Designing a predictive model for Student Food Expenditure using R

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***Abstract:** This study explores student purchasing habits and financial decision-making within college cafeteria settings by analyzing responses from a structured survey distributed to students from multiple institutions. Through this research, we identify patterns in cafeteria expenditures, preferred food choices, and key factors shaping student purchasing behavior. Using R Studio's statistical and visualization capabilities, we applied bar charts, pie charts, line graphs, and predictive models to reveal insights into how students manage their food spending, the impact of social and environmental factors, and shifts in spending habits, especially during exam periods. Our findings indicate that while most students utilize the cafeteria moderately, spending behavior is influenced by budgetary constraints, peer trends, impulse triggers, and payment preferences. Notably, students prioritize affordability, variety, and environmental sustainability when making food choices, while also adjusting their spending to meet academic demands. These findings help to deepen our understanding of college students' cafeteria spending, with possibilities for campus dining services to better meet student needs and preferences.*

***Keywords**: Cafeteria, Money Management, Student Expenses, Study, University Campus*

I. INTRODUCTION

In college life, the campus canteen is more than just a place to eat; it is a central hub where students socialize, recharge, and sometimes even make crucial decisions about time management and budgeting. The food choices and spending behaviors of students in canteens reflect broader patterns of financial management, social influences, and personal preferences that they are developing during these formative years. As students balance academics, social activities, and personal interests, their canteen purchasing habits reveal insights into their consumption habits, decision-making abilities, and the impact of peer pressure on their choices.

This study uses a comprehensive survey to investigate college students' spending habits and preferences, with the goal of determining how frequently students visit the canteen, the average amount spent per visit, and the impact of factors such as exam periods, social atmosphere, and payment methods on their spending. The research also explores how trends in spending vary when students are in the company of friends compared to when they are alone, how food popularity influences choices, and what changes students would make if they had control over the canteen's offerings. By employing statistical methods and visualization tools such as bar charts, pie charts, and line graphs in R Studio, this research will uncover insights into the motivations and patterns driving student spending in campus canteens.

Understanding these patterns can offer practical insights for canteen management, student organizations, and college administrators aiming to enhance the student dining experience and help students build sound financial habits. The findings will also contribute to the broader field of consumer behavior by illustrating how young adults make purchasing decisions in social, time-pressured, and budget-conscious settings.

II. LITERATURE REVIEW

Recent studies have explored various factors influencing food choices among college students. Schachtner (2017) identified convenience and price as significant motivators, noting that campus living arrangements restrict access to nutritious options, thus advocating for more affordable healthy meals on campuses. Complementing this, Galabo (2019) examined canteen service quality, revealing that food quality, cleanliness, and customer service are crucial for student satisfaction, suggesting that enhancing cafeteria quality could improve dining experiences. Additionally, Kumari and Kaur (2017) highlighted a strong preference for fast food among students in Ludhiana City, recommending health education initiatives to promote healthier dietary habits. Lastly, Yang et al. (2022) employed advanced clustering methods to analyze canteen consumption data, categorizing students by economic status, which aids in understanding spending patterns and the allocation of financial aid. Collectively, these studies underscore the importance of food quality, service, and economic considerations in shaping students' dining choices on college campuses.
Mikolajczyk et al. (2009) examined the relationship between food consumption, stress, and depressive symptoms among students from Germany, Poland, and Bulgaria, finding that unhealthy eating habits correlated significantly with higher stress and depressive symptoms, particularly in female students.

Conversely, no such links were found in male students, suggesting that addressing mental health in females may positively impact dietary habits. Raya and Bajracharya (2023) analyzed student satisfaction with campus canteen services at People's Campus, identifying a mean satisfaction rating of 3.28, indicating the necessity for improvements in food quality and service to meet student expectations. Bernardo et al. (2017) conducted a literature review on university students' food consumption habits, revealing prevalent unhealthy eating patterns across 37 studies, particularly among students living independently, thereby calling for public health interventions to encourage healthier eating on campuses. Finally, Kajenthiran and Karunanithy (2015) highlighted the significance of service quality in enhancing student satisfaction in higher education institutions in Jaffna, Sri Lanka, using a multifaceted service quality scale to underscore its role in providing a competitive edge to educational institutions.

In recent studies, service quality and student satisfaction in educational cafeteria settings were examined. AR (2023) evaluated the College of Business Education (CBE) cafeteria in Tanzania using the SERVQUAL model with 150 respondents, revealing that perceived service quality was unsatisfactory across all dimensions. This indicates a pressing need for improvements to align with customer expectations. At the same time, Arenasa et al (2023) studied the association between food and nutrition literacy and academic performance in the Philippines, but found no meaningful relationship despite students' high levels of reading. This suggests that while food education is valuable, it may not directly influence academic outcomes. Lastly, Cha and Seo (2019) investigated factors affecting student satisfaction in university cafeterias, identifying menu, taste, price, and cleanliness as pivotal elements. The study also indicated that financial circumstances notably impact satisfaction, as students' preferences vary according to their allowances. Together, these studies contribute valuable insights to the discourse on service quality and student experiences in educational environments.

Wu et al. (2020) introduced a smart campus system in China designed to assist poverty-stricken students by utilizing big data for identifying which students need support and streamlining subsidy distribution. This system, currently used by over 17,000 students, also aids counselors by providing alerts for psychological support, minimizing the workload on college staff through effective data processing methods. In Malaysia, Bakhtiar et al. (2020) focused on understanding the spending habits of students, identifying that a lack of financial management knowledge contributes to poor budgeting practices, particularly in non-academic expenditures like food and beverages. The authors emphasize the importance of financial education in improving students' financial well-being and avoiding potential difficulties like bankruptcy. Furthermore, Freedman and Connors (2010) conducted a pilot study to determine how point-of-purchase nutrition labeling affects students' food shopping patterns. While the labeling did not result in statistically significant changes, there was a little rise in sales of labeled healthy goods, implying that such interventions may promote healthier eating choices among students. Together, these studies underscore the necessity for targeted support and education to enhance financial and nutritional decision-making in university settings.

Several studies have investigated the dietary habits and satisfaction with food services among university students. Kabir, Miah, and Islam (2018) conducted a qualitative study in Bangladesh, identifying factors influencing students' eating behaviors, including individual attributes like cooking skills and knowledge of nutrition, societal influences, university culture, and environmental elements such as food availability and pricing. Their findings suggested that poor dietary habits could harm students' health and academic performance, prompting the proposal of multilevel nutritional treatments. According to [16] (2015), food consumption patterns among university students in Tucumán showed a concerning shift between 1998-1999 and 2012-2013, with an increase in unhealthy foods and a decrease in fruit and vegetable intake, resulting in nutrient deficiencies and highlighting the need for nutrition education. Finally, El-Said and Fathy (2015) evaluated student satisfaction with campus cafeteria services using questionnaires and discovered that overall satisfaction was below average, emphasizing the importance of improving food quality, pricing, and service efficiency to meet student expectations and compete with external food providers. Collectively, these studies underscore the significance of addressing dietary habits and service quality to enhance the health and satisfaction of university students.

In the investigation conducted by Lambert, Chivers, and Farringdon (2019), the focus was on university students' food choices, revealing a significant lack of understanding of the Australian Dietary Guidelines (ADG). Students often turned to social media for nutritional information, which influenced their eating habits, emphasizing appearance over health. This indicates a need for health promotion strategies that resonate with students' lifestyles. Similarly, Peterson and Freidus (2020) highlighted food insecurity among college students as a complex issue, where financial struggles are one of several barriers to accessing adequate food. Their findings suggest a broader range of influences, including logistical challenges, indicating that existing assessments may underestimate the extent of food insecurity. Furthermore, Malinauskas et al. (2007) examined energy drink usage among college students, noting that over half consumed these drinks monthly, primarily for energy and sleep deficiency. The associated side effects, such as jolt and crash episodes, raise concerns regarding health impacts, especially when combined with alcohol. These studies collectively highlight various nutritional and social challenges faced by university students, necessitating tailored approaches to address their needs effectively.

III. METHODOLOGY

This study utilizes a combination of predictive modeling, data visualization, and statistical testing to understand and forecast spending behaviors among students in college cafeterias. Four specific models were developed to address various facets of student expenditure, each designed with unique input parameters and objectives. R programming was utilized for data analysis, leveraging its statistical tools and robust visualization features. The data was gathered through a structured Google Forms survey, with a snowball sampling approach ensuring a diverse range of student participants from different academic backgrounds.

Data Collection

Data for this study was collected via a structured Google Forms questionnaire, targeting a variety of factors influencing food expenditure patterns among students. The survey gathered both quantitative data (such as canteen visit frequency and average expenditure per visit) and qualitative insights. This questionnaire was distributed using snowball sampling, which involved initial respondents sharing the survey with their peers. This method increased the sample size and ensured broader representation.

The primary variables considered in the study included:

1. Canteen Visit Frequency: Frequency of visits, often expressed as weekly or biweekly.
2. Average Expenditure per Visit: Average amount students spend per canteen visit.
3. Expenditure During Exam Periods: An important indicator of spending fluctuations under time or stress constraints.
4. Social Influences: The role of social dynamics in spending decisions, such as the presence of friends.
5. Perception of Canteen Costs: Subjective assessment of food pricing and its impact on purchasing decisions.
6. Payment Method: Analysis of mobile payments, cash, and cards as potential influences on spending.

Model Development

Model 1: Forecasting Maximum Expenditure Level

This model is designed to predict the highest level of expenditure a student might reach under various conditions, using multiple influencing factors to increase predictive accuracy.

```
+ }
>
> if (as.integer(choice) == 1) {
+   func1()
+ } else if (as.integer(choice) == 2) {
+   func2()
+ } else if (as.integer(choice) == 3) {
+   func3()
+ }else if (as.integer(choice) == 4) {
+   func4()
+ }else {
+   cat("Invalid choice.\n")
+ }
How often do you visit the college canteen in a week?
                daily means enter 5
                once means enter 1
                2-3 time means enter 2.5
                4-5 time means enter 4.5

2.5
average how much do you spend in the canteen per visit?
              the corresponding ranges enter the corrct value
              [0-100,100-200,200-300,300-400,400-500,500+]
              [50,150,250,350,450,550]

250
How does your spending at the canteen change during exam periods compared to regular weeks?
spend more 3
spend less 1
spending remains the same 2
I do not visit the canteen 0
3
 How does your spending habits differ when you are with friends compared to when you are alone?
spend more 3
spend less 1
spending remains the same 2
i tend to spend more 4
1
[1] "the excepted maximum spending as per input is :"
  1
158
```

.The key input parameters included:

1. Canteen Visit Frequency: Weekly or biweekly visit frequency.
2. Average Expenditure per Visit: The typical spending amount per visit.
3. Expenditure During Exam Times: Changes in expenditure during exam periods.
4. Influence of Social Environment: The effect of social context on spending decisions.

The objective of this model is to estimate the maximum spending level a student may reach in different situational contexts. By integrating both individual and situational influences, the model provides insights into how spending behaviors fluctuate under varied conditions.

Model 2: Predicting Food Choices Based on Expenditure Patterns

This model predicts students' food choices based on spending behaviors, their perception of costs, and situational triggers for spending. Input parameters include:

1. Spending Patterns During Examination Times: Spending variations during exams.
2. Perception of Canteen Costs: Cost sensitivity and preference for budget-friendly or indulgent options.
3. Impulsive Buying Behaviors: Frequency and causes of unplanned purchases.
4. Preferred Payment Method: How cash, mobile payments, and credit cards may impact dining choices.

```
+   }
+ }
>
> if (as.integer(choice) == 1) {
+   func1()
+ } else if (as.integer(choice) == 2) {
+   func2()
+ } else if (as.integer(choice) == 3) {
+   func3()
+ }else if (as.integer(choice) == 4) {
+   func4()
+ }else {
+   cat("Invalid choice.\n")
+ }
How does your spending at the canteen change during exam periods compared to regular weeks?
spend more 3
spend less 1
spending remains the same 2
I do not visit the canteen 0
3
Do you find the prices at the canteen reasonable?
 yes 1
 no -1
 sometime0
-1
How often do you make spontaneous purchases at the canteen, and what typically triggers these decisions?
Frequently 3
Occasionally 2
Rarely 1
Never 0
3
What is your preferred method of payment in the canteen?
cash 1
card 2
mobile payment 3
3
[1] "the possible food are:"
[1] "Snacks"
[1] "Meals"
```

The goal is to estimate what type of food (snack, meal, dessert) a student would choose, taking into account both economical and situational factors.This model provides insights into food selection tendencies under different spending scenarios.

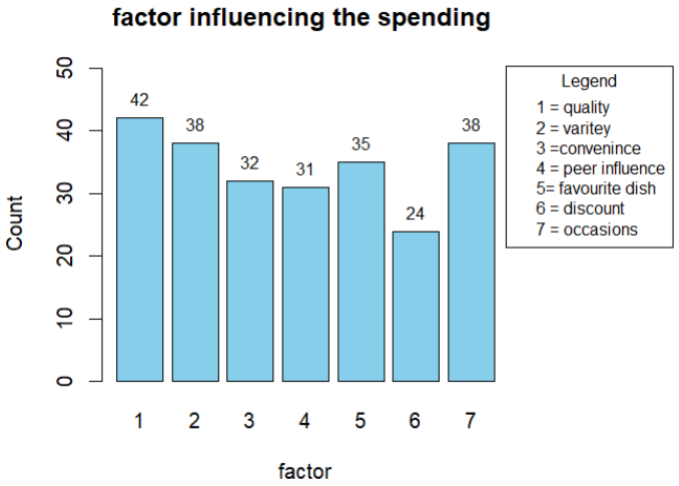
Model 3: Visualizing Student Feedback with Bar Graphs

This model focuses on visualizing student preferences and spending habits by generating bar graphs based on specific user input from survey data

```
+   mp = as.numeric(as.character(mp))
+   cp = as.numeric(as.character(cp))
+   t_test_result <- t.test(mp, cp, alternative = "two.sided")
+   print(t_test_result)
+   if (t_test_result$p.value < 0.05) {
+     cat("\nThere is a significant difference in spending between mobile payments and cash users (p < 0.05).\n")
+     cat("Students who prefer mobile payments tend to spend more.\n")
+   } else {
+     cat("\nThere is no significant difference in spending between mobile payments and cash users (p >= 0.05).\n")
+   }
+ }
>
> if (as.integer(choice) == 1) {
+   func1()
+ } else if (as.integer(choice) == 2) {
+   func2()
+ } else if (as.integer(choice) == 3) {
+   func3()
+ }else if (as.integer(choice) == 4) {
+   func4()
+ }else {
+   cat("Invalid choice.\n")
+ }
press 1 for how spending affect due to social atmosphere
press 2 for how popularity affects the spending
press 3 for what changes can be brought if you are given a chance
press 4 for factor influence spending in canteen
press 5 for how payment mode affects the spending
enter the choice4
```

The process includes:

1. User Input Selection: Users select a specific survey column (e.g., payment methods, food choices).
2. Categorization of Responses: The selected column is analyzed to categorize responses (e.g., frequency of payment methods).
3. Bar Graph Generation: A bar graph is produced, showing the distribution of preferences or behaviors for the selected category.



The objective is to allow for quick visual interpretation of trends and behaviors, making survey data accessible and easily interpretable.

Model 4: Hypothesis Testing for Spending Differences

This model evaluates whether a significant difference exists in spending patterns between mobile payment users and cash users. The hypothesis tested is:

- **The null hypothesis (H0):** There is no significant difference in spending between mobile payment and cash users.
- **Alternative Hypothesis (H1):** There is a considerable difference in expenditure between mobile payments and cash users.

```
+     cat("\nThere is no significant difference in spending between mobile payments and cash users (p >= 0.05).\n")
+   }
+ }
>
> if (as.integer(choice) == 1) {
+   func1()
+ } else if (as.integer(choice) == 2) {
+   func2()
+ } else if (as.integer(choice) == 3) {
+   func3()
+ }else if (as.integer(choice) == 4) {
+   func4()
+ }else {
+   cat("Invalid choice.\n")
+ }

        Welch Two Sample t-test

data:  mp and cp
t = -0.77433, df = 99.514, p-value = 0.4406
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -69.63364  30.53930
sample estimates:
mean of x mean of y
 142.4528  162.0000


There is no significant difference in spending between mobile payments and cash users (p >= 0.05).
>
```

The process for this model includes:

1. User Input of Payment Data: Data based on students' preferred payment methods.
2. Statistical Testing: Hypothesis testing (t-test or ANOVA) to assess whether spending differences are statistically significant.
3. Result Interpretation: The results reveal whether the payment method impacts spending behavior.

```
> show_options <- function() {
+   cat("The following operations can be done on the dataset:\n")
+   cat("Press 1 for predicting the output of how much a student can spend under some condition\n")
+   cat("Press 2 for predicting what type of food a student will choose under some condition\n")
+   cat("press 3 for plotting or summarising a column\n")
+   cat("press 4 for testing the hypotesis that there is no siginficant difference in spending with respect to payment
mode \n")
+ }
> show_options()
The following operations can be done on the dataset:
Press 1 for predicting the output of how much a student can spend under some condition
Press 2 for predicting what type of food a student will choose under some condition
press 3 for plotting or summarising a column
press 4 for testing the hypotesis that there is no siginficant difference in spending with respect to payment mode
> choice=readline(prompt="Enter the choice")
Enter the choice1
>
```

The objective is to understand how payment methods may influence spending habits, providing insights into the financial decision-making behaviors of students.

Statistical Tools and Analysis

Each model was implemented and analyzed using R Studio, selected for its powerful statistical analysis and data visualization capabilities. The correlations between spending variables were assessed using predictive analysis and hypothesis testing approaches such as t-tests and ANOVA. R's visualization capabilities, such as ggplot2, were used to create bar graphs, pie charts, and line graphs that visually represented the data's patterns and trends.

IV. RESULTS AND DISCUSSIONS

The analysis of student spending habits at the campus canteen reveals nuanced patterns influenced by situational, personal, and financial factors. By examining responses from a diverse sample of students, this study identifies key drivers of expenditure and preference in campus dining. The findings, detailed below, reflect the complex interplay of individual and social factors that shape spending behaviors.

1. Frequency and Spending Patterns: The majority of students report moderate usage of the campus canteen, typically visiting once or 2-3 times weekly. The average expenditure per visit generally falls within the range of 0 to 100 rupees. This moderate frequency suggests that while the canteen remains a popular choice, students appear conscious of balancing their budgetary constraints. It is likely that limited spending per visit reflects efforts to allocate financial resources to other essential expenses, underscoring the cost-conscious nature of student consumption.
2. Spending Adjustments During Exams: A notable shift in spending behavior was observed during examination periods, where students reported either reducing their visits to the canteen or avoiding it entirely. This pattern may result from increased academic demands, as students prioritize study time over social dining. Furthermore, stress associated with exams may reduce the desire to engage in discretionary spending, highlighting the impact of academic cycles on student expenditure behavior.
3. Influence of Crowding: Crowding was found to be a significant determinant in students' decision to visit the canteen. Many students prefer to avoid peak times, indicating that crowd density may serve as a deterrent. However, a subset of students noted that crowding does not influence their spending decisions, suggesting that tolerance for crowded environments varies. This finding points to a potential area for canteen management to consider—providing a more comfortable and accessible environment may encourage more consistent patronage.
4. Impact of Trends: The influence of trends on spending varied among students. While some students reported a tendency to follow popular trends in food choices, others appeared less affected by social trends. This suggests individual differences in susceptibility to peer influence, with certain students more inclined to spend based on social trends, while others adhere to personal preferences irrespective of popularity. Understanding these behavioral nuances can help canteen management cater to both trend-driven and budget-conscious segments of the student body.
5. Suggested Improvements: Students reported a strong desire for canteen improvements such as cheaper prices, a wider range of food selections, and the implementation of environmentally friendly methods. The emphasis on affordability and sustainable techniques indicates a growing awareness of environmental impact and a desire for low-cost dining. Addressing these preferences could enhance the canteen's appeal, potentially increasing student satisfaction and loyalty.
6. Impulse Buying Behavior: Impulse buying behavior showed significant variability. For some students, hunger prompts unplanned purchases, especially when convenient, affordable options are available. However, a considerable portion of students adhere to a strict spending plan, minimizing spontaneous expenditure. This variability reflects differing levels of financial discipline and impulse control, with some students maintaining greater adherence to budgets. This insight suggests that canteen management could cater to both impulse-driven and planned spenders by providing budget-friendly snack options alongside meal choices.
7. Social Influence on Spending: While the social environment can influence spending decisions, most students reported that their expenditures are generally unaffected by social settings. Some, however, indicated that social gatherings might increase their spending on items such as snacks or beverages. This limited impact of social influence on overall spending may indicate that students' canteen usage is primarily driven by individual financial preferences rather than social interactions. However, occasional spending surges in group settings suggest opportunities to market group-friendly options, such as shared snacks or combo meals.
8. Factors Influencing Spending Decisions: The primary factors influencing student spending include accessibility, food quality, and the availability of desired items. These practical considerations outweigh other factors, such as peer presence, though celebratory or social occasions occasionally encourage increased spending. This insight suggests that students prioritize the value and convenience of canteen options when deciding where to dine. For canteen management, ensuring high-quality, accessible options that align with student preferences may lead to greater consistency in spending and loyalty.
9. Food Preferences and Payment Methods: Students' preferred food choices include light meals, beverages, and desserts, with a notable shift toward mobile payment methods such as Google Pay. The increasing preference for cashless transactions highlights a trend toward mobile payments, aligning with broader societal shifts toward digital convenience. The popularity of mobile payments reflects the need for accessible, tech-

enabled payment solutions that cater to students' evolving preferences, which could also enable faster service during peak times.

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V. CONCLUSION

This study offers valuable insights into the spending behaviors of students within a campus canteen environment, revealing complex interactions between budgetary practices, social influences, and situational factors. Findings indicate that the majority of students engage in moderate, planned spending, typically reserving smaller amounts for canteen purchases. Spending declines notably during examination periods, as students prioritize academic focus and limit discretionary spending. Additionally, environmental factors like crowding and popular trends have variable effects on spending, reflecting individual differences in response to social and situational cues. While some students' purchasing behaviors are swayed by peer presence, others exhibit minimal susceptibility to external influences, underscoring the varied nature of student financial decisions.

Student feedback also highlights areas for canteen improvement, particularly in terms of affordability, food variety, and sustainable practices. While impulse buying and social surroundings influence spending behavior to some extent, these factors are generally minor in comparison to more consistent considerations like accessibility, food quality, and payment convenience. The growing preference for mobile payment methods further underscores a trend toward digital transactions, aligning with broader shifts toward cashless convenience.

Limitations

Despite the insights provided, this study has several limitations that warrant consideration. First, as the data is self-reported, there is potential for biases such as social desirability, which may affect the accuracy of reported spending habits. Additionally, this study does not account for students' income levels or other financial constraints, factors that could offer important context for their expenditure patterns. The limited sample size restricts the generalizability of the findings, as the trends observed may not fully represent student behaviors across other educational institutions with diverse canteen services and facilities. Furthermore, unexamined variables, such as socio-economic status, family background, and broader economic conditions, could also shape spending behaviors in ways not captured in this study. Finally, variations in canteen usage and expenditure during examination periods may differ across academic disciplines, study practices, or individual coping strategies. Further research could address these nuanced aspects to deepen understanding of student spending behaviors in campus dining settings.

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