Proceedings of ICBioMed 2025 Symposium: AI for Healthcare: Advanced Medical Data Analytics and Smart Rehabilitation
DOI: 10.54254/2753-8818/2025.AU29920

Healthy and Economical Diet Options for Busy Young Adults

Jiayi Zhou[1*†], Yining Hu[2†], Jinhang Li[3†], Mingwenxi Bao[4†]

[1]The First High School of Changsha, Changsha, China
[2]Zhenhai High School of Zhejiang Cambridge A-Level Center, Ningbo, China
[3]The Affiliated High School of Peking University, Beijing, China
[4]High School Affiliated To Nanjing Normal University, Nanjing, China
**Corresponding Author. Email: 3354982863@qq.com*
[†]All the authors contributed equally to this work and should be considered as co-first author.

Abstract. While young adults have less time to attribute to their meal plan and cooking because of increasing workload, more of them choose to finish their meal at convenience stores. However, people actually have more concerns about their physical health. Some of them even want to eat with purpose like losing weight or gaining muscle. To address this contradictory situation, we want to create a model to help young adults diet healthily both when they have enough time to cook by themselves and when they do not. In this case, based on principle of Dietary Guidelines for Americans 2020-2025, Mifflin-st Jeor equation, and constrains of some allergic element, we use python and PuLP to create the linear model with the purpose of minimizing the total expenses. This model is going to collect some basic information of the customers and then generate the best and two alternative plans for different customers with different requests, time cost, and physical situations. It shows the usefulness of linear programs in daily life and provides people with an effective machine to solve their problems.

Keywords: diet optimization, linear program, personalized nutritional requirement

1. Introduction

Recently, the diet problem for young adults, especially those who just enter the job market with limited budgets or college students who need financial support from their guardian, has become more serious. Research shows that young adults lack some important intake such as vegetables and fruit, which contain a wealth of important nutrition such as Vitamin C and carbohydrate. Rather, the intake of some nutrition is overwhelmed, such as sodium, lipid, and trans-fatty acid [1]. These kinds can be the main leader or some serious disease like gastric carcinoma, intestine cancer obesity, and high blood pressure [2]. However, it is not because of the lack of consciousness. On the contrary, thanks to the advancement of education, people get more knowledge of diet-related health consciousness and nutrition knowledge [3]. A lot of young adults have a positive attitude toward healthy diet and a big amount of them have some personal insight about their own physical health [4]. Besides, people put attentions to their body type and want to shape their body by gaining muscle

© 2026 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2753-8818/2025.AU29920

or casting off weight [5]. This shows that people actually have the tendency to have a healthy meal plan.

There is extremely increasing convenience store around the world [6]. These stores provide good place for busy young people to get daily necessities, such as food, drinks, cigarettes, and so on [7]. Thus, instead of cooking by themselves, which is time-consuming, young adults show more preference to convenient food [8]. However, the foods in the convenience store are not as healthy as foods cooked at home since those foods usually contain overwhelm sugar, salt, fat, or additive to prolong their expiration date. What is the original cause of this ambivalent situation? According to others' observation, the primary cause is the lack of time for young adults to consider nutritional meal plans for them. As the work stress increasing, young adults cannot squeeze enough time to go to the supermarket and pick ingredients by themselves [9]. This forms a contradictory situation: people have less time, so they have to finish their meal at convenience store, but the nutritional level of food in convenience store may not satisfy the health principle or some physical subjects of customers. Although there is plenty of advice on the internet like 'which food is the healthiest in the convenience store' on the internet [10]. one significant drawback is that they usually based on original or average database, it does not consider the situation of the customers. Therefore, customers must decide by considering their own requirement or comparing two similar productions, which is inefficient. Other calculators, such as calculators for loss weight or gaining muscle and calculators of basal metabolic rate (BMR), do provide specific data for users, but they do not generate a distinct plan for them. Moreover, all the calculators and research do not consider some special situation for people with allergy, which is widespread over the word [11]. Accordingly, to address the problems above, our group plans to create a model that can directly generate meal plans based on customers' own requirements, including allergic factors Moreover, not all of them will go to the convenience store to deal with their meal. In this case, this model is also able to make plans for those who have enough time and want to cook by themselves. Customers can also choose their cooking method and find the most economical plan for them. By using a linear program to realize cost minimization with constraining of different nutritional requests, this model can search in the database of convenience store or grocery store and provide the best plan and two alternative plans for customers. In the following paragraph, the proposed work will be demonstrated in the second part. In the third part, there is a comparation between our project and other literature. Then, we will show the result of our coding, and finally, the conclusion.

2. Proposed work

2.1. Introduction of this model

2.1.1. The constructure of data

$$MinZ = \sum_{j=1}^{n} C_j \times X_j \tag{1}$$

In this program, there is some constrain about these indispensable foods to make sure that customers do not get a meal which seems confusing (e.g. five pieces of dark chocolate). There are two tables, one is for convenience store while another is for grocery store. Each table has five sheets which are divided according to their categories, and for each category, there are constraints of the amount of food based on our real-life requirement by using constraint dictionary. Each table consists of eight columns, they are name, the price (yuan), the calories (KJ), the protein (g), the fat (g), the sodium (mg), and the allergen of the products. The allergens are nuts, dairy products, cereals, and

DOI: 10.54254/2753-8818/2025.AU29920

eggs, which are represented by number 1 to 4. The data of convenience stores are from the official website of a famous convenience store—LAWSON [12]. It is well-known convenience store that provides daily necessities around Asia, especially Japan and China. And the data of grocery stores are based on online research [13] and an online application which helps people buy food resources online. The fifth sheet of the table for grocery store is not the food resource. Instead, it is the cooking method. If customers have enough time and want to buy food in the grocery store, they are able to choose at most three methods to cook

2.1.2. Input of customers' information

Then, there is an interface for customers which will ask them to input some basic questions about their own physical situation:

Table 1. User input information

1. The weight of the customer (kg)
2. The height of the customer (m)
3. The age of the customer (years old)
4. The gender of the customer (male or female)
5. The daily activity level of the customer (from 1 to 4)
6. The allergic factor of customer (from 0 to 4)
7. The diet subject of customer (from 1 to 3)
8. Available time(minutes)

According to Table 1, the first four questions are for the calculation of Mifflin-St Jeor equation later to generate the minimum requirement for calories. The fifth question has four levels, from 1, which represent sedentary life activity, to 4, which represents very active. The information will be shown on the screen to help customers understand it. The sixth question is going to collect the data of factors that customers are allergic to. 0 means that the customer is not allergic to any kind of food. The following numbers represent nuts, dairy products, cereals, and eggs successively. 0 means that the customer is not allergic to any kind of food. The following numbers from 1 to 4 represent nuts, dairy products, cereals, and eggs successively. With the allergen of the customer, the model will exclude the food that contain these allergens later. For the seventh question, the subject of customers is divided into three kinds: loss weight, gain muscle, and maintenance, and are represented by numbers for 1 to 3 respectively. Later calculations about macro-nutrient and calories will be different depending on this information. And the last question is whether the customer has enough time. Customers need to input their available time in to the table, and if their time budget is less than 60 minutes, the data will be the table for the convenience store, if not, the data will be the table for grocery store. Also, if the data is grocery store, there will be another question to ask users to choose at most three kinds of cooking method.

2.1.3. Calculations for constraints of calories

Then, the machine is going to calculate the basal metabolic rate (BMR), which is the minimum number of calories consumed for the body to physically function at rest based on people's physical situation. Thus, we use the Mifflin-st Jeor equation, which is a recognized equation for calculation of BMR [14]. The unit of BMR is kilocalories per day (kcal/day).

DOI: 10.54254/2753-8818/2025.AU29920

For men:

$$\text{BMRmale} = 10 \times \text{weight (kg)} + 6.25 \times \text{height (cm)} - 5 \times \text{age (years)} + 5 \tag{2}$$

For women:

$$\text{BMRfemale} = 10 \times \text{weight (kg)} + 6.25 \times \text{height (cm)} - 5 \times \text{age (years)} - 161 \tag{3}$$

After that, the model calculates that total daily energy expenditure (TDEE) depending on users' activity level and BMR [14]:

Sedentary:

$$BMR \times 1.2 \tag{4}$$

Slightly active:

$$BMR \times 1.37 \tag{5}$$

moderately active:

$$BMR \times 1.55 \tag{6}$$

Very active:

$$BMR \times 1.725 \tag{7}$$

Then, by timing dividing 4.184, the calories can change it unit for kcal into kj. The model turns the estimated TDEE into a range by slightly increasing and decreasing 5%.

2.1.4. Adjusting the requirement for macro-nutrition and sodium

After getting the range of requirements for the calories which represented by TDEE, it is possible to turn the calories into the requirement of macro-nutrient depending on their goal. According to Atwater System [15], the requirement for calories can change into requirement of carbohydrate by dividing by 17 and fat by dividing by 37. This step is referred to the advice in Dietary Guidelines for Americans [16] and advice for ACSM [17]. For people who want to lose weight or gain muscle, the principle for protein increases since it can, and the requirement for fat decreases for people who want to lose weight.

Goal for maintaining according to the standard for ordinary people in Dietary Guidelines for Americans, the proportion of the calories for the carbohydrate is from 45% to 65%; the proportion of the fat is from 20% to 35%; and the principle for protein is 0.8grams to 1.2 grams per kilogram of body weight.

Goel for weight loss: the proportion of the calories for the carbohydrate is from 40% to 50%; the proportion of the fat is from 20% to 25%; and the principle for protein is 2 grams to 2.4grams per kilogram of body weight [18].

Goel for gain muscle: the proportion of the calories for the carbohydrate is from 50% to 60%; the proportion of the fat is from 20% to 35%; and the principle for protein is 2 grams to 2.6grams per kilogram of body weight [18].

DOI: 10.54254/2753-8818/2025.AU29920

For sodium, according to the World Health Organization, the intake of sodium per day is better to be under 2200mg [19].

2.1.5. Turn the constraint from per day to per meal

The principles above are all for the nutritional requirements per day. Usually, lunch proport 20% to 30% of one day's calories' requirement [20], so by timing the medium of this range, which is 25%, the range of requirement for calories and other nutrients can be turned into the requirements for per meal instead of per day.

2.1.6. Linear programming

Linear programming is a mathematical optimization method, aiming to optimize the allocation of resources. In our model, to minimize the amount of money spent, and ensure that the content of each nutrient does not exceed the maximum value, the objective function is

j: the kind of food

C_j : the cost of food j

X_j : the amount of the food

a_j: the amount of nutrition included in one portion of food

the constraints

$$Min_{car} \leq \sum ja_j^{car} \times x_j \leq Max_{car} \tag{8}$$

$$Min_{pro} \leq \sum ja_j^{pro} \times x_j \leq Max_{pro} \tag{9}$$

$$Min_{lip} \leq \sum ja_j^{lip} \times x_j \leq Max_{lip} \tag{10}$$

$$Min_{cal} \leq \sum ja_j^{cal} \times x_j \leq Max_{cal} \tag{11}$$

$$\sum ja_j^{sod} \times x_j \leq Max_{sod} \tag{12}$$

Non-negativity constraints

$$x_j \in Z^+ \quad x_j \geq 0 \tag{13}$$

2.1.7. Generating alternative plans

There are almost two alternative meal plans. The first plan will be generated by adjusting the upper and limits for protein 15% while other constraints are still. This is because the available food range will be expanded, so the original plan may change. By relaxing the constrain of protein, some food that is a little bit short of being feasible are all available, so the program has a high probability to generate a new plan. The "marginal error" of 15% is appropriate since it not only provide enough extra space for the program to change it plan but also be restrict enough in order to ensure that the new plan is within the basic requirements for nutrition instead of generating unhealthy plan.

The second alternative plan is created by using slack variable. If some requirement cannot be reached, the slack variable will relax some constraints. However, if this happens, the objective value of this program will increase relative score. Usually, this is unworthy, but sometimes it has to violate

DOI: 10.54254/2753-8818/2025.AU29920

the constrain, so the second alternative plan will turn the extra part of request to another kind of "cost". By doing this, the subject of program is not only minimizing the food cost. Rather, this needs to minimize a composite objective function by considering the price and the nutritional value at the same time.

However, not all kinds of situations have two alternative plans. If the alternative plan is the same as the best plan, the alternative plan will not be shown. This help provide a clear and simple plan instead of redundancy one.

The program first shows the distinct range of calories and nutrients for the customers, letting them know how much nutrition should the user intake. Then, it will generate the best meal plan and two alternative plans, and the constituent of this plan includes the price of each food production in this plan.

2.2. Tool

2.2.1. Introduce about the package

PulP is an open-source Python library being widely used for linear programming and optimization. It's very popular in logistics problems, operation research, and supply chain. to help our modelling progress. PulP's embedded mathematical program helps us to convert our input to something that the solver can easily solve. PulP is like a bridge which connects formulae with outside solvers. Automatically, it'll use CBC (Coin-or Branch and Cut) solver, which is used for mixed-integer programming. And it usually used Revised Simplex Method for the linear relaxation part.

2.2.2. How PulP works

First thing is to define the problem and get a scenario of what should be like. We need to think about the data available for the project. This step is significant since we may change the formulation of our project according to the data availability.

Second thing is to identify the key variables, our objectives, the limiting conditions, and identify the data needed. For the variables, we need to pay attention to the unit. For objectives, it could be either maximizing or minimizing. Common choice for objective functions is minimizing cost and maximizing profit. The common limitation to the variables is non-negative and must belong to integer. For data, it's necessary to pay attention to the coefficient and variable bounds.

Third thing is to formulate models. As I mentioned above, PulP'll help to convert it to forms that solvers can easily understand. By default, it'll choose CBC. But you can also connect PulP with other solvers like GLPK, which uses the Revised Simplex Method and an Interior Point Method for LPs, and Gurobi / CPLEX → both have simplex and barrier (interior point) methods, plus advanced heuristics.

After that, it's critical to examine the validity of the result. We can modify some of the coefficients of the model to the changes. This change is also very useful in realistic contexts. We can make more considered and strategic decisions in a more reasonable way. What's more, we can also just intuitively think about whether the result is in accordance with our original assumption of the project and if it makes senses.

Last thing to do is show the results and our thinking process, as shown in Fig.1. PulP will help us translate the solvers' language into data. What we need to do is to translate the data into a concise and easily understandable summary for customers to comprehend.

DOI: 10.54254/2753-8818/2025.AU29920

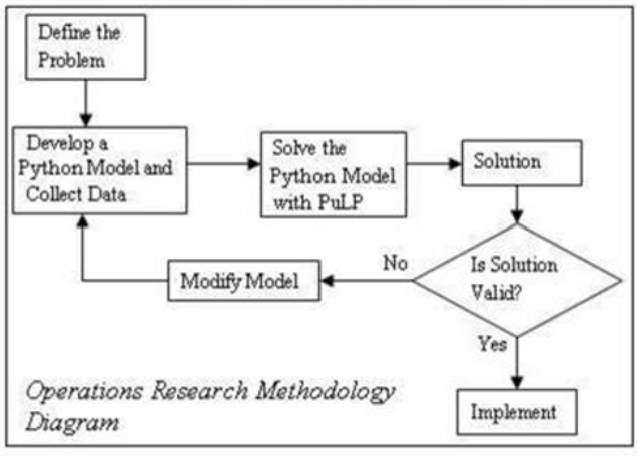

Figure 1. Optimization process in pulp (source: PuLP official documentation (https://coin-or.github.io/pulp/))

2.2.3. Technical features of PulP

PulP can be very technically flexible. It can handle both linear program (LP) and integer linear program (ILP). This is a very crucial aspect since in real life cases, they have different requirements for integers or fractions or binary values.

In addition, PulP can export models we have written in LP or MPS format. In optimization field, these are standard forms that external solvers can understand without the need to rewrite the formulations. That's why PulP is so handy and widely used. This feature also enhances the popularity and utility of the project.

What's more, it fits well in python's environment. PulP can be used in the same time with numpy, pandas, and openpxyl. These features can help us to deal with large number of data and update the data automatically without the need to enter it twice. In this case, PulP can get advantage of both the flexibility of python programming and powerful optimization tools.

2.2.4. Advantage

The first advantage is beginner friendly. We don't need to formulate the direct form of mathematical program into the software of solver. And the form we need to enter is pretty straight forward and handy.

The second advantage is flexibility and reusability. As we have already formed a model, we just need to add different database files so that the model can be used in more contexts, instead of just being used once. This can increase the utility of our project and is very convenient if there is any update in food items in both Lawson or supermarket.

The third advantage is open-source and free. Compared to other commercial solvers, it doesn't charge fees and can be easily downloaded online.

Furthermore, it can be connected to different solvers and databases. It's very convenient as we only need to add new file path to our model.

2.2.5. Conclusion

PuLP makes optimization easier to implement. What's more, it's scalable, reusable, and highly accessible. These features are why it is widely used.

DOI: 10.54254/2753-8818/2025.AU29920

3. Result

The model demonstrated a clear ability to transform complex user inputs into practical, optimized meal plans by combining dietary guidelines, user-specific data, and linear programming techniques. After collecting personal information—including height, weight, age, gender, activity level, allergen factors, dietary goals (weight loss, muscle gain, or maintenance), and available time—the system calculated the individual's basal metabolic rate and total daily energy expenditure, then derived per-meal calorie and macronutrient ranges. Using these ranges as constraints, the model applied cost-minimizing linear programming to search the convenience store or grocery store databases, automatically excluding any food containing allergens. It first displayed the recommended ranges for energy and nutrients, then generated an optimal meal plan and, when feasible, up to two alternative plans. Each plan specified food items alongside their price, energy, protein, fat, carbohydrate, sodium content, and allergen annotations, allowing users to clearly understand the nutritional and economic profile of each option. The alternative plans offered additional flexibility by relaxing some constraints or introducing slack variables to balance cost and nutritional value while maintaining health standards. Taken together, these results show that the model can efficiently and consistently convert abstract nutritional requirements into concrete, customizable, and cost-effective meal plans under real-world conditions, illustrating the practical value of linear programming in everyday diet optimization and providing a robust basis for comparison with existing literature and for future enhancements.

Several examples will be presented next. When a user's available time is less than one hour, the model will generate a set of recipes based on convenience store food for the customer. As shown in Fig.3.1.



Figure 2. Result from Pycharm

As shown in the figure. 2, the client is a 37-year-old male weighing 80 kilograms and standing at 1.8 meters tall. Based on the information he input, it was found that he usually exercises lightly to lose weight and is allergic to cereals. And his available time is 40 minutes. After calculation, the model concluded that this customer needs to consume approximately 3,242-3583 kJ (774-856 kcal) of calories per meal, 80-100g of carbohydrates, 64-76g of protein, 18-23g of fat, and less than 880 milligrams of sodium per meal. As shown in Fig.3.

DOI: 10.54254/2753-8818/2025.AU29920



Figure 3. Result from Pycharm

After calculation, it was found that there was no plan that strictly met all nutritional restrictions and had the lowest price. Fortunately, there was an alternative plan. After slightly lowering the constraints, a complete recipe was obtained. Customers can choose a tuna salad rice ball, a kelp (a kind of seaweed), a “zero degree” penguin dark chocolate and a brown sugar steamed bun. This recipe, on the basis of basically meeting the nutrient requirements and striving to achieve a proper combination, makes the overall price the lowest

When the user's available time exceeds one hour, the model will select ingredients from the supermarket and generate recipes. As shown in Fig.4.



Figure 4. Result from Pycharm

When the user's available time exceeds one hour, the model will select ingredients from the supermarket and generate recipes. In the example, the user is a 45-year-old male who weighs 78 kilograms, is 1.7 meters tall, exercises regularly, wants to build muscle, and is allergic to nuts. After calculation, it is concluded that this user needs to consume approximately 4894-5410 kJ (1169-1292 kcal) of calories per meal, about 151-181g of carbohydrates, 62-81g of protein, 27-34g of fat, and less than 880 milligrams of sodium. As shown in Fig.5.

DOI: 10.54254/2753-8818/2025.AU29920



Figure 5. Result from Pycharm

After obtaining the specific nutrient limits, a recipe can be generated. Although there is no recipe that fully meets the conditions, fortunately, after relaxing the constraints, a recipe was obtained: baby pumpkin, shiitake mushrooms, streaky pork, and avocado. The cooking methods are fried pumpkin strips, pan-fried shiitake mushrooms and stir-fried pork belly. The total price of the final recipe is 43.42 yuan, with a total of 1819KJ of calories, 34.8g of protein, 115.7g of fat, and 653.3 milligrams of sodium

4. Difference between our work and what is in literature

While there is a huge amount of model that can generate specific and exact number for users to evaluate their health situation (e.g. calculator of basal metabolic rate (BMR)) for everyone, none of them create a distinct meal plan for customers. In other words, although these models help people analyze their situation, they require the customers to translate the abstract number into a clear and feasible plan, which consumes a huge amount of time and effort to finish. Moreover, these models usually work with general assumption instead of considering the critical plan for people with special requests, to be more specific, the customers with allergies.

In order to solve this problem, we focus our object on a relatively small number of people: people eat at restaurants who do not have enough time. By combining enough database and linear program with the calculator, our model turns the dull number to practical and optimized recommendation. There are some significant distinctions of our model:

4.1. Practicality

Instead of academic numbers or equations generated by traditional models, our model bridges the gap between daily life and abstract principles and results. By combing nutritional goals with abundant database in the convenience store, our model can provide a particular meal plan in the convenience store.

4.2. Consideration of specific circumstances

Allergy is not a rare circumstance in everyday life; researchers show that there are more than 80 million people over the world who have allergies [21]. Because of this widespread of this instance, our model includes a part that exclude any food that contain the allergen from the database. This seems like easy progress, but it actually provides invaluable convenience for people with this special requirement since they do not have to check the ingredients list after choosing the food products.

DOI: 10.54254/2753-8818/2025.AU29920

4.3. Economy

Our model uses linear programming, with the object of minimizing the total cost and other constraints about calories and macro-nutrition, to generate economical meal plans. There are plenty of passages to show how to eat healthily. However, although financial factors are important for college students and young adults who just step into the job field because of limited budgets, these passages rarely contain the aim of cost minimization or put the cost factor into a consequential position [11].

4.4. Diet with purpose

Since people nowadays have different diet requests, like loss weight or gaining muscle. Our model tries to use some deficit or surplus in the requirement of calories and other macro-nutrients to modify the meal plan.

4.5. Feasibility

This model makes some intentional constraints about the number of different kinds of food, such as staple food. This model asks for the plan to contain at least one piece of staple food to ensure the meal has the basic requirement of the meal.

4.6. Have two circumstances

Besides the data from convenience stores, we also consider the situation that users have enough time to cook by themselves. Thus, we also add data from grocery stores, and also the cooking method which will influence calories and macro-nutrients. It helps create a wide range of uses.

4.7. Discussion

Our data only comes from Lawson and some common supermarkets. Therefore, in areas where Lawson convenience stores are not widespread or where other convenience stores such as 7-Eleven are dominant, the results of our model may have some errors.

Considering regional restrictions (inland residents usually consume seafood less frequently) and seasonal restrictions (some vegetables are not available in winter), although the food in the supermarket section of our model can be obtained normally in most cases, in some cases, users cannot smoothly purchase the ingredients in the recipes provided by the model. When we have obtained sufficient data in the future, we will also take regions and seasons into consideration, enabling the model to provide appropriate recipes based on the region where the user is located and the season at that time

Our model offers fat loss, muscle building, and normal diet recipes suitable for the majority of people and also takes into account the situation where some people are allergic to certain foods. However, it lacks those with diabetes or other diseases. Our current data is insufficient to support us in including these groups of people among our target users

As everyone has different cooking habits and the materials used are difficult to be uniform, we have cited the data from the article for the cooking part and calculated the average value. There are still some uncommon or more complex cooking methods that we have not included in the model

DOI: 10.54254/2753-8818/2025.AU29920

5. Conclusion

This project aims to solve the problem of letting young people with limited budget to eat healthily at convenience stores or cook by themselves. It successively generates healthy, economical, and practical plans for customers to refer in their daily life by using linear program. It helps people make a specific meal plan based on their time cost, special requests, including allergic factors and meal purpose, and physical activity. Compared to some models that exist now, it turns the abstract theory or number into a feasible and distinct plan, combing linear program with real life situations. Our results show that this model can generate a best plan and two alternative plans with minimum cost in a short time period and ensure the plans' accessibility.

However, it also has some disadvantages. First, it does not relate to the consumer's taste and preference. In this case, although the model provides the most nutritional and economical plan for customers, they may disregard the plan since the plan may include something they hate, or they have high appetite to one specific food which is not included in the meal plan. Second, this model do not have the constraint about water and micro-nutrition, such as vitamins and other minerals except sodium because it is difficult to get such information of the food, even to speculate. Accordingly, meal plans generated by the model sometimes are not comprehensive. Third, the data for the model is limited and confined, not only for convenience stores but also for the grocery store. All of the data is forming only one convenience store and one grocery store, and this data does even not include every production in these two places. For example, data in both places do not contain any drinks, which is impossible to happen in real life.

In the future, we hope that in the future, this model can also consider the preference in the flavor for customers, and some other factors like water and micro-nutrient can be added into the constraint to help generate plans that suit better with customer real situations. Besides that, the date for our model can also be enhanced by adding more products according to different places that can by food products, like convenience stores, grocery stores and even shopping centers with various brands. In addition, if it is possible to use this model in real life situations, it needs to build an interactive interface, a website, or an application.

All in all, it seems that although this model shows the efficiency of using linear programming to solve the nutritional problem in real life, it has a lot to modify and improve. But with the advance of technology and methods, it can be a start of application that provide convenience for wider range of people over the world.

Acknowledgement

Yining Hu, Jiayi Zhou, Mingwenxi Bao and Jinhang Li contributed equally to this work and should be considered co-first authors.

References

[1] Cowan-Pyle, AE., Bailey, RL., Gao, J., Hess, JM., Ademu, LO., Smith, JL., Mitchell, DC., & Racine, EF. (2024). Dietary Quality and Diet-Related Factors Among Emerging Adults (18-23 y) in the United States Are a Cause for Concern: National Health and Nutrition Examination Survey 2015-2018. The Journal of Nutrition. 154(8): 2524–253. doi: 10.1016/j.tjnut.2024.06.015. https: //pmc.ncbi.nlm.nih.gov/articles/PMC11826523/

[2] Pipoyan, D., Stepanyan, S., Stepanyan, S., Beglaryan, M., Costantini, L., Molinari, R., & Merendino, N. (2021). The Effect of Trans Fatty Acids on Human Health: Regulation and Consumption Patterns. Foods. 10(10): 2452. doi: 10.3390/foods10102452. https: //pmc.ncbi.nlm.nih.gov/articles/PMC8535577/

[3] Siegrist M, Bearth, A, & Hartmann, C. (2022). The impacts of diet-related health consciousness, food disgust, nutrition knowledge, and the Big Five personality traits on perceived risks in the food domain. Food Quality and

DOI: 10.54254/2753-8818/2025.AU29920

Preference. https: //www.sciencedirect.com/science/article/pii/S0950329321003232#ab005
[4] Poobalan, AS., Aucott, LS., Clarke, A., & Smith, WC. (2014). Diet behaviour among young people in transition to adulthood (18-25 year olds): a mixed method study. Health Psychol Behav Med. 2(1): 909–928. doi: 10.1080/21642850.2014.931232. https: //pmc.ncbi.nlm.nih.gov/articles/PMC4346025/
[5] Lang, M., Chen, P., Li, X., & Ye, Y. (2023). "Refusing appearance anxiety": A content analysis of body positive posts on Chinese social media. Body Image. https: //doi.org/10.1016/j.bodyim.2023.04.002
[6] Deakin University. (2025, March 4). Supermarkets, convenience stores spread junk food diet across world. Deakin University .https: //www.deakin.edu.au/about-deakin/news-and-media-releases/articles/supermarkets, -convenience-stores-spread-junk-food-diet-across-world
[7] NACS. (2019). Convenience stores and their communities: The positive impact U.S. convenience stores have in providing jobs, growing the local economy and supporting community initiatives. NACS. https: //www.lilanduseandzoning.com/wp-content/uploads/sites/937/2020/01/How-Stores-Work.pdf
[8] Eastlake, D. (2024). Convenience over cooking: The unstoppable food trend. FoodNavigator. https: //www.foodnavigator.com/Article/2024/06/26/Convenience-foods-over-cooking-food-trend/
[9] Escoto, KH., Laska, MN., Larson, N., Neumark-Sztainer, D., & Hannan, PJ. (2012). Work hours and perceived time barriers to healthful eating among young adults. Am J Health Behav. 36(6): 786–796. doi: 10.5993/AJHB.36.6.6. https: //pmc.ncbi.nlm.nih.gov/articles/PMC3464955/
[10] Kassraie, A. (2020). 10 Surprisingly Healthy Foods You Can Find at Convenience Stores. AARP. https: //www.aarp.org/health/healthy-living/healthier-choices-convenience-stores/?msockid=0fed63226fa165a2201476ab6e4664e5
[11] Halnon, E. (2025). Healthy eating for weight loss. WebMD. https: //www.webmd.com/women/nutrition-101-how-to-eat-healthy
[12] LAWSON. (n.d.). LAWSON. https: //www.chinalawson.com.cn/product.html
[13] Joseph, M. (2025). 60 types of vegetables and their nutrition facts. Nutrition Advance. https: //www.nutritionadvance.com/healthy-foods/types-of-vegetables/
[14] Mifflin, MD., St Jeor, ST., Hill, L A., Scott, BJ., Daugherty, SA., & Koh, YO. (1990). A new predictive equation for resting energy expenditure in healthy individuals. The American Journal of Clinical Nutrition. 51(2): 241–247. https: //doi.org/10.1093/ajcn/51.2.241
[15] Food and Agriculture Organization of the United Nations. (2003). Chapter 3: Calculation of the Energy Content of Foods - Energy Conversion Factors. https: //www.fao.org/4/y5022e/y5022e04.htm
[16] U.S. Department of Agriculture & U.S. Department of Health and Human Services. (2020). Dietary Guidelines for Americans, 2020-2025 (9th ed.). U.S. Government Publishing Office. https: //www.dietaryguidelines.gov/
[17] ACSM. (n.d.). ACSM Position Stands. ACSM. https: //www.acsm.org/education-resources/pronouncements-scientific-communications/position-stands
[18] Cummings, M. (2024). Protein Calculator: How Much Protein Do You Really Need? BarBend. https: //barbend.com/protein-intake-calculator/ 1
[19] World Health Organization. (2025). Sodium reduction. World Health Organization. https: //www.who.int/news-room/fact-sheets/detail/sodium-reduction
[20] Luckett, C. (2025). How many calories is a good lunch for your daily nutritional needs and energy levels?. Dish Pairing. https: //dishpairing.com/how-many-calories-is-a-good-lunch/#: ~: text=For%20adults%2C%20lunch%20typically%20accounts%20for%2020%25%20to, better%20weight%20management%2C%20increased%20energy%2C%20and%20improved%20focus.
[21] Allergy & Asthma Network. (2025). Allergy statistics in the US. A Complete Guide to Allergies. https: //allergyasthmanetwork.org/allergies/allergy-statistics/#: ~: text=It%E2%80%99s%20estimated%20that%2080%2B%20million%20people%20in%20the, Allergies%20are%20a%20common%20issue%20for%20many%20children.