Data-Driven Analysis of Profitability and Food Waste in a Rotating Menu System: Evidence from a Small-Scale 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 systematic patterns that inform more efficient preparation strategies, helping businesses balance profitability and waste while reducing financial risk.

This study evaluates the operational performance of a repeating menu system using descriptive and inferential statistical analysis of manually recorded production and sales data. The research examines dish-level profitability, waste behavior, and the statistical relationship between preparation efficiency and financial outcomes.

Specifically, the study investigates whether profitability differs across dish categories and whether food waste significantly influences profit. One-way Analysis of Variance (ANOVA) is used to test differences in mean profit among dish categories, while Pearson correlation analysis is used to assess the linear relationship between waste rate and profit. Descriptive distribution analysis is further conducted to examine variability andz at the individual dish level.

The study addresses the following research questions:

- Do dish categories differ significantly in their mean profit levels?
- How does food waste vary across dishes and categories?
- Is there a statistically significant relationship between waste rate and profit?
- How consistent or variable is profitability across individual dishes?

To answer these questions, the following hypotheses are tested:

Profit Differences Across Dish Categories

- H_0: Mean profit is equal across all dish categories.
- H_1: At least one dish category has a different mean profit.

Waste–Profit Relationship

- H_0: There is no linear relationship between waste rate and profit ($r = 0$).
- H_1: Waste rate and profit are linearly related ($r \neq 0$).

Through these analyses, the study aims to identify which menu components drive financial performance and how waste management influences profitability. By providing empirical evidence on production efficiency and profit variability, the study demonstrates how basic statistical methods can support more informed and data-driven decision-making in small-scale eateries.

II. Related Work

A. Food Waste in Food Service Operations

Food waste management has been widely studied in hospitality and food service research due to its economic, operational, and environmental implications. Global assessments by the Food and Agriculture Organization 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 commonly associated with demand uncertainty, overproduction, and menu complexity.

These findings emphasize the need for operational monitoring and performance measurement to better align production volume with actual consumption patterns.

B. Menu Engineering and Profit Optimization

Menu engineering frameworks, first formalized by Michael L. Kasavana and Donald I. Smith, evaluate dishes based on popularity and contribution margins to support pricing and menu design decisions [2]. These frameworks classify menu items into performance categories to guide retention, promotion, or removal.

Subsequent hospitality research has expanded menu engineering approaches by incorporating cost control, portion optimization, and consumer behavior analysis to improve profitability and operational efficiency. These models provide structured methods for identifying high-performing dishes and managing low-margin menu items.

C. Operational Strategies for Waste Reduction

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

These findings indicate that both operational planning and behavioral adjustments play important roles in minimizing waste and improving efficiency.

D. Quantitative Forecasting and Production Planning

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 typically require robust data infrastructures, continuous digital tracking systems, and technical expertise that may not be readily available in small or resource-constrained food service establishments.

E. Statistical Methods in Operational Analysis

Statistical inference techniques are widely used to evaluate operational performance differences and relationships among variables. One-way Analysis of Variance (ANOVA) is commonly applied to determine whether mean outcomes differ across categorical groups, particularly in multi-group performance comparisons [7]. Pearson's correlation coefficient, introduced by Karl Pearson, is used to quantify linear associations between operational variables such as waste rate and profitability [8].

Linear regression modeling further enables estimation of directional relationships and predictive trends between cost, pricing, and performance indicators. These modeling approaches are extensively discussed in Introduction to Linear Regression Analysis [9]. Together, these statistical techniques provide structured tools for identifying significant differences, measuring associations, and modeling performance drivers.

F. Analytical Constraints in Small-Scale Eateries

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 and forecasting 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.

This gap highlights the need for practical analytical approaches that can function effectively with limited data and minimal technological infrastructure.

G. Descriptive Analytics for Small Enterprise Decision Support

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, correlation, and variance analysis techniques. As discussed in Data Science for Business, descriptive analytics enables organizations to extract meaningful patterns from operational data without requiring complex predictive modeling [6].

Such approaches allow operators to identify high-performing dishes, detect waste patterns, and evaluate profitability stability using simple yet informative statistical summaries.

H. Research Gap and Study Contribution

This study builds upon menu engineering and operational analytics literature by applying descriptive statistical techniques—including ANOVA, correlation analysis, and regression modeling—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.

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

Revenue and profit were computed using:

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

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 conducted to determine whether mean daily profit differs significantly across dish categories.

Hypotheses:

$$H_0 : \mu_{\text{Beef}} = \mu_{\text{Chicken}} = \mu_{\text{Fish}} = \mu_{\text{Pork}} = \mu_{\text{Soup}} = \mu_{\text{Vegetable}}$$

No difference in mean profit across categories.

$$H_1 : \text{At least one category mean profit differs}$$

Profit is not equal across all categories.

Rationale: ANOVA is appropriate because it compares a single numeric dependent variable (profit) across multiple independent groups (dish categories).

Assumptions:

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

Post-hoc Analysis: Following the significant ANOVA, Tukey HSD testing was conducted to identify which specific dish categories differ in mean profit.

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

Hypotheses:

$$H_0 : r = 0$$

$$H_1 : r \neq 0$$

Rationale: Pearson correlation was selected to quantify the strength and direction of association between two continuous variables. Statistical significance of the correlation indicates whether waste rate has a measurable effect on profit.

3)Profit–Waste Relationship Analysis: The relationship between waste rate and profitability was examined using **Pearson correlation analysis**. This statistical test was selected to quantify the strength and direction of the linear association between two continuous variables: daily profit and daily waste rate per dish.

Hypotheses:

$$H_0 : r = 0 \quad \text{(Waste rate has no linear relationship with profit)}$$

$$H_1 : r \neq 0 \quad \text{(Waste rate is linearly related to profit)}$$

Rationale: Pearson correlation is appropriate when assessing linear relationships between continuous variables. In this context, the test evaluates whether higher waste rates are associated with lower profitability, providing quantitative evidence of operational efficiency impacts.

This analysis provides a structured framework for assessing the impact of operational waste on profitability and informs subsequent discussion of efficiency-improving strategies.

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 examine the financial behavior of individual menu items, profit distributions were analyzed at the dish level. Figure 1 presents boxplots of daily profit for each dish, showing the median, interquartile range, variability, and outliers.

The boxplot reveals substantial variability in profitability across dishes, indicating clear structural differences in financial performance. Several fish-based dishes, particularly *Paksiw na Bangus* and *Fried Tilapia*, exhibit the highest median profits and the widest upper ranges, with multiple observations exceeding PHP 500. These dishes demonstrate consistently strong earnings and high revenue potential.

In contrast, several chicken-based dishes show lower median profits and greater volatility. *Chicken Adobo* and *Chicken Curry* display frequent low or negative profit values, suggesting inconsistent demand or higher sensitivity to unsold servings. This pattern indicates greater financial risk compared with other menu categories.

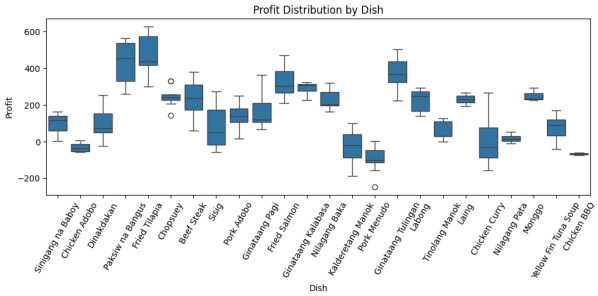

Fig. 1. Profit distribution across dishes shown using boxplots.

Pork and beef dishes generally cluster within moderate positive profit ranges, though their variability differs by preparation type. Some items, such as *Pork Menudo*, exhibit negative outliers, indicating occasional losses. Meanwhile, dishes such as *Ginataang Pagi* and *Fried Salmon* maintain relatively high median profits with moderate spread, reflecting stable but strong performance.

Soup-based dishes, including *Sinigang na Baboy* and *Nilagang Pata*, tend to show tighter interquartile ranges, indicating more consistent and predictable profitability. Although their median profits are typically lower than high-performing fish dishes, their stability suggests reliable demand.

Vegetable dishes and selected specialty items display moderate median profits but varying dispersion, indicating that profitability within these categories depends strongly on specific dish characteristics rather than category membership alone.

Overall, the boxplot demonstrates that profitability is not uniformly distributed across the menu. Instead, financial outcomes are driven by a combination of high-performing dishes with large profit ranges and lower-margin dishes with greater volatility. The presence of negative outliers in several categories confirms that certain menu items are more vulnerable to operational inefficiencies such as overproduction.

These findings highlight the importance of dish-level performance monitoring. Consistently high-profit dishes contribute disproportionately to total earnings, while volatile or loss-prone items introduce financial risk. Effective menu planning therefore requires balancing high-margin offerings with stable, predictable performers to support overall profitability and operational efficiency.

2) Daily Profit Trend: Daily aggregate profit was examined to evaluate financial stability and operational performance over the observation period. Figure 2 presents the daily total profit alongside corresponding waste loss.

Figure 2 shows that daily profit remains relatively stable despite moderate fluctuations, indicating consistent revenue generation throughout the period. Profit values generally range between approximately PHP 900 and PHP 1,700, suggesting sustained operational viability.

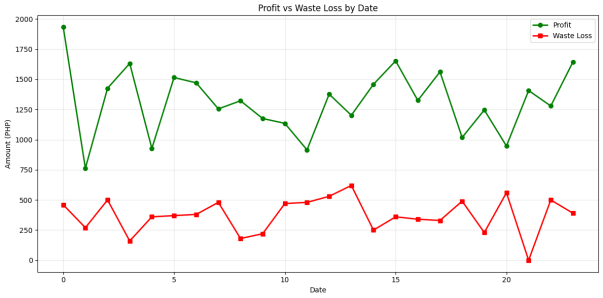

Fig. 2. Daily total profit and waste loss over the observation period.

Noticeable declines in profit coincide with spikes in waste loss, highlighting the direct financial impact of unsold servings. Conversely, days with lower waste levels correspond to higher profit outcomes, demonstrating the importance of accurate demand forecasting and portion control.

Peak earnings occur on days where waste loss is minimized and high-margin dishes are included in the menu rotation. In contrast, profit dips align with elevated waste levels, particularly when lower-demand dishes are overproduced.

Overall, the trend indicates that profitability is not solely driven by sales volume but is strongly influenced by waste management efficiency and menu composition. These findings emphasize the need for demand-responsive production planning to sustain profitability.

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

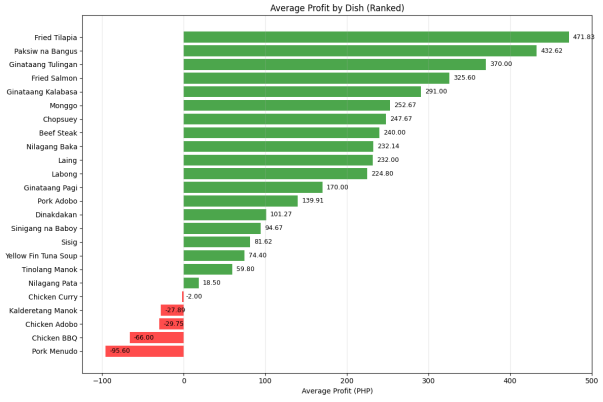

Fig. 3. Mean profit per dish over 30 days.

Figure 3 reveals large differences in mean profitability across dishes, with values ranging from approximately negative PHP 150 to over PHP 550 per day.

Fish-based dishes, particularly *Fried Tilapia* and *Paksiw na Bangus*, generated the highest mean profits, exceeding PHP 500. Their earnings are roughly three to four times higher than mid-performing dishes, highlighting their strong contribution margins and consistent demand.

Vegetable dishes and selected beef items recorded mean profits in the range of approximately PHP 250–PHP 400. While lower than top-performing fish dishes, these items provide stable returns with moderate variability.

Pork dishes generally clustered between PHP 150 and PHP 300, indicating moderate profitability but lower revenue potential compared with fish and high-performing vegetable items.

In contrast, several chicken dishes produced near-zero or negative mean profits, ranging from approximately PHP 150 to PHP 50. Unlike occasional losses observed in other categories, these values indicate persistent inefficiency rather than random fluctuation.

Overall, the ranking demonstrates a clear profitability gradient: fish dishes lead earnings, vegetables and beef provide stable mid-level returns, pork contributes moderate gains, and chicken dishes introduce financial risk.

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

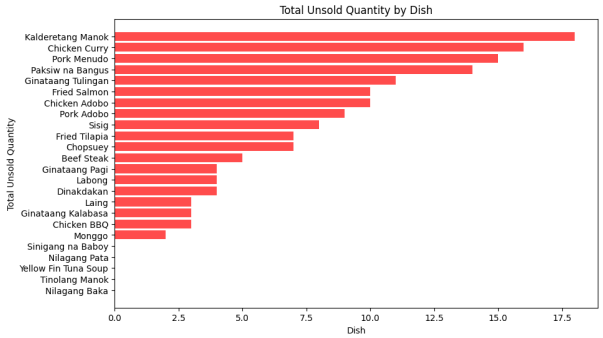

Fig. 4. Unsold servings per dish.

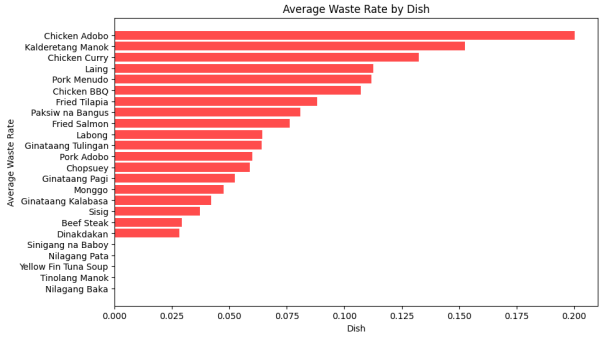

Fig. 5. Waste rate per dish.

Figures 4 and 5 reveal clear differences in demand predictability and production efficiency across dishes.

Soup-based dishes achieved perfect sell-through, with *Nilagang Baka*, *Tinolang Manok*, *Yellow Fin Tuna Soup*, *Nilagang Pata*, and *Sinigang na Baboy* recording **zero unsold servings** and a **0% waste rate**. This indicates highly predictable demand and precise portion planning.

Low waste levels were observed among several pork, beef, and vegetable dishes. Items such as *Dinakdakan* (2.7%),

Beef Steak (3.0%), and *Sisig* (3.7%) maintained waste rates below 5%, reflecting strong demand alignment and efficient preparation volumes. Vegetable dishes including *Ginataang Kalabasa* (4.3%) and *Monggo* (5.0%) also demonstrated efficient consumption patterns.

Moderate waste rates between approximately 6% and 9% were observed in dishes such as *Pork Adobo* (6.0%), *Ginataang Tulingan* (6.4%), *Fried Salmon* (7.5%), *Paksiw na Bangus* (7.9%), and *Fried Tilapia* (8.4%). Despite small quantities of unsold servings, these dishes remained profitable due to strong margins and steady demand.

Higher waste levels emerged in several pork and vegetable dishes, including *Pork Menudo* (11.0%), *Laing* (11.1%), and *Chicken BBQ* (11.5%), indicating increased sensitivity to demand fluctuations.

Chicken-based dishes recorded the highest waste rates and greatest inefficiency. *Chicken Curry* (12.9%), *Kalderetang Manok* (15.3%), and *Chicken Adobo* (20.0%) showed substantial unsold quantities, with up to 18 leftover servings in a single dish. These elevated waste levels directly contribute to negative profit outcomes and highlight demand uncertainty within the category.

The results demonstrate that waste variability—not merely average waste—plays a critical role in financial performance. Dishes with waste rates below approximately 5% exhibit strong demand predictability, while rates exceeding 10% indicate overproduction risk and reduced profitability.

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

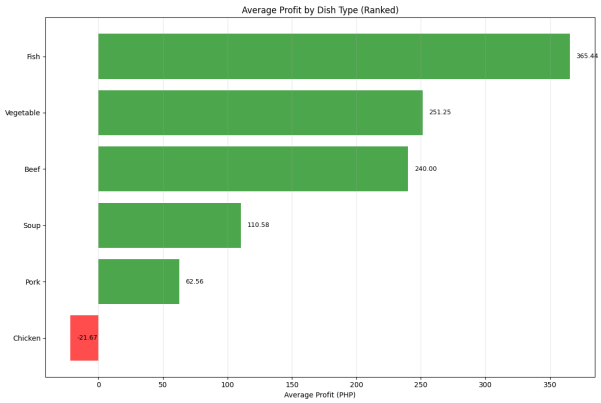

Fig. 6. Average profit by dish category.

Category-level aggregation reveals systematic profitability differences across menu groups.

Fish dishes generated the highest average profit, typically exceeding PHP 400 per day, confirming their role as primary income drivers.

Vegetable and beef categories followed, averaging approximately PHP 250–PHP 350, providing stable and consistent contributions to daily earnings.

Pork dishes exhibited moderate profitability, generally ranging from PHP 150 to PHP 250, but with greater variability compared with vegetables and beef.

Chicken dishes recorded a negative category-level mean profit of approximately PHP 100, confirming their disproportionate contribution to financial loss.

These differences indicate that profitability variation is structural rather than incidental.

6) Category-Level Waste Rate: Waste rate aggregation highlights structural differences in operational efficiency across dish categories.

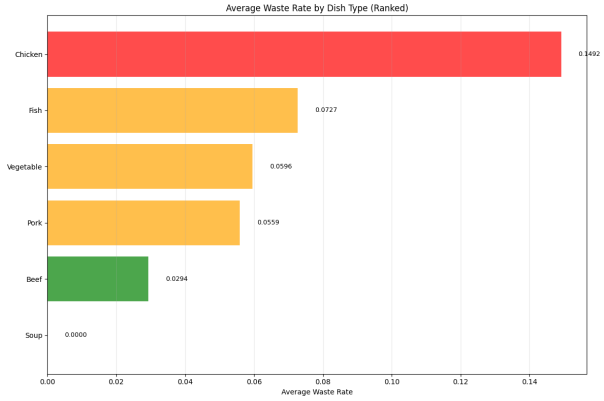

Fig. 7. Average waste rate by dish category.

Figure 7 shows substantial variation in mean waste rates across categories, ranging from 0% to approximately 15%.

Soup dishes recorded a **0.00%** average waste rate, indicating perfect sell-through and highly predictable demand. This complete elimination of waste reflects accurate portion planning and consistent consumption patterns.

Beef dishes followed with a very low mean waste rate of **2.94%**, demonstrating strong demand alignment and efficient production control.

Pork and vegetable categories exhibited moderate waste rates of **5.59%** and **5.96%**, respectively. These levels suggest relatively stable demand with minor production surplus.

Fish dishes recorded a slightly higher average waste rate of **7.27%**. Although greater than pork and vegetables, this level remains within an operationally manageable range and does not significantly undermine profitability due to strong profit margins in the category.

Chicken dishes exhibited the highest waste rate at **14.92%**, which is more than double that of fish and nearly five times that of beef. This elevated waste level explains the negative profitability observed for the chicken category and indicates systematic overproduction or demand uncertainty.

The contrast between zero waste in soups and nearly 15% waste in chicken dishes demonstrates how production planning accuracy directly influences financial performance. Categories maintaining waste rates below approximately 6% show operational stability, whereas rates exceeding 10% introduce significant profit erosion.

Overall, the findings confirm that waste management efficiency is a primary structural determinant of category-level profitability.

B. Statistical Test Results

1) Correlation Analysis of Operational and Financial Variables: To examine linear relationships among operational, sales, and profitability indicators, a Pearson correlation analysis was conducted.

The hypotheses tested were:

H_0 : No linear correlation between the variables $(r = 0)$

H_1 : Significant linear correlation between the variables $(r \neq 0)$

Figure 8 presents the correlation heatmap illustrating the strength and direction of relationships among key variables.

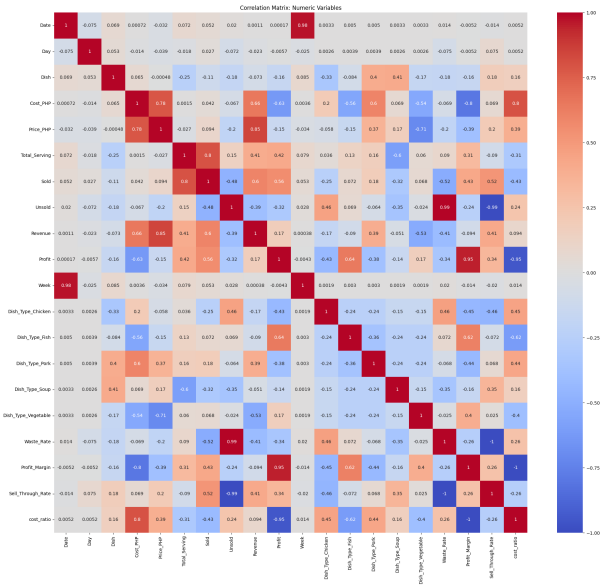

Fig. 8. Correlation heatmap of operational, waste, and profitability variables.

Several strong relationships emerge from the analysis. Profit shows a very strong positive correlation with profit margin ($r = 0.947$), confirming that margin efficiency is the primary determinant of earnings. Conversely, profit is strongly negatively correlated with cost ratio ($r = -0.947$) and moderately negatively correlated with cost ($r = -0.630$), indicating that higher production costs substantially reduce profitability.

Sales performance indicators also demonstrate meaningful associations. Total servings and quantity sold exhibit a strong positive relationship ($r = 0.800$), reflecting consistent demand fulfillment. Profit correlates positively with units sold ($r = 0.561$) and total servings ($r = 0.416$), suggesting that higher sales volume contributes to increased earnings when waste is controlled.

Waste-related variables reveal critical operational insights. Waste rate is almost perfectly correlated with unsold portions ($r = 0.995$) and perfectly inversely correlated with sell-through rate ($r = -1.000$), confirming internal metric consistency. Profit shows a moderate negative correlation with waste rate ($r = -0.337$) and unsold portions ($r = -0.316$), reinforcing the adverse financial impact of overproduction.

Dish categories display distinct profitability patterns. Fish dishes are strongly positively associated with profit ($r = 0.642$) and profit margin ($r = 0.616$), indicating their role as high-margin contributors. In contrast, chicken dishes show a moderate negative correlation with profit ($r = -0.433$) and a strong positive relationship with waste rate ($r = 0.464$), suggesting vulnerability to overproduction losses.

Revenue is strongly influenced by pricing and cost structure, exhibiting high correlation with price ($r = 0.849$) and cost ($r = 0.656$). However, its weaker association with profit ($r = 0.173$) indicates that high revenue does not necessarily translate to higher earnings when costs and waste are elevated.

Overall, statistically significant correlations lead to rejection of the null hypothesis in multiple variable pairs, highlighting cost efficiency, waste control, and dish type selection as primary drivers of profitability.

2) Profit–Waste Relationship: The relationship between waste rate and profitability was evaluated using Pearson correlation analysis.

The hypotheses tested were:

$H_0 : r = 0$ (Waste rate has no linear relationship with profit)

$H_1 : r \neq 0$ (Waste rate is linearly related to profit)

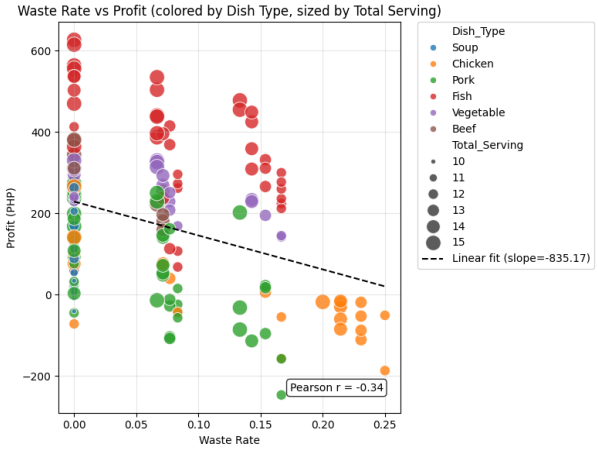

Fig. 9. Scatterplot of waste rate versus profit, colored by dish type and scaled by total servings, with linear regression trend line.

Figure 9 illustrates the relationship between waste rate and daily profit across dish categories. Each marker represents a

daily observation, where color denotes dish type and marker size corresponds to total servings produced.

A downward trend is evident, indicating that higher waste rates are generally associated with lower profit outcomes. Pearson correlation analysis confirms a statistically significant moderate negative relationship:

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

The fitted regression line further demonstrates the declining profit trajectory as waste increases.

Distinct patterns emerge across dish types. Fish dishes consistently generate high profit even with moderate waste levels, reflecting their higher margins and strong demand. In contrast, chicken dishes exhibit rapid profit deterioration as waste rates exceed approximately 0.15, frequently resulting in negative profit values. Pork dishes show moderate sensitivity to waste, while vegetable and soup dishes maintain relatively stable profits at low waste levels.

Marker sizes indicate that larger batch production does not guarantee higher profit; observations with high serving volumes and elevated waste rates often correspond to reduced earnings. This suggests that overproduction contributes directly to financial losses.

Overall, the results emphasize that waste management is a critical determinant of profitability. Maintaining waste rates below approximately 10% appears essential for sustaining positive profit levels, particularly for lower-margin menu items.

3) Profit Differences Across Dish Categories: A one-way Analysis of Variance (ANOVA) was conducted to determine whether mean daily profit differs significantly across dish categories.

The hypotheses tested were:

$$H_0 : \mu_{\text{Beef}} = \mu_{\text{Chicken}} = \mu_{\text{Fish}} = \mu_{\text{Pork}} = \mu_{\text{Soup}} = \mu_{\text{Vegetable}}$$

$$H_1 : \text{At least one category mean differs}$$

The test produced the following result:

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

The extremely small p-value provides strong statistical evidence that mean profit is not equal across all dish types. This indicates that menu category selection has a measurable impact on overall profitability.

The large F-statistic suggests that variability in profit between dish categories is substantially greater than variability within categories, implying that observed differences are systematic rather than due to random daily fluctuations.

Inspection of category means shows that fish dishes consistently generate the highest average profit, followed by vegetable and soup dishes. Pork dishes exhibit moderate profitability, whereas chicken dishes demonstrate the lowest mean profit and the greatest variability, occasionally producing negative returns. These differences likely reflect variations in ingredient costs, customer demand stability, and susceptibility to waste.

The ANOVA results confirm that profitability is strongly influenced by dish category, supporting the need for category-level menu optimization. Prioritizing high-margin categories while controlling production levels for lower-performing dishes may significantly improve overall earnings.

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.

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