauerwald, P., & Sukpatch, K. (2021). Are you looking for special menu? An examination of variety seeking behavior for Promotional Menu (VaPM) Model. International Journal of Gastronomy and Food Science, 23, 100295. https://doi.org/10.1016/j.ijgfs.2020.100295

[38] Kozak, M., & Piepho, H.-P. (2018). What's normal anyway? Residual plots are more telling than significance tests when checking ANOVA assumptions. Journal of Agronomy and Crop Science, 204(1), 86–98. https://doi.org/10.1111/jac.12220

[39] Kumar, V., & Kumar, S. (2025). A Study on Punjabi Cuisine and Its Role in Tourism Development. OSR Journal of Business and Management, 19(5), 1–5. https://doi.org/10.9790/487X-1905020105

[40] Kyriakidis, A., & Tsafarakis, S. (2025). Extracting knowledge from customer reviews: An integrated framework for digital platform analytics. International Transactions in Operational Research, 32(4), 2061–2086. https://doi.org/10.1111/itor.13537

[41] Lai, H. B. J., Karim, S., Krauss, S. E., & Ishak, F. A. C. (2020). A review of approaches to manage menu profitability. International Journal of Revenue Management, 11(3), 151. https://doi.org/10.1504/IJRM.2020.109415

[42] Lee, S. J., & Cranage, D. A. (2007). The Relative Importance of Menu Attributes at Point of Menu Selection Through Conjoint Analysis: Focused on Adolescents. Journal of Foodservice Business Research, 10(2), 3–18. https://doi.org/10.1300/J369v10n02_02

[43] Linassi, R., Alberton, A., & Marinho, S. V. (2016). Menu engineering and activity-based costing: An improved method of menu planning. International Journal of Contemporary Hospitality Management, 28(7), 1417–1440. https://doi.org/10.1108/IJCHM-09-2014-0438

[44] Mao, S. (2022). Statistical derivation of linear regression. 12163, 121633F. International Conference on Statistics, Applied Mathematics, and Computing Science (CSAMCS 2021). https://doi.org/10.1117/12.2628017

[45] Marsman, M., & Wagenmakers, E.-J. (2017). Three Insights from a Bayesian Interpretation of the One-Sided P Value. Educational and Psychological Measurement, 77(3), 529–539. https://doi.org/10.1177/0013164416669201

[46] Mason, K., Jones, S., Benefield, M., & Walton, J. (2016). Building consumer relationships in the quick service restaurant industry. Journal of Foodservice Business Research, 19(4), 368–381. https://doi.org/10.1080/15378020.2016.1181508

[47] McAuliffe, R. E. (2015). Standard Error of the Coefficient (C. L. Cooper, Ed.; 1st ed.). Wiley. https://doi.org/10.1002/9781118785317.weom080202

[48] Mhlanga, O. (2018). Factors impacting restaurant efficiency: A data envelopment analysis. Tourism Review, 73(1), 82–93. https://doi.org/10.1108/TR-07-2017-0109

[49] Miles, J. (2005). Tolerance and Variance Inflation Factor. In Encyclopedia of Statistics in Behavioral Science. John Wiley & Sons, Ltd. https://doi.org/10.1002/0470013192.bsa683

[50] Miller, J. E., & Pavesic, D. V. (1996). Menu: Pricing and Strategy, 4th Edition | Wiley (4th ed.). https://www.wiley.com/en-us/Menu%3A+Pricing+and+Strategy%2C+4th+Edition-p-9780471287476

[51] Modica, P. (2009). Il management dei rendimenti nelle imprese della ristorazione. Economia Aziendale Online, 1(4). https://doi.org/10.4485/ea2038-5498.139-147

[52] Mohammad Haghighi. (2012). Evaluation of factors affecting customer loyalty in the restaurant industry. AFRICAN JOURNAL OF BUSINESS MANAGEMENT, 6(14). https://doi.org/10.5897/AJBM11.2765

[53] Nakagawa, S., Johnson, P. C. D., & Schielzeth, H. (2017). The coefficient of determination R2 and intra-class correlation coefficient from generalized linear mixed-effects models revisited and expanded. Journal of The Royal Society Interface, 14(134), 20170213. https://doi.org/10.1098/rsif.2017.0213

[54] Namin, A. (2017). Revisiting customers' perception of service quality in fast food restaurants. Journal of Retailing and Consumer Services, 34, 70–81. https://doi.org/10.1016/j.jretconser.2016.09.008

[55] Nemeschansky, B., von der Heidt, T., & Kim, P. B. (2020). Customer-driven menu analysis (CDMA): Capturing customer voice in menu management. International Journal of Hospitality Management, 91, 102417. https://doi.org/10.1016/j.ijhm.2019.102417

[56] Nugroho, H. S. W., Polnok, S., Auta, T. T., & Dalle, A. (2024). What is a Good Way to Visualize the Positive Correlation between Two Numerical Variables? | Request PDF. Aloha International Journal of Multidisciplinary Advancement (AIJMU), 3(2). https://doi.org/10.33846/aijmu30201

[57] Ozili, P. K. (2023). The acceptable R-square in empirical modelling for social science research. Social Research Methodology and Publishing Results. https://mpra.ub.uni-muenchen.de/115769/

[58] Park, J.-Y., & Jang, S. (Shawn). (2014). Revisit and satiation patterns: Are your restaurant customers satiated? International Journal of Hospitality Management, 38, 20–29. https://doi.org/10.1016/j.ijhm.2013.12.006

[59] Pavesic, D. V. (1983a). Cost/margin analysis: A third approach to menu pricing and design. International Journal of Hospitality Management, 2(3), 127–134. https://doi.org/10.1016/0278-4319(83)90033-6

[60] Pavesic, D. V. (1983b). Cost/margin analysis: A third approach to menu pricing and design. International Journal of Hospitality Management, 2(3), 127–134. https://doi.org/10.1016/0278-4319(83)90033-6

[61] Peterson, R. A. (1994). A Meta-Analysis of Cronbach's Coefficient Alpha. Journal of Consumer Research, 21(2), 381. https://doi.org/10.1086/209405

[62] Pirie, W. (2005). Spearman Rank Correlation Coefficient (S. Kotz, C. B. Read, N. Balakrishnan, & B. Vidakovic, Eds.; 2nd ed.). Wiley. https://doi.org/10.1002/0471667196.ess2499.pub2

[63] Puth, M.-T., Neuhäuser, M., & Ruxton, G. D. (2015). Effective use of Spearman's and Kendall's correlation coefficients for association between two measured traits. Animal Behaviour, 102, 77–84. https://doi.org/10.1016/j.anbehav.2015.01.010

[64] Raab, C., Mayer, K., Kim, Y.-S., & Shoemaker, S. (2009). Price-Sensitivity Measurement: A Tool for Restaurant Menu Pricing. Journal of Hospitality & Tourism Research, 33(1), 93–105. https://doi.org/10.1177/1096348008329659

[65] Ramos, Y., & Castro, Á. (2017, February 20). Point-Of-Sales Systems in Food and Beverage Industry: Efficient Technology and Its User Acceptance. https://www.semanticscholar.org/paper/Point-Of-Sales-Systems-in-Food-and-Beverage-and-Its-Ramos-Castro/99b9c54c4abec530008bbc05ac124860d07f09b6?utm_source=consensus

[66] Rodríguez-López, M. E., Alcántara-Pilar, J. M., Del Barrio-García, S., & Muñoz-Leiva, F. (2020). A review of restaurant research in the last two decades: A bibliometric analysis. International Journal of Hospitality Management, 87, 102387. https://doi.org/10.1016/j.ijhm.2019.102387

[67] Roy, D., Spiliotopoulou, E., & De Vries, J. (2022a). Restaurant analytics: Emerging practice and research opportunities. Production and Operations Management, 31(10), 3687–3709. https://doi.org/10.1111/poms.13809

[68] Roy, D., Spiliotopoulou, E., & De Vries, J. (2022b). Restaurant analytics: Emerging practice and research opportunities. Production and Operations Management, 31(10), 3687–3709. https://doi.org/10.1111/poms.13809

[69] Senkey, F., & Flavina Osin, R. (2023). Analysis of the Menus' Factors that are Influential in Determining the Marketing Mix: An Empirical Study on Mawar Saron Restaurant in Puri Saron Hotel Seminyak—Bali | Jurnal Manajemen Pelayanan Hotel. 7(1), 260–276. https://doi.org/dx.doi.org/10.37484/jmph.070113

[70] Senthilnathan, S. (2019). Usefulness of Correlation Analysis. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3416918

[71] Shimmura, T., Takenaka, T., & Akamatsu, M. (2010). Improvement of Restaurant Operation by Sharing Order and Customer Information: International Journal of Organizational and Collective Intelligence, 1(3), 54–70. https://doi.org/10.4018/joci.2010070104

[72] Stamat, V. (2022). Modern Trends in Restaurant Business Management. Modern Economics, 36, 130–136. https://doi.org/10.31521/modecon.V36(2022)-19

[73] Stephen, LeBruto, Quain, W. J., & Albert. (1995). Menu Engineering: A Model Including Labor. Hospitality Review. https://www.semanticscholar.org/paper/Menu-Engineering%3A-A-Model-Including-Labor-Stephen-LeBruto/83bd88d4ff733a7e6d8ae6968bf689891d5f27b3

[74] Sureiman, O., & Mangera, C. M. (2020). F-Test of Overall Significance in Regression Analysis Simplified. Journal of the Practice of Cardiovascular Sciences, 6(2), 116. https://doi.org/10.4103/jpcs.jpcs_18_20

[75] Szende, P. (2017). Kitchen Organization in Full-Service Restaurants: Reducing Heat and Stress. Boston Hospitality Review. https://www.academia.edu/102070280/Kitchen_Organization_in_Full_Service_Restaurants_Reducing_Heat_and_Stress

[76] Tatik Sriwulandari, & Ramadhani, H. (2022). Analisis menu dengan pendekatan matriks di eboni restaurant akhsaya hotel karawang, jawa barat. Bogor Hospitality Journal, 5(2). https://doi.org/10.55882/bhj.v5i2.23

[77] Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

[78] Taylor, J., & Brown, D. (2007). Menu Analysis: A Review of Techniques and Approaches. Hospitality Review, 25(2). https://digitalcommons.fiu.edu/hospitalityreview/vol25/iss2/6