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GROW MUSCLES NOT BY STEROIDS BUT BY LINEAR ALGEBRA

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ABSTRACT

In today's world, health, nutrition, and diet have become central concerns across various demographics, from urban centers to rural areas. While steroid use remains a common but hazardous approach to muscle growth, an alternative and scientifically grounded method exists: the application of Linear Algebra in nutritional planning for muscle gain. This work explores how the principles of linear algebra can be effectively utilized to design optimal dietary plans that ensure a precise balance of macro nutrients—proteins, carbohydrates, and fats. By framing dietary requirements as a system of linear equations, we are able to determine the ideal combination of food sources to meet an individual's specific nutritional needs. Inspired by optimization techniques widely used in diet formulation, this method offers a mathematically rigorous, efficient, and sustainable approach to muscle growth without relying on harmful substances such as steroids. Through computational analysis and real-world examples, we illustrate how matrix operations and row reduction techniques can be employed to tailor nutrition plans for different body types, training goals, and metabolic requirements. This work demonstrates the potential of mathematics as a powerful tool not only in health and fitness optimization but also in promoting long-term physical well-being, providing a new perspective on how mathematical frameworks can intersect with practical, real-world applications in the realm of nutrition and exercise science.

KEYWORDS: Linear Algebra, Diet Formulation, Nutritional Value

While Steroids bulk you up fast, but do they fuel your health or just wreck it faster? Studies show that steroid use may lead to severe side effects, including liver damage, heart disease, hormonal imbalances, and psychological issues like aggression and depression. Ensuring proper nutrition and physical fitness has always been a significant challenge for everyone, whether a student, a nuclear family, or someone dealing with an illness (Yadav and Dhabas, 2024). Throught out the years there are many ways designed to tackle this problem of diet preparation such as the formula for the Cambridge Diet, Schijf van Vijf and etc. The Cambridge diet is a popular diet problem, provides solution for achieving a clinical diet chart for obese patients. The very low-calorie powdered formula diet combines a precise balance of carbohydrate, high-quality protein, and fat, together with other essential nutrients. The concept of Schijf van Vijf to plan correct diet to maintain BMR (Body Mass Ratio) of a person is calculated by providing proper constraints like nutritional and budget restrictions etc. (Kalayci, 2022). To address the problem of sufficient access to macro- and micro-nutrients at affordable price and proper food combinations have been achieved from new generation of products with specific nutritional characteristics and use of software for industrial and small-scale diet preparations like Oracle E-Business Suite etc is a significant approach to the problem (Musina *et al.*, 2017; Yadav and Dhabas, 2024) formulated the problem as a linear program where the objective was to minimize cost and the constraints are to satisfy the specified nutritional requirements and provide Cost-effective solutions for students and low budgeted people, determined by tools like Tora and excel solver. Authors used mathematical tool like Linear Programming, Non-Linear programming, Dynamic Programming and theory of decisions etc. to attain optimized solutions of Healthcare problems involving Economics and Nutrition (Moreira, 2003; Cristina-Elena and Ciprian-Ionel, 2017) studied nutrient content of a proposed menu which a person generally consumes, throughout an entire day to find an optimal combination of foods to cater the daily nutritional requirements of a person with mathematical optimization methods and tools like Sover tool MS Excel gives useful insights. Most of these approaches demonstrates the problem of healthy diet within different spheres targeting only the healthy section of the society and hence one questions arises: What about people suffering from diseases? How can we implement the same problem to prepare a diet for them

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and find a solution to it. By the use of Linear Algebra, mathematical models are prepared such that a diet with proper nutritional values can be achieved by creating different food groups prepared on the basis of their overall nutrient content and then considering food groups as variable and finding value through a linear equation, usually in vector form. (Moreira, 2003; Kalayci, 2022) This paper advocates for the powerful role of linear algebra, showing how basic concepts such as matrix operations can be effectively used to create personalized dietary plans. We have taken 2 most widespread Modern-Day health problems i.e. Diabetes and cardiovascular disease and made a dietary plan for them. To achieve this, a system of linear equations was formulated to model the relationships between different food items and their nutritional values. The constraints, including daily nutrient requirements and budget limitations, were incorporated into the mathematical model.

METHODOLOGY

Collecting Data

A simple survey is done with neighborhood families and classmates to learn about their eating habits. The purpose was to understand what both healthy people and those with diabetes or cardiovascular disease (CVD) like to eat. People were asked about their favorite foods for breakfast, lunch, and dinner. The survey also aimed to understand their thoughts on healthy eating.

Food nutrient information was taken from the Indian Council of Medical Research and the Ministry of Health. This data helps build the Linear Algebra model. The survey looks at seven important nutrients: protein, healthy fats, carbohydrates, calcium, fiber, sugar, and vitamin C. However, getting all these nutrients in the right amounts at the same time can be challenging.

Since every family has different food choices, the Linear Algebra model is made for each person separately. This means the goals and limits of the model change based on whether a person is healthy or has a medical condition. The limits in the model follow the recommended daily intake Table1 for each nutrient.

Table 1: Estimated Daily intake

S.No.	Nutrient	Daily Intake	Healthy Person	Diabetic Person	A person with CVD
1	Protein	1.8-2.2 g/kg	165g	145g	160g
2	Fats(Healthy Fats)	0.8-1 g/kg	60g	30g	20g
3	Carbohydrates	5-6 g/kg	413g	250g	400g
4	Calcium	1000 mg/day	1000mg	1000mg	1000mg
5	Fiber	25-30 g/day	30g	30g	30g
6	Sugar	≤36 g/day	36g	25g	25g
7	Vitamin C	65 mg/day	65mg	65mg	65mg
8	Energy	2500 cal	2500cal	2500cal	2500cal

FORMULATION

A common mathematical model that can be adapted for each health condition. This provides a simple structure that can be changed to fit different health conditions. The mathematical models in this section are all linear; that is, each describes a problem by means of a linear equation, in matrix form.

Considering a "nutrient vector" for each foodstuff , the amount of nutrients supplied by $x_1$units of oats is the scalar multiple .

(x_1 units oats)*(nutrient per 100g of oats) = $x_1\ b_1$

Then $x_2\ b_2$ and $x_3\ b_3$ give the nutrients supplied by x_2 units of paneer and x_3 units of roti etc. Objective Function:

Maximize: $Z = c_1\ x_1 + c_2\ x_2 + c_3\ x_3 + \ldots\ldots + c_n\ x_n$

where ,

c is the corresponding vector for each nutrient,

x is the desired amount of the nutrient required and Z is the vector that lists the total nutrients required

Constraints:

Nutrient Requirements:

$b_{11}\ x_1 + b_{12}\ x_2 + \ldots\ldots\ldots\ldots + b_{1n}\ x_n \leq$ Protein Target

$b_{21}\ x_1 + b_{22}\ x_2 + \ldots\ldots\ldots\ldots + b_{2n}\ x_n \leq$ Carbohydrate Target

$b_{31}\ x_1+b_{32}\ x_2+.\ .\ .\ .\ .\ .\ .\ .\ .+b_{3n}\ x_n \leq$ Fat Target (healthy fats)

$b_{41}\ x_1+b_{42}\ x_2+.\ .\ .\ .\ .\ .\ .\ .\ .+b_{4n}\ x_n \leq$ Fiber Target

$b_{51}\ x_1+b_{52}\ x_2+.\ .\ .\ .\ .\ .\ .\ .\ .+b_{5n}\ x_n \leq$ Calcium Target

$b_{61}\ x_1+b_{62}\ x_2+.\ .\ .\ .\ .\ .\ .\ .\ .+b_{6n}\ x_n \leq$ Sugar Target (for Diabetes)

$b_{m1}\ x_1+b_{m2}\ x_2+.\quad +b_{mn}\ x_n \leq$Additional nutrient

where, b_1, b_1, ...,b_n are coefficients representing the contribution of each food item to the objective. These coefficients will be different for each health condition based on the specific nutrients being prioritized And b_{mn} is the amount of nutrient type (m) in menu type (n) and x_1, x_2, , $x_n \leq 0$ (non-negativity constraint)

Now, the data collected for the research is based on survey done between our classmates and family. The below data in table 2 , table 3 and table 4 are the example of common choices from their eating habits.

Table 2: Menu for a healthy person

Menu Label	Menu Name	Protein	Carbohydrates	Fat
x_1	Chicken Roti Nut Butter Mixed Vegitable	32g	72g	15g
x_2	Paneer Cooked Millet Dal Almonds	40g	57g	13g
x_3	Rice/Roti Chickpea Table Spoon Ghee Yogurt	20g	170g	7g
Total Daily Need		165g	413g	60g

Table 3: Menu for Diabetic Person

Menu label	Menu Name	Protein	Carbohydrates	Fat	Sugar
x_1	Rice Raita Salmon Fish Almonds	89g	90g	80g	16g
x_2	Rice Dal Paneer Lassi	10g	70g	30g	25g
x_3	Besan Chilla Banana Chickpea Sprount	80g	150g	7g	13g
x_4	Yogurt Roti Kidney bean Chicken	75g	75g	14g	14g
Total Daily Need		145g	250g	30g	25g

Table 4: Menu for a person suffering with Cardiovascular Diseases

Menu Label	Menu Name	Protein	Carbohydrates	Fat
x_1	Roti	90g	50g	11g
	Chicken			
	Spinach			
	Moong Dal			
x_2	Paneer	40g	50g	9g
	Rice			
	Chickpea			
	Dal			
x_3	Idli	40g	110g	5g
	Buttermilk			
	Egg White			
	Dry Vegetable			
Total Daily Need		165g	210g	25g

Implementation

Using the above tables 2, table 3 and table 4 and the information collected through them, we will now solve the linear equations for a healthy, diabetic and a person suffering form cardio vascular diseases.

Healthy Person

$37x_1+40x_2+20x_3=165,$

$71x_1+57x_2+170x_3=413,$

$15x_1+13x_2+7x_3=60$

where x_1 , x_2 , $x_3 \geq 0$

Diabetic Person

$80x_1+10x_2+80x_3+75x_4 =145,$

$90x_1+70x_2+150x_3+75x_4 =250,$

$80x_1+30x_2+7x_3+14x_4 =30,$

$16x_1+25x_2+13x_3+14x_4 =25,$

where x_1 , x_2 , x_3 , $x_4 \geq 0$

A person with cardiovascular disease

$90x_1+40x_2+40x_3=145,$

$50x_1+50x_2+110x_3=400,$

$11x_1+9x_2+5x_3=60$

where x_1 , x_2 , $x_3 \geq 0$

RESULTS AND DISCUSSION

Bases on the equation formed and data collected from survey using *Wolfarm Alpha* software for respective people of different health condition. The result of nutrient and food intake are as follow:

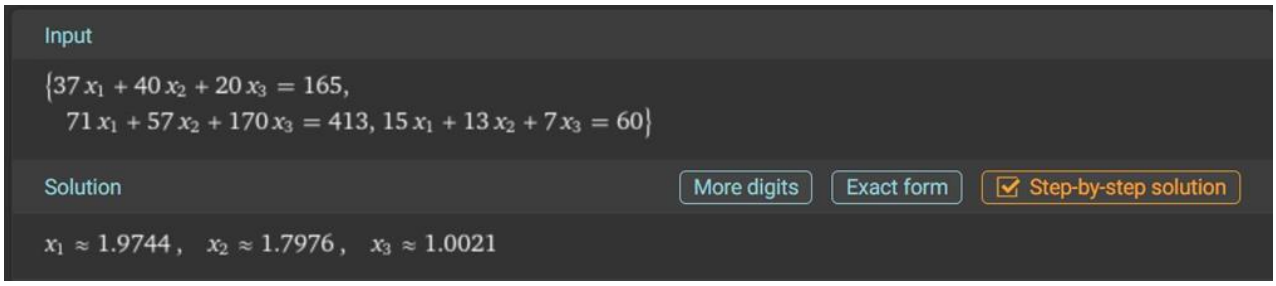

Figure 1: Optimum Nutrient intake for a Healthy Person

The above figure 1 is the outcome that in what amount the surveyed food combination should be taken for required amount of protein, carbohydrates and fats. Based on the solution of the above equations, the suggested daily serving for different food are as follow:

$x_1 \approx 2$ $x_2 \approx 1.8$ $x_3 \approx 1$

1. Food A→{Chicken, Roti, Nut Butter, Mixed Vegetable} is recommended as 2 serving per day.
2. Food B→{Paneer, Cooked Millet, Dal , Almonds} is recommended as 1.5 serving per day.
3. Food C→{Roti , Chickpea ,Ghee , Yogurt } is recommended as 1 serving per day.

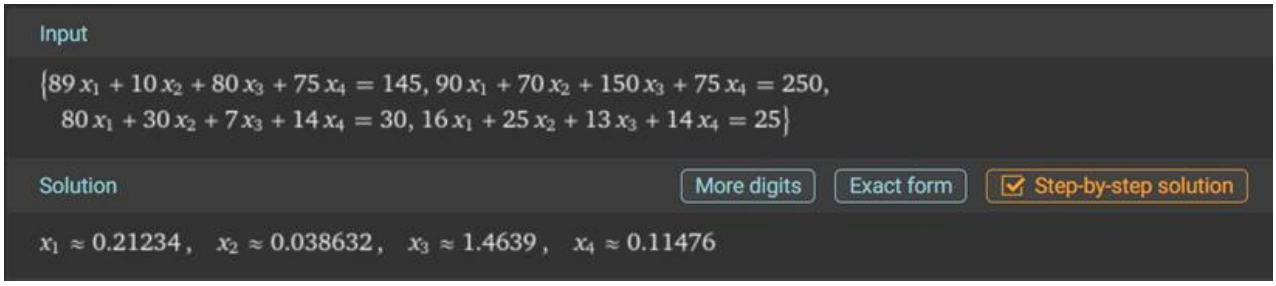

Figure 2: Optimum Nutrient intake for Diabetic person

The above figure 2 is the outcome that in what amount the surveyed food combination should be consumed by the diabetic person .Based on solution of the equation for a diabetic person the suggested daily serving for different food as follows:

x_1 ≈0.21

x_2 ≈0.03

x_3 ≈1.5

x_4 ≈0.1

Food A→ *{*Rice, Raita, fish, Almonds*}*

According to the solution this food group should be taken in minimalist amount can be considered with other food groups as side dish

Food B→ *{*Rice, Dal, Panner, Lassi*}*

The Recommended Daily intake is coming out be 0.03 serving which can be considered as negligible hence food group B can be ignored or taken in a very minute quantity with other food Group B.

Food C→ *{*Besan Chilla, Banana, Chickpea, Sprout*}*

The intake is 1.46 ≈ 1.5 serving daily can be taken in any time of day. 4-Food D→ *{*Yogurt, Roti, Kidney bean, Chicken*}*

Also the Recommended Daily Intake is coming out to be 0.1 serving which can be taken with other food groups for daily Requirement.

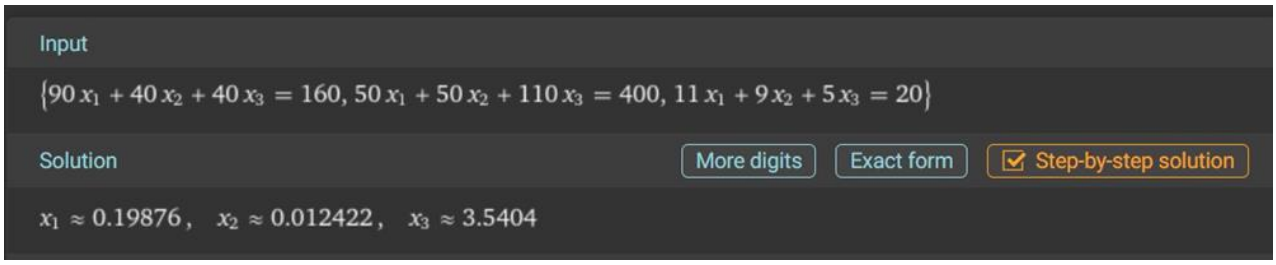

Figure 3: Optimum Nutrient intake for a person with Cardio Vascular Diseases

The above figure 3 is the outcome that in what amount the surveyed food combination should be consumed by a person with cardiovascular disease for their daily requires intake of protein, carbohydrates and fats. Recommended Daily Intake is coming out to be 0.1 serving which can be taken with other food groups for daily Requirement. For a person suffering from Cardiovascular Disease the suggested daily serving for different food groups.

x_1 ≈ 0.1

x_2 ≈0.01

x_3 ≈3.5

FOOD A→*{*Roti, Chicken, Spinenet, Moong Dal*}*

The Daily intake is coming to be 0.1 serving which is very low to be taken as a whole so it can be taken it could be other food groups.

FOOD B→ *{*Panner, Rice, Chickpea, Dal*}*

The result is coming out be to be 0.01 serving which can be neglected or we can take any one item of Recom- mended food group with other groups.

FOOD C→ *{*Idli, Buttermilk, Egg White, Dry Vegetable*}*

The Daily Recommended intake for food group C is 3.5 serving daily, which should be taken other food is with groups which are in smaller smaller serving

CONCLUSION

This paper has presented a novel approach to muscle growth using linear algebra, offering an achievable alter- native to harmful steroids and other industrially prepared nutritional supplements. By modeling different food groups based on their nutritional content and dietary requirements as systems of linear equations, we can design personalized nutrition plans that optimize proper nutrition while prioritizing health. By this method we can prepare plans for individual body types, their deficiencies, and making it a powerful tool for promoting long- term physical well-being and addressing diseases if any. This work demonstrates the potential of mathematics to address real-world challenges in health and fitness, which offers a new way of looking at how mathematical frameworks apply to real-world problems. It bridges the gap between abstract concepts and practical solutions. Future studies could look into adding more factors, like budget limitations or personal food preferences, to make nutrition plans more tailored. This would help in creating meal plans that are both effective and more suited to individual needs. This approach not only benefits individuals but also contributes to a healthier global community by promoting sustainable and science-backed methods for achieving fitness goal.

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