Profit and Waste Analysis of Repeating Menu Systems in a Filipino Eatery

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***Abstract*—Small-scale eateries operate under tight financial margins where inaccurate production planning leads to material waste and lost profit. Repeating menu systems are widely used to stabilize preparation routines, yet their operational impact is rarely examined quantitatively. This study analyzes profitability and waste behavior using operational data manually recorded over a 30-day period from a Filipino eatery employing a rotating menu structure. Descriptive analytics techniques including ranking, aggregation, and correlation analysis were applied to evaluate dish-level and category-level performance. Results reveal measurable differences in profitability, waste behavior, and consistency across menu items. The findings demonstrate how simple data-driven evaluation can support better menu planning and operational efficiency in small food service environments.**

***Index Terms*—menu analytics, food waste, profitability analysis, descriptive data science, operational efficiency**

I. Introduction

Small food service businesses operate in environments where production decisions directly affect profitability. Preparing too many servings results in food waste and unnecessary cost, while insufficient production leads to missed revenue opportunities. To manage this uncertainty, many eateries adopt repeating menu systems that simplify planning and stabilize ingredient usage.

Despite the popularity of such systems, operational decisions are often guided by intuition rather than quantitative evidence. Data-driven evaluation can reveal patterns that inform more efficient preparation strategies, helping businesses balance profitability and waste.

This study investigates the operational performance of a repeating menu system through descriptive analysis of manually recorded production and sales data. The research focuses on identifying dish profitability patterns, waste behavior, and relationships between preparation accuracy and financial outcomes.

The study addresses the following questions:

- Which dishes generate the highest profit?
- How does waste vary across dish categories?
- Is there a measurable relationship between waste and profit?

The goal is to demonstrate how basic analytical techniques can support informed decision-making in small-scale eateries.

II. Related Work

Food waste management and menu engineering have been extensively studied in hospitality and food service research due to their economic, operational, and environmental implications. Global assessments such as the report by the Food and Agriculture Organization (FAO) highlight that inefficiencies in preparation planning and demand forecasting contribute significantly to resource waste and financial losses across food systems [1]. Within restaurant operations, waste is often linked to demand uncertainty, overproduction, and menu complexity.

Menu engineering frameworks, first formalized by Kasavana and Smith [2], evaluate dishes based on popularity and contribution margins to support pricing and menu design decisions. These frameworks classify menu items into performance categories to guide retention, promotion, or removal. Subsequent hospitality research has expanded these models by integrating cost control, portion optimization, and consumer behavior analysis to improve profitability.

Research in hospitality operations has also examined strategies for reducing food waste and improving production planning. Studies in food service systems demonstrate that operational inefficiencies and preparation surplus contribute significantly to waste generation [4]. Behavioral and operational interventions have likewise been shown to reduce waste without compromising customer satisfaction [3].

Quantitative analytics approaches, including demand forecasting and production planning models, have shown effectiveness in improving efficiency in large-scale hospitality operations. Forecasting techniques and data-driven demand estimation methods help align production with expected consumption patterns, thereby reducing waste and improving cost control [5]. However, these approaches often require robust data infrastructures and continuous digital tracking systems.

Small-scale eateries, particularly family-run establishments and local carinderias, typically rely on experiential knowledge rather than formal analytics. Limited record-keeping practices and resource constraints hinder the adoption of advanced optimization methods. As a result, operational decisions such as serving volume, dish selection, and menu rotation are often based on intuition rather than measurable performance indicators.

Recent developments in applied data science emphasize the value of descriptive analytics and lightweight decision-support tools for small enterprises. Even modest datasets can yield actionable insights when analyzed using aggregation, ranking, and correlation techniques. Descriptive analytics enables operators to identify high-performing dishes, detect waste patterns, and evaluate profitability stability without requiring complex predictive models [6].

This study builds upon menu engineering and operational analytics literature by applying descriptive statistical techniques to evaluate profit behavior and waste patterns in a repeating menu system. Unlike large-scale forecasting approaches, the study emphasizes practical, low-complexity analysis methods suitable for small eateries. By focusing on dish-level profitability, category efficiency, and waste relationships, the research contributes a grounded framework for data-informed decision-making in resource-constrained food service environments.

III. Methodology

A. Data Collection

Operational data were manually recorded from a Filipino eatery operating under a repeating menu system over a continuous 30-day period. The eatery prepares a rotating selection of dishes daily, with serving quantities determined prior to opening hours.

The following variables were tracked for each prepared dish:

- Dish name
- Dish category (Chicken, Pork, Fish, Vegetable, Beef, Soup)
- Preparation cost per batch (PHP)
- Selling price per serving (PHP)
- Total servings prepared
- Servings sold
- Unsold servings

Data were recorded manually at the end of each business day using structured tabular logs and later encoded into a spreadsheet for analysis. Recording frequency was daily, and all entries were verified at closing time to ensure consistency between prepared quantities, sales, and remaining portions.

The study covered a fixed 30-day operational window. No personal customer information, payment details, or sensitive data were collected. The dataset consists exclusively of operational production and sales records, ensuring no ethical or privacy concerns.

B. Data Description

Table I summarizes the variables used in the analysis.

Revenue and profit were computed using:

- Revenue = Selling Price $\times$ Servings Sold
- Profit = Revenue $-$ Preparation Cost
- Waste Rate = Unsold / Total Servings

TABLE I
Summary of Variables

Variable	Type	Unit	Description
Date	Categorical	–	Business day
Dish	Categorical	–	Menu item name
Dish_Type	Categorical	–	Dish category
Cost_PHP	Numeric	PHP	Batch preparation cost
Price_PHP	Numeric	PHP	Selling price per serving
Total_Serving	Numeric	Count	Servings prepared
Sold	Numeric	Count	Servings sold
Unsold	Numeric	Count	Remaining servings
Revenue	Numeric	PHP	Price $\times$ Sold
Profit	Numeric	PHP	Revenue $-$ Cost
Waste_Rate	Numeric	Ratio	Unsold / Total Serving

C. Data Cleaning and Preprocessing

The dataset was reviewed for completeness and internal consistency before analysis.

Handling Missing Values: All daily records were complete. No missing values were detected.

Outlier Inspection: Extreme profit and waste values were examined using descriptive statistics and boxplot visualization. Observations were retained since they reflected actual operational outcomes rather than data-entry errors.

Derived Features: Additional variables were engineered to support analysis:

- Revenue
- Profit
- Waste Rate
- Binary indicator variables for category-based correlation testing (e.g., is_chicken)

No normalization or transformation was applied, as the analysis relied primarily on descriptive statistics and correlation measures using natural operational units.

D. Exploratory Data Analysis (EDA)

Exploratory Data Analysis was conducted to identify trends, patterns, and variability in profitability and waste behavior.

The following visualizations were generated:

- Histogram of profit distribution
- Line chart of daily profit trends
- Boxplots comparing profit across dish categories
- Bar charts of mean profit by dish
- Bar charts of mean waste rate by dish type
- Scatterplot of waste rate versus profit

EDA revealed that profit distribution is skewed, with several high-performing fish dishes driving upper-tail earnings. Waste patterns were not uniformly distributed, with chicken dishes showing higher variability and greater unsold quantities.

Category-level aggregation revealed structural differences in both profitability and waste rates, motivating further statistical testing.

E. Statistical Tests

Two primary statistical tests were conducted to evaluate observed patterns.

1) One-Way ANOVA: A one-way Analysis of Variance (ANOVA) test was performed to determine whether mean profit differed significantly across dish categories.

Rationale: ANOVA was selected because multiple independent groups (dish types) were compared against a single numeric dependent variable (profit).

Assumptions:

- Independence of observations
- Approximate normality of profit distribution within groups
- Homogeneity of variance

The ANOVA test produced a statistically significant result ($F = 57.27$, $p < 0.001$), indicating that at least one dish category has a mean profit significantly different from the others.

Post-hoc Tukey HSD testing was conducted to identify specific category differences.

2) Pearson Correlation Test: Pearson correlation analysis was conducted to measure the linear relationship between waste rate and profit.

Rationale: Pearson correlation was selected to quantify the strength and direction of association between two continuous variables.

The analysis yielded a moderate negative correlation ($r = -0.34$, $p < 0.001$), indicating that higher waste rates are associated with lower profit levels.

Statistical significance suggests that the relationship is unlikely due to random variation.

F. Correlation and Modeling Analysis

The primary quantitative modeling approach in this study involved correlation analysis and linear trend examination.

Linear Relationship Assessment: A regression line was fitted to the waste–profit scatterplot to visualize directional association. While no predictive model was developed, the regression trend confirmed a negative slope consistent with correlation findings.

Category-Level Comparative Modeling: Binary indicator variables were created (e.g., is_chicken) to test category-specific profit associations using correlation analysis.

No advanced machine learning or forecasting models were implemented, as the study focused on descriptive and inferential statistical evaluation. However, the analytical framework provides a foundation for future predictive modeling and menu optimization strategies.

IV. Results and Discussion

A. Exploratory Data Analysis Results

1) Descriptive Distribution of Profit: To understand overall financial behavior, the distribution of profit across all observations was examined.

Figure 1 shows that profit values are right-skewed. While several dishes generate moderate daily profit, a smaller number of high-performing fish and vegetable dishes create large positive profit values, forming the upper tail of the distribution.

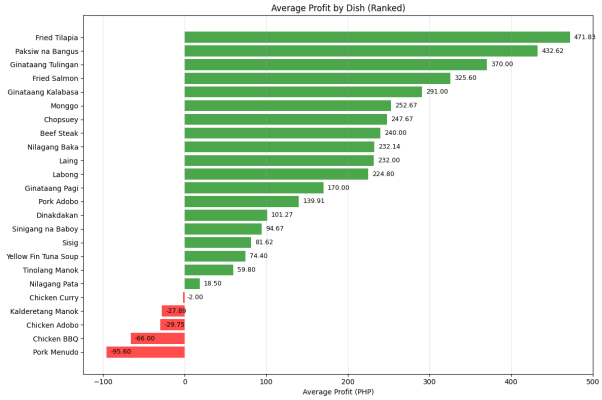

Fig. 1. Histogram of profit distribution across all dishes.

Negative profit observations are concentrated within chicken dishes. The skewed distribution suggests that overall earnings are driven by a subset of high-margin menu items rather than evenly distributed contributions. This confirms that menu composition significantly influences total profitability.

2) Daily Profit Trend: Daily aggregate profit was analyzed to evaluate financial stability over time.

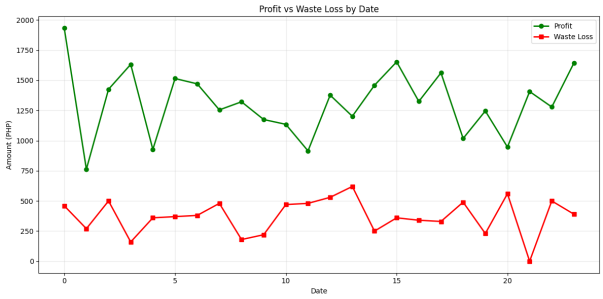

Fig. 2. Daily total profit over the 30-day period.

Figure 2 illustrates moderate daily fluctuations but no strong downward trend, indicating operational stability. Variations in daily profit correspond to differences in dish combinations served on specific days.

Days featuring multiple high-performing fish dishes exhibit noticeably higher total earnings, reinforcing the importance of strategic menu composition.

3) Dish-Level Profit Ranking: Mean profit per dish was computed to identify high- and low-performing items.

Figure 3 reveals substantial variation in dish-level profitability. Fish dishes such as Fried Tilapia and Paksiw na Bangus generated the highest mean profits.

Vegetable dishes and beef-based items also demonstrated strong performance. Conversely, several chicken dishes produced negative or near-zero mean profit, indicating persistent inefficiency rather than random fluctuation.

4) Waste Distribution Across Dishes: Waste behavior was examined through unsold servings and computed waste rate.

Soup dishes achieved near-perfect sell-through, resulting in minimal waste. Chicken dishes exhibited the largest variability

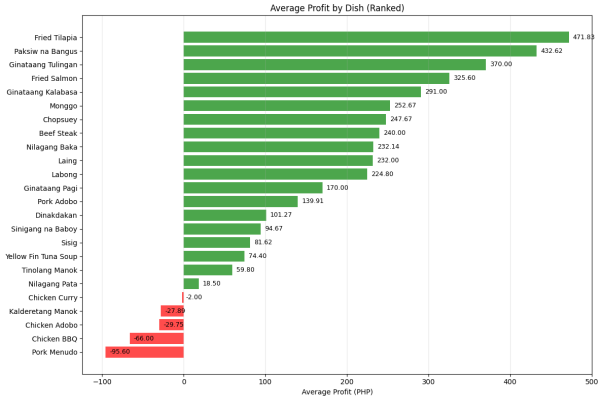

Fig. 3. Mean profit per dish over 30 days.

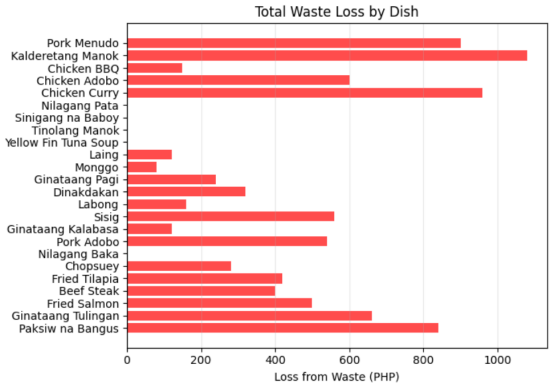

Fig. 4. Distribution of unsold servings per dish.

in unsold servings, directly contributing to reduced profitability.

5) Category-Level Profitability: Profit was aggregated by dish category to examine structural performance differences.

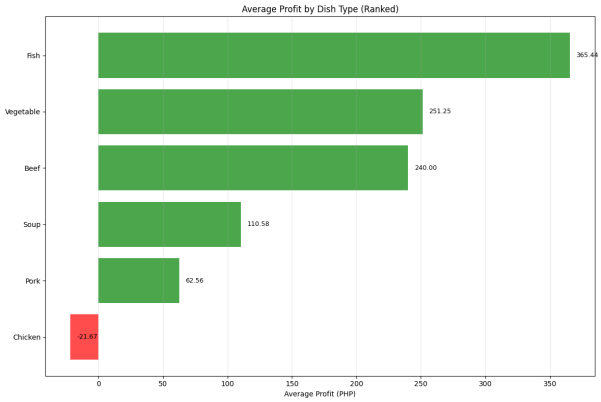

Fig. 5. Average profit by dish category.

Fish dishes generated the highest average profit, followed by vegetable and beef categories. Chicken dishes recorded a negative category-level mean profit, confirming their disproportionate contribution to financial loss.

6) Category-Level Waste Rate: Waste rate aggregation highlights operational efficiency differences.

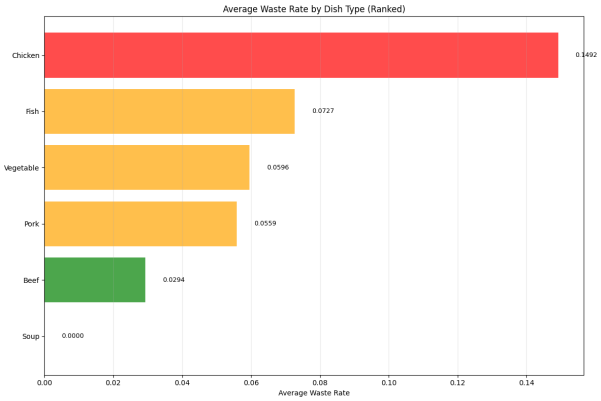

Fig. 6. Average waste rate by dish category.

Soup dishes maintained zero waste, while chicken dishes recorded the highest waste rates, reinforcing the link between overproduction and profit loss.

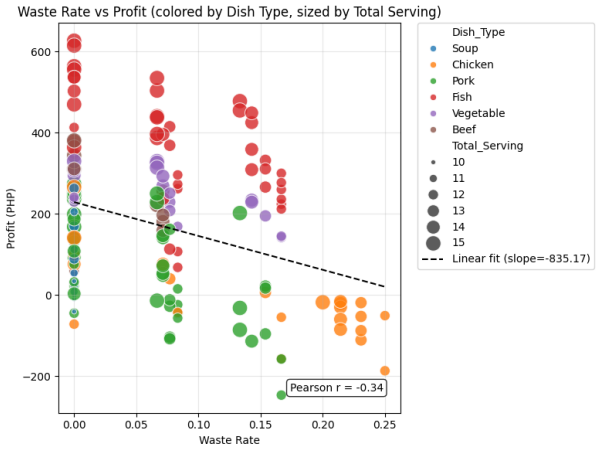

Fig. 7. Scatterplot of waste rate versus profit with regression trend line.

7) Profit–Waste Relationship: Figure 7 shows a downward relationship between waste rate and profit. The Pearson correlation coefficient was:

$$r = -0.34, \quad p < 0.001$$

This indicates a statistically significant moderate negative association. As unsold portions increase, profit generally decreases. However, high-margin fish dishes remain profitable even with moderate waste, whereas low-margin chicken dishes experience rapid profit decline.

B. Statistical Test Results

1) One-Way ANOVA: Profit Differences by Dish Category: A one-way ANOVA was conducted to test whether mean profit differs significantly across dish categories.

$$F = 57.27, \quad p < 0.001$$

The extremely small p-value indicates strong statistical evidence that at least one category's mean profit differs from the others.

TABLE II
TUKEY HSD POST-HOC COMPARISON OF PROFIT BY DISH CATEGORY

Group 1	Group 2	Mean Diff	p	Lower	Upper	Sig
Beef	Chicken	-261.6667	0.0000	-375.3636	-147.9697	Yes
Beef	Fish	125.4375	0.0081	21.6469	229.2281	Yes
Beef	Pork	-177.4375	0.0000	-281.2281	-73.6469	Yes
Beef	Soup	-129.4167	0.0156	-243.1136	-15.7197	Yes
Beef	Vegetable	11.2500	0.9997	-102.4469	124.9469	No
Chicken	Fish	387.1042	0.0000	306.7083	467.5000	Yes
Chicken	Pork	84.2292	0.0341	3.8333	164.6250	Yes
Chicken	Soup	132.2500	0.0009	39.4168	225.0832	Yes
Chicken	Vegetable	272.9167	0.0000	180.0835	365.7498	Yes
Fish	Pork	-302.8750	0.0000	-368.5180	-237.2320	Yes
Fish	Soup	-254.8542	0.0000	-335.2500	-174.4583	Yes
Fish	Vegetable	-114.1875	0.0009	-194.5834	-33.7916	Yes
Pork	Soup	48.0208	0.5197	-32.3750	128.4167	No
Pork	Vegetable	188.6875	0.0000	108.2916	269.0834	Yes
Soup	Vegetable	140.6667	0.0003	47.8335	233.4998	Yes

2) Tukey Post-Hoc Comparison: Tukey's HSD test identified where these differences occur:

- Chicken dishes produced significantly lower profit than fish, vegetable, beef, and soup categories.
- Fish dishes significantly outperformed pork and soup categories.
- Vegetable dishes demonstrated consistently high profit relative to most categories.

The Tukey HSD post-hoc analysis was conducted following the significant one-way ANOVA result to determine which dish categories differed in mean profit. The pairwise comparisons indicate statistically significant differences across most category combinations at the 0.05 significance level. Chicken dishes were found to produce significantly lower mean profit than beef, fish, soup, and vegetable categories, confirming their relative underperformance. Fish dishes generated significantly higher mean profit compared to pork and soup categories, reinforcing their role as primary revenue drivers. No statistically significant difference was observed between beef and vegetable dishes, nor between pork and soup dishes, suggesting comparable profitability within these pairs. Overall, the Tukey results demonstrate that category-level profit variation is systematic rather than random, supporting the conclusion that menu composition has a measurable impact on financial outcomes.

3) Pearson Correlation: Waste vs Profit: Pearson correlation analysis quantified the relationship between waste rate and profitability:

$$r = -0.34, \quad p < 0.001$$

This statistically significant negative correlation confirms that production inefficiency contributes to financial decline, especially for low-margin dishes.

C. Synthesis of Findings

Exploratory analysis and statistical testing jointly reveal that:

- Profitability is unevenly distributed and driven by high-margin categories.
- Chicken dishes consistently exhibit high waste and low profit.
- Soup dishes stabilize operations through predictable demand.
- Category differences are statistically significant.
- Waste reduction is critical for low-margin items.

These findings demonstrate that repeating menu systems produce measurable performance patterns. Strategic category balancing — prioritizing fish and vegetable dishes while controlling high-waste items — improves operational sustainability.

V. CONCLUSION AND RECOMMENDATIONS

A. Conclusion

This study analyzed the operational performance of a repeating menu system using 30 days of manually recorded production and sales data from a Filipino eatery. Descriptive statistical analysis revealed significant variation in profitability and waste behavior across dishes and categories.

Fish and vegetable dishes consistently generated the highest profits, serving as primary revenue drivers. Soup dishes demonstrated perfect sell-through, functioning as operational stabilizers that reduce financial risk. In contrast, chicken dishes recorded the highest waste rates and lowest profitability, with several items producing recurring losses.

Statistical testing confirmed that dish category significantly affects profit outcomes. The moderate negative correlation between waste rate and profit further supports the importance of production accuracy in sustaining earnings.

Overall, the findings demonstrate that repeating menu systems produce measurable and predictable operational patterns that can be improved through data-driven evaluation.

B. Managerial Implications

The results highlight several actionable insights:

- Profitability is strongly category-dependent.
- Demand predictability significantly reduces operational risk.
- High-margin dishes can tolerate moderate waste.
- Low-margin dishes require strict production control.

Small-scale eateries can substantially improve financial outcomes through systematic dish-level performance monitoring.

C. Recommended Operational Strategy

To maximize profitability while minimizing waste, the following strategy is recommended:

- Maintain at least one soup dish daily to ensure stable sales.
- Increase rotation frequency of high-performing fish and vegetable dishes.

- Review pricing and production volume for underperforming chicken dishes.
- Adjust serving quantities using historical sell-through patterns.
- Conduct periodic cost reviews to maintain margin efficiency.

A balanced combination of revenue drivers and stability anchors provides the most sustainable financial structure.

D. Limitations

The analysis was limited to a single establishment and a 30-day observation window. Seasonal demand variation and broader market factors were not examined. Additionally, the study relied solely on descriptive statistics without predictive modeling.

E. Future Work

Future research may incorporate longer observation periods, predictive demand modeling, pricing experiments, and multi-location comparisons to enhance generalizability and decision-support capability.

F. Final Statement

This study demonstrates that even small-scale food service operations can benefit from structured data analysis. By aligning menu composition with observed demand and profitability patterns, eateries can reduce waste, improve margins, and enhance long-term operational sustainability.

REFERENCES

[1] G. Gustavsson, C. Cederberg, U. Sonesson, R. van Otterdijk, and A. Meybeck, "Global Food Losses and Food Waste: Extent, Causes and Prevention," :contentReference[oaicite:0]index=0, Rome, Italy, 2011.

[2] :contentReference[oaicite:1]index=1 and :contentReference[oaicite:2]index=2, "Menu Engineering: A Practical Guide to Menu Analysis," Lansing, MI: Hospitality Publications, 1982.

[3] S. Kallbekken and H. Sælen, "'Nudging' hotel guests to reduce food waste as a win–win environmental measure," *Economics Letters*, vol. 119, no. 3, pp. 325–327, 2013.

[4] A. Betz, G. Buchli, C. Göbel, and C. Müller, "Food waste in the Swiss food service industry – Magnitude and potential for reduction," *Waste Management*, vol. 35, pp. 218–226, 2015.

[5] L. Wang, Y. Liu, and J. Gao, "Forecasting restaurant demand using time series and machine learning approaches," *International Journal of Hospitality Management*, vol. 65, pp. 1–10, 2017.

[6] F. Provost and T. Fawcett, *Data Science for Business*. Sebastopol, CA: O'Reilly Media, 2013.