WQD7011
NUMERICAL OPTIMIZATION
2022/2023 SEMESTER 2

DIET COST OPTIMIZATION

GROUP ASSIGNMENT

NUMERICAL OPTIMIZATION (FOUR-WARD THINKERS)		
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1 Introduction

Maintaining a healthy lifestyle is essential, and optimizing the cost for diet plays a critical role in achieving this goal. Food stands as one of humanity's essential requirements, yet maintaining a healthy diet can prove daunting for many individuals. The ascent in healthcare expenses has prompted researchers to turn towards machine learning techniques to help optimize diets and lessen the expense of nutritious food. By employing these methods, not only do individuals benefit from cost-effective and healthy eating habits but also institutions and communities at large. In recent years, machine learning algorithms have become increasingly sophisticated enabling analysis of vast nutritional datasets. Schools and hospitals encounter similar challenges providing wholesome meals at affordable prices; therefore, they could significantly profit by optimizing their menus through the aid of machine learning techniques. Additionally, communities that lack access to inexpensive nutrient-rich food can benefit from practical solutions offered through diet optimization. Given the immense potential benefits on both personal and institutional levels, further research is imperative for optimum results regarding diet optimization using machine learning techniques.

1.1 Problem Statement

For many individuals, maintaining a healthy diet proves to be difficult particularly for those on a tight budget. Regrettably, the cost of healthy food items often serves as a barrier preventing consumers from making health-conscious choices and instead settling for cheaper but less nutritious alternatives. Moreover, the fact that dietary recommendations are in constant flux, leaving many at odds with what they should consume and how much they ought to spend. In matters of optimizing diets, machine learning algorithms and numerical optimization methods hold extraordinary promise. By capitalizing on their capabilities, it may very well become feasible to pinpoint affordable substitutes for costly yet widely popular food, ultimately fostering wholesome eating habits while reducing costs.

1.2 Objectives

- To identify the right numerical optimization techniques for diet cost optimization.
- To examine the constraints and limitations associated with diet cost optimization.
- To build a model that finds optimal diets that meet nutritional requirements with the minimum cost.

2 Discussion

2.1 Study Problem

Many individuals hold the belief that healthy food comes at a higher cost, and research has indeed demonstrated that unhealthy food tends to be approximately $1.50 cheaper per day compared to healthier food options (Rao et al., 2013). To exacerbate the situation further, the prices of food have surged due to the economic downturn caused by the Covid-19 pandemic, reaching levels comparable to the peak of the global food price crisis experienced in 2007 and 2010, according to the FAO food price index. The rising cost of food has presented challenges for individuals striving to maintain a nutritious diet. However, there is a glimmer of hope that the situation can be

improved through the application of mathematical algorithms to devise meal plans that are both cost-effective and nutritionally adequate.

According to Tadia (2021), operational research techniques using machine learning present an optimistic answer by optimizing menu planning to meet the day-to-day nutritional requirements of patients at a lower cost. Also, in a study conducted by Corrêa (2019), it was argued that using algorithmic models for meal planning provides individuals the ability to make comparisons between various options and select those with the highest nutritional value at a lower expense. By distributing foods based on their nutritional worth rather than just their costs, algorithms can ensure meals are balanced and filled with nutrients without breaking the bank. With food prices continuously on the rise and its repercussion for public health increasing, employing these intelligent systems can provide individuals with affordable and nutritious alternatives that would otherwise be unavailable.

From business perspectives, these algorithms are anticipated to yield benefits for numerous industries, with the health and wellness sector being particularly poised to gain advantages. Despite the significance of nutrition for health and recuperation during hospitalization, medical institutions are struggling to deliver meals that adequately meet patients' daily dietary needs. Research has proposed that limited availability of nutritionists and dietitians within hospitals is one of the contributing factors to this issue (Yona et al., 2020). The implementation of algorithms presents an opportunity for medical institutions to streamline the process of creating personalized meal plans that cater to specific dietary restrictions, allergies, and health conditions of patients. Simultaneously, these algorithms can assist institutions to achieve a delicate balance between providing optimal nutrition and maintaining affordability. In fact, this technology not only benefit the institutions, but also has the potential to offer significant benefits to a wide range of individuals, particularly health-conscious individuals who depend on health and fitness mobile apps to plan their daily meals and track food intake for weight management and overall health objectives. This functionality can be seamlessly integrated into a diet-tracking app, allowing users to receive tailored suggestions for cost-effective meal plans that meet their nutritional needs based on historical plans, daily preferences, and even specific meal planning objectives.

2.2 Data Collection

To build a diet cost optimization model, the following set of information are collected:

1. **Food Composition Data:**

   The data includes information of nutrition components in different food items, including calories and 5 major macronutrients (carbohydrates, proteins, fats, cholesterol, and fibre). The food items are divided into 8 food groups, which are Fruits, Vegetables, Grains, Poultry/Meat/Egg, Fish, Milk and Milk Products, Legumes and Fats/Oils, based on the Malaysian Food Pyramid 2020 suggested by the Ministry of Health Malaysia. There are 5 different foods gathered for each food group, resulting in a total of 40 different foods in our dataset. The nutrients of each food item are based on its recommended single serving size. The food composition data with the full reference list table on nutrition breakdown and food serving size are displayed in Appendix 7.1 and Appendix 7.2 respectively.

2. **Food Price Data:**
   The data describes the cost of 40 different food items per food item serving, where the cost is calculated based on the weight of single serving size in grams. Note that the cost is based on price in common hypermarkets or shopping platform resellers in Malaysia. As such, the food price collected is served as a benchmark only, as it may vary by brand, platforms, locations etc. The food price data is attached as part of the food composition data in Appendix 7.1, while the references for prices for each item are shown in the full reference list table in Appendix 7.2.

3. **Dietary Guidelines:**
   The data outlines the required daily serving guidelines for the 8 main food groups based on the Malaysian Food Pyramid 2020 which is shown in Appendix 7.3. In summary, the recommended daily serving for each food groups are: ≥ 3 servings of vegetables, 2 servings of fruits, 3 to 5 servings of grains, 1 serving of fish, 1 to 2 servings of poultry/eggs/meat, 1 serving of legumes, 2 servings of milk and milk products and limited intake of fats/oils. Note that the suggested serving size is based on the majority of the population.
4. **Nutritional Targets:**
   The data as shown in Appendix 7.4 showcases the recommended nutrient intakes for different populations groups based on gender, age, and level of physical activity. The population are grouped into 2 genders (male and female), 4 age groups (16 to 17, 18 to 29, 30 to 59, and ≥ 60 years old) and 4 level of physical activity (PAL). The rationale behind selecting this grouping is attributed to the substantial differences in calorie and macronutrient needs based on these factors. The desired nutritional goals such as calorie limits, macronutrients ratio or constraints for each group are based on the Malaysia Recommended Nutrient Intakes guideline published in 2017 by Ministry of Health Malaysia. An optimized diet plan will be designed for each population group in the 32 distinct groups, with a list of constraints which will be discussed in the Modelling stage.

2.3 Algorithms and Tools Applied

Linear programming is a tool for optimizing complex systems and finding the most cost-effective solutions. One area in which it has proven particularly effective is in creating diet plans that meet nutritional requirements while minimizing costs. As Alaini et al. (2019) note, linear programming can be used to translate dietary guidelines into a well-balanced menu that promotes cancer prevention at minimal cost. By analyzing the nutrient content of various foods and factoring in their respective costs, one can create an optimized meal plan that meets all necessary criteria while also being affordable and accessible Donato (2020). This approach has numerous applications beyond just cancer prevention, as it allows for personalized diets tailored to individual needs and preferences without sacrificing quality or nutrition. With the rising prevalence of chronic diseases such as obesity and diabetes, utilizing tools like linear programming to create healthy eating habits will only become more important in ensuring optimal health outcomes for individuals across all demographics (Gupta, Haq, & Ali, 2022).

Octave is an open-source numerical computing package that can be used to track food expenses and optimize grocery shopping. By using Octave, individuals can save money while enjoying a varied and healthy diet. This powerful tool can analyze spending habits, identify areas of overspending or underspending on certain nutrients, and adjust accordingly. According to Krynke and Mielczarek (2021), Octave offers a service that generates personalized grocery lists based on an individual's dietary preferences and budget. Moreover, Octave can assist in making informed decisions about what foods to buy, promotes healthy eating habits by encouraging individuals to choose nutrient-dense options that fit within their financial means. Based on research done by Abrishami, et.al, (2023), with Octave's recipe database and meal planning tools, you can easily and affordably incorporate more plant-based foods into your diet. As Abrishami, et.al (2023) points out, "Octave's recipe database and meal planning tools make it easy to incorporate more plant-based foods without breaking the bank", this would help individuals who are looking for ways to improve their overall health by consuming less meat and processed foods. With all these benefits in mind, taking advantage of Octave's resources seems like a no-brainer when it comes to maintaining a healthy lifestyle on a budget.

3 Modelling

Constrained optimization is used to find the minimum objective function while fulfilling a set of constraints. In our project, as both objective function and the constraints are in linear form, we are solving a linear programming type of constrained optimization problem.

Our objective is to find out the minimum cost for a healthy diet plan and 40 types of food coming from different food groups are selected to provide a variety of choices for end users. Thus:

Standard Form:

$$\min f(x)\ s.t. Ax = b, \qquad x \geq 0$$

Where vectors b, c, x and matrix A :

$c, x \in \mathbb{R}^{n}$, $b \in \mathbb{R}^{m}$, $A \in \mathbb{R}^{m\,x\,n}$

$c, x \in \mathbb{R}^{40}$, $b \in \mathbb{R}^{20}$, $A \in \mathbb{R}^{20\,x\,40}$

m: 20 constraints, i.e. $c_1, c_2, c_3, \ldots c_{20}$

n: 40 variables, i.e. $x_1, x_2, x_3, \ldots x_{40}$

Decision Variables:

The following represents the decision variables.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
u	v	w	x	y	z	aa	ab	ac	ad	ae	af	ag	ah	ai	aj	ak	al	am	an

Cost Function:

$$Min\ f(x) = 0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an$$

The cost function is a linear function with 40 decision variables. Cost per serving size represents the coefficient of each variable. The linear functions are smooth and have continuous derivatives of all orders. Therefore, it is considered a smooth cost function.

There are a total of 20 constraints which consist of both equality (E) and inequality (I) forms, as stated below.

Subject to:

Daily nutrients requirements

Calories constraint:

$$179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2050 \qquad \boldsymbol{i} \in \mathbf{E}$$

Protein constraint:

$$14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an \geq 51 \qquad \boldsymbol{i} \in \mathbf{I}$$

Carbohydrates constraints:

$$1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an \geq 256.25 \qquad \boldsymbol{i} \in \mathbf{I}$$

$$1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an \leq 333.13 \qquad \boldsymbol{i} \in \mathbf{I}$$

Fats constraints:

$$12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an \geq 65 \qquad \boldsymbol{i} \in \mathbf{I}$$

$$12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an \leq 91 \qquad \boldsymbol{i} \in \mathbf{I}$$

Cholesterol constraint:

$$432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an \leq 300 \qquad \boldsymbol{i} \in \mathbf{I}$$

Fibre Constraints:

$$0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an \geq 20 \qquad \boldsymbol{i} \in \mathbf{I}$$

$$0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an \leq 30 \qquad \boldsymbol{i} \in \mathbf{I}$$

Food Group

Poultry/Meat/Egg constraints:

$$a + i + p + z + aa \geq 1 \qquad \boldsymbol{i} \in \mathbf{I}$$

$$a + i + p + z + aa \leq 2 \qquad \boldsymbol{i} \in \mathbf{I}$$

Vegetable constraints:

$$b + g + j + o + u \geq 3 \qquad \boldsymbol{i} \in \mathbf{I}$$

$$b + g + j + o + u \leq 5 \qquad \boldsymbol{i} \in \mathbf{I}$$

Grains constraints:

$$c + l + q + x + y \geq 3 \qquad \boldsymbol{i} \in \mathbf{I}$$

$$c + l + q + x + y \leq 5 \qquad \boldsymbol{i} \in \mathbf{I}$$

Fruit constraint:

$$d + f + k + v + w = 2 \qquad \boldsymbol{i} \in \mathbf{E}$$

Milk/Milk Products constraint:

$$e + h + r + ab + ac = 2 \qquad \boldsymbol{i} \in \mathbf{E}$$

Fish constraint:
$m + ah + ai + aj + ak = 1 \quad \boldsymbol{i} \in \mathbf{E}$

Legumes constraint:
$n + ad + ae + af + ag = 1 \quad \boldsymbol{i} \in \mathbf{E}$

Fats/Oils constraint:
$s + t + al + am + an \leq 1 \quad \boldsymbol{i} \in \mathbf{I}$

For the daily nutrients requirement constraints, the coefficients (A) of each food are derived from the suggested serving size, whereas the right-hand side vector (b) is derived from the daily nutrients requirement of each individual that varies according to the age, gender, and level of physical activity of individuals. **In the example given above, the individual's age range is between 16-17, male with 1.4 PAL.** Refer to the Appendix 7.4 for RNI table of different age group, gender, and PAL.

For the food group constraints, the sum of food quantity from the same food group are limited to the suggested daily food intake, which is in accordance with the Malaysian Food Pyramid 2020.

Bounds:
All decision variables ≥ 0

Optimization Method:
Simplex method can be used to solve this linear programming problem manually. Alternatively, it can be easily solved using Octave programming, as shown in Appendix 7.5.

Appendix 7.5 is only for 1 population group (age 16-17, male with 1.4 PAL). Refer to Appendix 7.7 & 7.8 for all the constraints equations for other groupings.

4 Results

Table 4.1 below is based on the minimum cost generated by Octave as shown in Appendix 7.5.

	Actual	Daily Nutrients Required
Min Cost Function	9.41	
Calories	2050	= 2050
Protein	83.78	≥ 51
Carbohydrates	281.00	256.25≤ x ≤ 333.13
Fats	65.00	65 ≤ x ≤ 91
Cholesterol	300	≤ 300
Fibre	27.67	20 ≤ x ≤ 30
Poultry/ Meat/ Egg	1	1 ≤ x ≤ 2
Vegetable	3	3 ≤ x ≤ 5
Grains	5	3 ≤ x ≤ 5
Fruit	2	= 2
Milk & Milk Products	2	= 2
Fish	1	= 1
Legumes	1	= 1
Fats /oils	1	= 1

Table 4.1 Minimum Cost, Nutrients and Food Group that meet all constraints

Using fmin function in Octave, Table 4.1 shows that the minimum cost to get a daily healthy diet plan for population group (age 16-17, male with 1.4 PAL) is RM9.41, which is RM3.14 per meal, while fulfilling all the constraints, i.e., daily nutrients requirement and food group constraints.

Table 4.2 below shows the optimal combination and amount of foods that are able to meet the requirements/constraints with the minimum cost in Table 4.1.

Food Type and Size	**Formula (Value Generated by Octave * Single Serving Size)**
37 g of Hard-boiled Egg	0.3151 * 116g
38 g of Cucumber	0.726 * 52 g
203 g of Cabbage	2.274 * 89 g
42 g of Cooked Beef	0.4894 * 85g
280 g of Fettuccine	5 * 56g
280 g of Orange	2 * 140g
2 g of Bacon	0.1955 * 8g
12 g of Butter	2 * 5.7g
90 g of Red Kidney Bean	1 * 90g
143 g of Catfish	1 * 143g
14 g of Cooking Oil	1 * 14g

Table 4.2 Optimal Foods Combos and its Servings Size

Using xmin function in Octave, the output indicates the coefficient for each food item. In this scenario, the recommended daily food consumption for a 16 - 17 years old young man with PAL of 1.4 is the combination of foods in Table 4.2. Of all 40 food types, 11 coefficients generated non-zero values as shown in Table 4.2 while the rest are zero in values.

Appendix 7.6 showcased the recommended food combinations and serving size for each food items with the minimum cost for all 32 population groups. The diet with highest cost belongs to age group 18-29, male with PAL of 2.0 with a daily cost of RM 38.60, equivalent to RM12.67 per meal. This is due to high nutrients required for high level of physical activity at that age group. Female senior citizen age above 60 with 1.4 PAL has the lowest daily cost of RM7.46.

From the results, we can conclude that:
1. The higher the PAL, the higher the cost as more nutrients are required.
2. Cost for male is relatively higher than female in general.
3. The diet cost decreases as age increases, which is justifiable as adolescent requires more nutrients during puberty stage.

5 Conclusion

In modern society, there is a heightened emphasis on the significance of healthy eating and sustainability. Consequently, it becomes imperative to explore innovative approaches for optimizing the cost of our diets without compromising nutritional value. The utilization of machine learning algorithms and numerical optimization techniques provides a promising avenue to empower individuals in their pursuit of healthier food choices.

In this study, we have analyzed how machine learning can optimize diet costs while acknowledging the challenges on the feasibility and sustainability of the solutions. A healthy diet plan should vary based on individuals from different age groups, gender, and level of physical activity, instead of producing a one-size-fits-all solution. This variation is due to the different needs of daily nutrients requirements by each individual. Nonetheless, data collected has to be localized and food ingredients have to be made accessible to consumers to ensure that the end result of this project is realistic and beneficial to society. Based on the data gathered, linear programming emerges as the ideal technique for implementing a diet cost optimization model due to its compatibility with linearly expressed objective functions (minimizing cost) and constraints (nutritional requirements, recommended dietary intakes), efficiency and flexibility in handling large-scale problems. The study successfully accomplished all objectives, including the primary goal of minimizing diet costs without compromising nutritional requirements through the implementation of linear programming algorithm using Octave.

Thus far, the initial outcomes indicate considerable potential benefits from using machine learning techniques to optimize diet costs effectively. In the near future, there are promising opportunities to harness the power of large datasets for more dynamic decision-making processes that will identify better alternatives that are lower cost but equally nutrient-dense. This includes exploring additional variables, collecting more comprehensive data, refining objective functions, and even leveraging technology to achieve real-time meal planning. Undoubtedly, continued research and innovation in this field can further advance the implementation of diet cost optimization, ultimately leading to enhanced nutrition and overall well-being for both individuals and society as a whole.

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7 Appendix

7.1 Food Composition and Costs

Food	Food Group	Serving Size (g)	Calories (kcal)	Protein (g)	Carbs (g)	Fats (g)	Cholesterol (mg)	Fibre (g)	Cost per serving (RM)
Hard-boiled Egg	Poultry/ Meat/ Egg	116	179.8	14.6	1.3	12.8	432.7	0	0.87
Cucumber	Vegetable	52	9.0	0.4	2.2	0.1	0	0.3	0.25
Whole wheat Bread	Grains	33	91.0	4.4	15.5	1.3	0	2.2	0.28
Banana	Fruit	118	105.0	1.3	27	0.4	0	3.1	0.77
Sliced Cheese	Milk & Milk Products	17	68.4	4.0	0.4	5.7	16.5	0	0.73
Avocado	Fruit	50	83.5	1.1	3.9	7.5	0.0	6.8	0.78
Tomato	Vegetable	180	32.0	0.4	7	1.6	0	2.2	0.70
Greek Yogurt	Milk & Milk Products	170	100.3	17.3	6.1	0.7	8.5	0	5.73
Grilled Chicken	Poultry/ Meat/ Egg	100	151.0	30.5	0.0	3.2	104.0	0	3.26
Cabbage	Vegetable	89	30.0	1	8	0	0	2	0.33
Apple	Fruit	182	95.0	0.5	25	0.3	0	4.4	1.58
Brown rice	Grains	100	124.0	2.8	25.8	1	0	1.6	0.21
Cooked Tilapia	Fish	85	108.8	22.2	0.0	2.3	48.5	0	2.14
Japanese Pressed Tofu	Legumes	85	40.0	5.4	4.3	0.1	0.0	0	0.52
Oyster Mushroom	Vegetable	86	28.0	2.8	5.2	0.4	0	0	1.68
Cooked Beef	Poultry/ Meat/ Egg	85	578.0	9.1	0.0	59.5	80.8	0	3.50
Fettuccine	Grains	56	210.0	7	42	1	0	2	0.47
Milk	Milk & Milk Products	227	61.0	3.2	4.8	3.3	10	0	1.61
Almonds	Fats /oils	28	164.2	6.0	6.1	14.2	0.0	12.5	3.54
Sesame Seeds	Fats /oils	36	206.3	6.4	8.4	18.0	0.0	11.8	4.25
Broccoli	Vegetable	90	30.0	2.5	5.9	0.3	0.0	2.3	1.47
Orange	Fruit	140	62.0	1.2	15.4	0.2	0.0	3.1	0.49
Pear	Fruit	178	102.0	0.6	27.1	0.2	0.0	5.5	2.90

Food	Food Group	Serving Size (g)	Calories (kcal)	Protein (g)	Carbs (g)	Fats (g)	Cholesterol (mg)	Fibre (g)	Cost per serving (RM)
Toasted Oats Cereal	Grains	30	120.0	4.0	22.0	1.0	0.0	3	1.46
Rice Vermicelli	Grains	50	186.0	3.9	41.0	0.0	0.0	0	0.92
Broiled Lamb	Poultry/ Meat/ Egg	85	241.0	21.0	0.0	16.7	82.5	0	5.30
Bacon	Poultry/ Meat/ Egg	8	42.0	3.0	0.0	3.0	9.0	0	0.54
Cream Cheese	Milk & Milk Products	28	99.0	1.7	1.6	9.8	28.6	0	1.39
Butter	Milk & Milk Products	5.7	32.0	0.0	0.0	3.6	9.7	0	0.30
Chickpea	Legumes	164	269.0	14.5	45.0	4.0	0.0	12.5	2.12
Pigeon Peas	Legumes	200	198.0	10.4	26.2	6.3	13.0	8.7	1.49
Red kidney bean	Legumes	90	113.5	7.8	20.0	0.5	0.0	6.7	0.67
Green peas	Legumes	89	70.0	5.0	12.0	0.0	0.0	4	0.89
Catfish	Fish	143	150.0	26.4	0.0	4.1	103.0	0	1.70
Saba Mackerel	Fish	100	202.0	19.0	0.0	14.0	0.0	0	3.18
Canned Tuna	Fish	56	50.0	10.0	1.0	1.0	25.0	0	1.57
Red Snapper	Fish	170	218.0	45.0	0.0	2.9	80.0	0	8.49
Extra Virgin Olive Oil	Fats /oils	14	119.0	0.0	0.0	14.0	0.0	0	0.76
Peanut	Fats /oils	28	161.0	7.3	4.6	14.0	0.0	2.4	0.29
Cooking Oil	Fats /oils	14	126.0	0.0	0.0	14.0	0.0	0	0.09

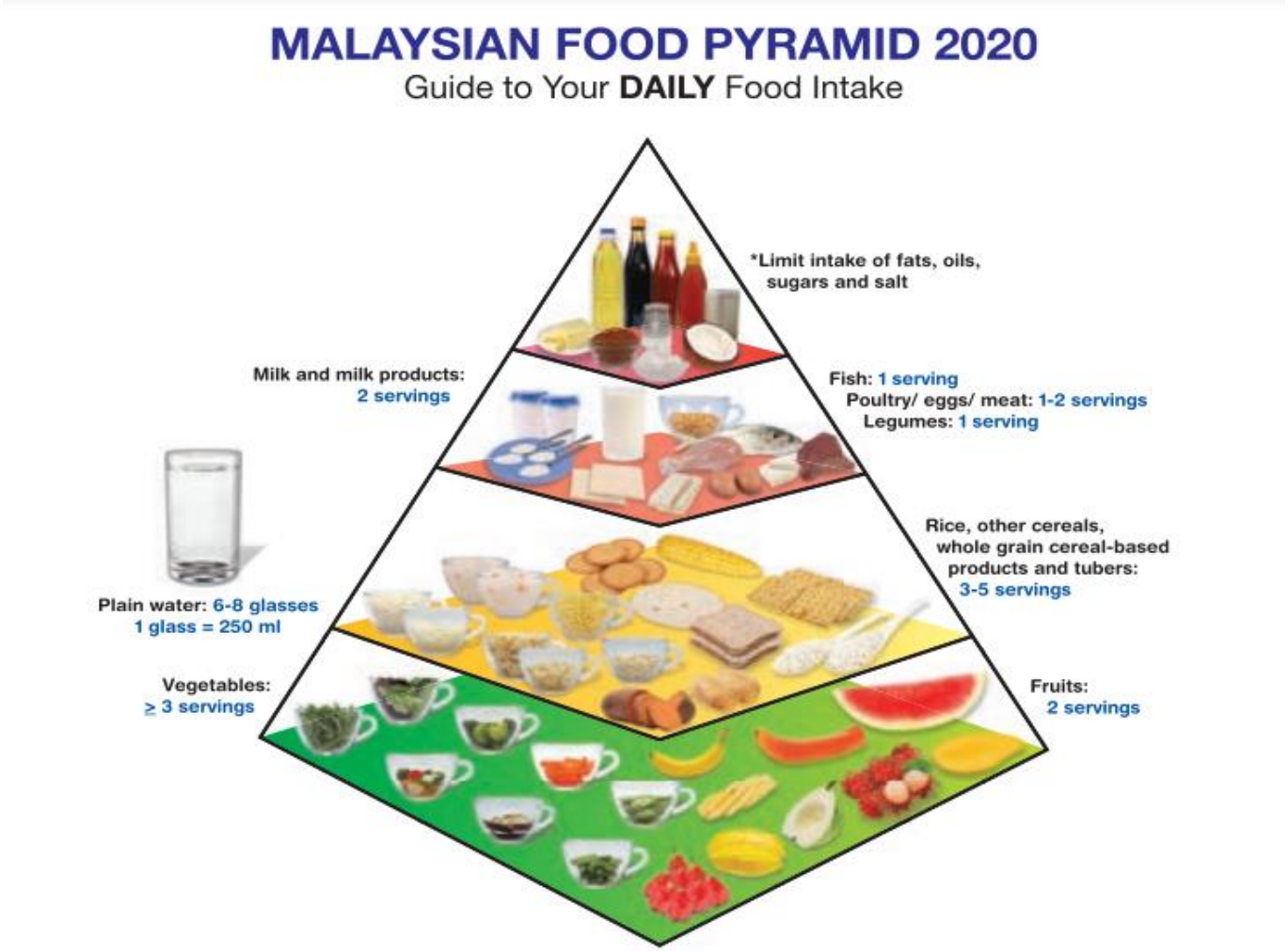
7.2 Food Servings, Nutrients/Calories, and Cost (Full Reference List)

Food	Reference			
	Servings	**Nutrients/Calories**	**Cost**	**Cooked & Uncooked**
Hard-boiled Egg	Single Serving Size of Egg	Egg Nutrients and Calories	Cost of egg	
Cucumber	Single Serving Size of Cucumber	Cucumber Nutrients and Calories	Cost of cucumber	
Whole wheat Bread	Single Serving Size of Whole Wheat Bread	Whole Wheat Bread Nutrients and Calories	Cost of whole wheat bread	
Banana	Single Serving Size of Banana	Banana Nutrients and Calories	Cost of banana	
Sliced Cheese	Single Serving Size of Sliced Cheese	Sliced Cheese Nutrients and Calories	Cost of sliced cheese	
Avocado	Single Serving Size of Avocado	Avocado Nutrients and Calories	Cost of avocado	
Tomato	Single Serving Size of Tomato	Tomato Nutrients and Calories	Cost of tomato	
Greek Yogurt	Single Serving Size of Greek Yogurt	Greek Yogurt Nutrients and Calories	Cost of greek yogurt	
Grilled Chicken	Single Serving Size of Grilled Chicken	Grilled Chicken Nutrients and Calories	Cost of grilled chicken	
Cabbage	Single Serving Size of Cabbage	Cabbage Nutrients and Calories	Cost of cabbage	
Apple	Single Serving Size of Apple	Apple Nutrients and Calories	Cost of apple	
Brown rice	Single Serving Size of Brown Rice	Brown Rice Nutrients and Calories	Cost of brown rice	Brown Rice: Cooked VS Uncooked
Cooked Tilapia	Single Serving Size of Tilapia	Tilapia Nutrients and Calories	Cost of Tilapia	
Japanese Pressed Tofu	Single Serving Size of Tofu	Tofu Nutrients and Calories	Cost of tofu	

Food	Reference			
	Servings	Nutrients/Calories	Cost	Cooked & Uncooked
Oyster Mushroom	Single Serving Size of Oyster Mushroom	Oyster Mushroom Nutrients and Calories	Cost of oyster mushroom	
Cooked Beef	Single Serving Size of Beef	Beef Nutrients and Calories	Cost of beef	
Fettuccine	Single Serving Size of Fettuccine	Fettuccine Nutrients and Calories	Cost of fettuccine	
Milk	Single Serving Size of Milk	Milk Nutrients and Calories	Cost of milk	
Almonds	Single Serving Size of Almonds	Almonds Nutrients and Calories	Cost of almonds	
Sesame Seeds	Single Serving Size of Sesame Seeds	Sesame Seeds Nutrients and Calories	Cost of sesame seeds	
Broccoli	Single Serving Size of Broccoli	Broccoli Nutrients and Calories	Cost of broccoli	
Orange	Single Serving Size of Orange	Orange Nutrients and Calories	Cost of orange	
Pear	Single Serving Size of Pear	Pear Nutrients and Calories	Cost of pear	
Toasted Oats Cereal	Single Serving Size of Toasted Oats Cereal	Toasted Oat Cereal Nutrients and Calories	Cost of toasted oat cereal	
Rice Vermicelli	Single Serving Size of Rice Vermicelli & Nutrients and Calories		Cost of rice vermicelli	
Broiled Lamb	Single Serving Size of Lamb	Lamb Nutrients and Calories	Cost of lamb	
Bacon	Single Serving Size of Bacon	Bacon Nutrients and Calories	Cost of bacon	
Cream Cheese	Single Serving Size of Cream Cheese	Cream Cheese Nutrients and Calories	Cost of cream cheese	
Butter	Single Serving Size of Butter	Butter Nutrients and Calories	Cost of butter	

Food	Reference			
	Servings	Nutrients/Calories	Cost	Cooked & Uncooked
Chickpea	Single Serving Size of Chickpea & Nutrients and Calories		Cost of chickpea	
Pigeon Peas	Single Serving Size of Pigeon Peas	Pigeon Peas Nutrients and Calories	Cost of pigeon peas	Pigeon Peas: Cooked VS Uncooked
Red kidney bean	Single Serving Size of red Kidney Bean & Nutrients and Calories		Cost of red kidney beans	Red kidney bean: Cooked VS Uncooked
Green peas	Single Serving Size of Green Peas		Cost of green peas	
Catfish	Single Serving Size of Catfish		Cost of catfish	
Saba Mackerel	Single Serving Size of Saba Mackerel & Nutrients and Calories		Cost of saba mackerel	
Canned Tuna	Single Serving Size of Canned Tuna	Canned Tuna Nutrients and Calories	Cost of canned tuna	
Red Snapper	Single Serving Size of Red Snapper & Nutrients and Calories		Cost of red snapper	
Extra Virgin Olive Oil	Single Serving Size of Extra Virgin Olive Oil & Nutrients and Calories		Cost of extra virgin olive oil	
Peanut	Single Serving Size of Peanut & Nutrients and Calories		Cost of peanut	
Cooking Oil	Single Serving Size of Cooking Oil	Cooking Oil Nutrients and Calories	Cost of cooking oil	

7.3 Dietary Guidelines based on Malaysia Food Pyramid 2020



7.4 Recommended Nutrients Intake (RNI) by Population Group

Age Groups	Gender	Level of Physical Activity (PAL)	Calories (cal)	Protein (g)	Carbs (g) - LB	Carbs (g) - UB	Fat (g)	Cholesterol (mg)	Fibre (g)
16 - 17	Male	1.4	2050	51	256.25	333.125	65 – 91	* 300mg	20 -30 g
		1.6	2340	51	292.5	380.25	65 – 91	* 300mg	20 -30 g
		1.8	2640	51	330	429	65 – 91	* 300mg	20 -30 g
		2.0	2930	51	366.25	476.125	65 – 91	* 300mg	20 -30 g
	Female	1.4	1660	42	207.5	269.75	53 – 74	* 300mg	20 -30 g
		1.6	1890	42	236.25	307.125	53 – 74	* 300mg	20 -30 g
		1.8	2130	42	266.25	346.125	53 – 74	* 300mg	20 -30 g
		2.0	2370	42	296.25	385.125	53 – 74	* 300mg	20 -30 g
18 - 29	Male	1.4	1960	62	245	318.5	62 – 75	* 300mg	20 -30 g
		1.6	2240	62	280	364	62 – 75	* 300mg	20 -30 g
		1.8	2520	62	315	409.5	62 – 75	* 300mg	20 -30 g
		2.0	2800	62	350	455	62 – 75	* 300mg	20 -30 g
	Female	1.4	1610	53	201.25	261.625	51 – 61	* 300mg	20 -30 g
		1.6	1840	53	230	299	51 – 61	* 300mg	20 -30 g
		1.8	2080	53	260	338	51 – 61	* 300mg	20 -30 g
		2.0	2310	53	288.75	375.375	51 – 61	* 300mg	20 -30 g
30 - 59	Male	1.4	1920	61	240	312	61 – 73	* 300mg	20 -30 g
		1.6	2190	61	273.75	355.875	61 – 73	* 300mg	20 -30 g
		1.8	2470	61	308.75	401.375	61 – 73	* 300mg	20 -30 g
		2.0	2740	61	342.5	445.25	61 – 73	* 300mg	20 -30 g
	Female	1.4	1660	52	207.5	269.75	53 – 63	* 300mg	20 -30 g
		1.6	1900	52	237.5	308.75	53 – 63	* 300mg	20 -30 g
		1.8	2130	52	266.25	346.125	53 – 63	* 300mg	20 -30 g
		2.0	2370	52	296.25	385.125	53 – 63	* 300mg	20 -30 g

Age Groups	Gender	Level of Physical Activity (PAL)	Calories	Protein (g)	Carbs (g) - LB	Carbs (g) - UB	Fat (g)	Cholesterol (mg)	Fibre (g)
≥ 60	Male	1.4	1780	58	222.5	289.25	56 – 68	* 300mg	20 -30 g
		1.6	2030	58	253.75	329.875	56 – 68	* 300mg	20 -30 g
		1.8	2280	58	285	370.5	56 – 68	* 300mg	20 -30 g
		2.0	2540	58	317.5	412.75	56 – 68	* 300mg	20 -30 g
	Female	1.4	1550	50	193.75	251.875	49 – 59	* 300mg	20 -30 g
		1.6	1770	50	221.25	287.625	49 – 59	* 300mg	20 -30 g
		1.8	1990	50	248.75	323.375	49 – 59	* 300mg	20 -30 g
		2.0	2220	50	277.5	360.75	49 – 59	* 300mg	20 -30 g

7.5 Octave Programming (Code Sample & Results)

Code Sample

```
%Min Cost Function
C = [0.87 ; 0.25 ; 0.28 ; 0.77 ; 0.73 ; 0.78 ; 0.7 ; 5.73 ; 3.26 ; 0.33 ; 1.58
  ; 0.21 ; 2.14 ; 0.52 ; 1.68 ; 3.5 ; 0.47 ; 1.61 ; 3.54 ; 4.25 ; 1.47 ; 0.49
  ; 2.9 ; 1.46 ; 0.92 ; 5.3 ; 0.54 ; 1.39 ; 0.3 ; 2.12 ; 1.49 ; 0.67 ; 0.89
  ; 1.7 ; 3.18 ; 1.57 ; 8.49 ; 0.76 ; 0.29 ; 0.09]

A= [%Calories
  179.8  9  91  105  68.35  83.5  32  100.3  151  30  95  124  108.8  39.95 28
  578  210  61  164.15  206.28  30  62  102  120  186  241  42  99  32  269  198
  113.5  70  150  202  50  218  119  161  126
;
%Protein
  14.59  0.4  4.4  1.3  4.04  1.12  0.4  17.32  30.54  1  0.5  2.8  22.23  5.44
  2.8  9.05  7  3.2  6  6.38  2.5  1.2  0.6  4  3.9  21  3  1.7  0  14.5  10.4
  7.8  5  26.4  19  10  45  0  7.3  0
;
%Carbohydrates -LB
  1.3  2.2  15.5  27  0.36  3.91  7  6.12  0  8  25  25.8  0  4.34  5.2  0  42
  4.8  6.11  8.44  5.9  15.4  27.1  22  41  0  0  1.6  0  45  26.2  20  12  0
  0  1  0  0  4.6  0
;
%Carbohydrates -UB
  1.3  2.2  15.5  27  0.36  3.91  7  6.12  0  8  25  25.8  0  4.34  5.2  0  42
  4.8  6.11  8.44  5.9  15.4  27.1  22  41  0  0  1.6  0  45  26.2  20  12  0
  0  1  0  0  4.6  0
;
%Fats -LB
  12.76  0.1  1.3  0.4  5.67  7.5  1.6  0.68  3.2  0  0.3  1  2.3  0.09  0.4
  59.5  1  3.3  14.18  18  0.3  0.2  0.2  1  0  16.7  3  9.8  3.6  4  6.3  0.5
  0  4.1  14  1  2.9  14  14  14
;
%Fats -UB
  12.76  0.1  1.3  0.4  5.67  7.5  1.6  0.68  3.2  0  0.3  1  2.3  0.09  0.4
  59.5  1  3.3  14.18  18  0.3  0.2  0.2  1  0  16.7  3  9.8  3.6  4  6.3  0.5
  0  4.1  14  1  2.9  14  14  14
;
%Cholesterol
  432.68  0  0  0  16.5  0  0  8.5  104  0  0  0  48.45  0  0  80.75  0  10  0
  0  0  0  0  0  0  82.5  9  28.6  9.7  0  13  0  0  103  0  25  80  0  0  0
;
  %Fibre -LB
  0  0.3  2.2  3.1  0  6.8  2.2  0  0  2  4.4  1.6  0  0  0  0  2  0  12.5
  11.8  2.3  3.1  5.5  3  0  0  0  0  0  12.5  8.7  6.7  4  0  0  0  0  0
  2.4  0
;
%Fibre -UB
  0  0.3  2.2  3.1  0  6.8  2.2  0  0  2  4.4  1.6  0  0  0  0  2  0  12.5
  11.8  2.3  3.1  5.5  3  0  0  0  0  0  12.5  8.7  6.7  4  0  0  0  0  0
  2.4  0
;
%Poultry/Meat/Egg -LB
  1  0  0  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0
  0  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0
```

```
;
%Poultry/Meat/Egg -UB
  1  0  0  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0
  0  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0
;
%Vegetable -LB
  0  1  0  0  0  0  1  0  0  1  0  0  0  0  1  0  0  0  0  0  1  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
;
%Vegetable -UB
  0  1  0  0  0  0  1  0  0  1  0  0  0  0  1  0  0  0  0  0  1  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
;
%Grains -LB
  0  0  1  0  0  0  0  0  0  0  0  1  0  0  0  0  1  0  0  0  0  0  0  1
  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
;
%Grains -UB
  0  0  1  0  0  0  0  0  0  0  0  1  0  0  0  0  1  0  0  0  0  0  0  1
  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
;
%Fruits
  0  0  0  1  0  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  1  1  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
;
%Milk & Milk Products
  0  0  0  0  1  0  0  1  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0
  0  0  0  1  1  0  0  0  0  0  0  0  0  0  0  0
;
%Fish
  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  1  1  1  1  0  0  0
;
%Legumes
  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  1  1  1  1  0  0  0  0  0  0  0
;
%Fats/Oils
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  1  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  1  1  1
];

b= [2050 ; 51 ; 256.25 ; 333.13 ; 65 ; 91 ; 300 ; 20 ; 30 ; 1 ; 2 ; 3 ;
5 ; 3 ; 5 ; 2 ; 2 ; 1 ; 1 ; 1
];

lb = zeros(40, 1);  % Creates a 40-by-1 column vector filled with zeros
ub=[];
cType="SLLULUULULULUSSSSU";
varType= "CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC";
sense=1;

%execute function
[xmin, fmin, status, extra] = glpk(C, A, b, lb, ub, cType, varType, sense);
disp(xmin)
disp(fmin)
```

Results

```
>> disp(xmin)
   0.3151
   0.7260
         0
         0
         0
         0
         0
         0
         0
   2.2740
         0
         0
         0
         0
         0
   0.4894
   5.0000
         0
         0
         0
         0
   2.0000
         0
         0
         0
         0
   0.1955
         0
   2.0000
         0
         0
   1.0000
         0
   1.0000
         0
         0
         0
         0
         0
   1.0000
>> disp(fmin)
9.4146
```

7.6 Minimum Cost and Recommended Food Type and Size for Each Age Group

Age Groups	Gender	Level of Physical Activity (PAL)	Minimum Cost (RM)	Recommended Food Type and Size (g)
< 18	Male	1.4	9.414527	37 g of Hard-boiled Egg, 38 g of Cucumber, 203 g of Cabbage, 42 g of Cooked Beef, 280 g of Fettuccine, 280 g of Orange, 2 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.6	11.102	28 g of Hard-boiled Egg, 54 g of Banana, 267 g of Cabbage, 81 g of Cooked Beef, 280 g of Fettuccine, 217 g of Orange, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 13 g of Peanut, 8 g of Cooking Oil
		1.8	18.616	51 g of Cucumber, 236 g of Banana, 34 g of Sliced Cheese, 118 g of Grilled Chicken, 182 g of Cabbage, 70 g of Cooked Beef, 128 g of Fettuccine, 137 g of Rice Vermicelli, 1 g of Bacon, 164 g of Chickpea, 111 g of Catfish, 23 g of Saba Mackerel, 28 g of Peanut
		2.0	26.158	34 g of Cucumber, 236 g of Banana, 137 g of Greek Yogurt, 100 g of Grilled Chicken, 388 g of Cabbage, 86 g of Cooked Beef, 272 g of Milk, 300 g of Rice Vermicelli, 164 g of Chickpea, 135 g of Catfish, 7 g of Saba Mackerel, 28 g of Peanut
	Female	1.4	7.8961	41 g of Hard-boiled Egg, 156 g of Cucumber, 266 g of Brown rice, 23 g of Cooked Beef, 132 g of Fettuccine, 280 g of Orange, 4 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.6	8.5932	41 g of Hard-boiled Egg, 152 g of Cucumber, 9 g of Cabbage, 23 g of Cooked Beef, 280 g of Fettuccine, 280 g of Orange, 4 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.8	9.8395	35 g of Hard-boiled Egg, 267 g of Cabbage, 53 g of Cooked Beef, 280 g of Fettuccine, 280 g of Orange, 1 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		2.0	13.379	21 g of Hard-boiled Egg, 156 g of Cucumber, 236 g of Banana, 34 g of Sliced Cheese, 44 g of Grilled Chicken, 14 g of Japanese Pressed Tofu, 45 g of Cooked Beef, 280 g of Fettuccine, 138 g of Chickpea, 143 g of Catfish, 28 g of Peanut

Age Groups	Gender	Level of Physical Activity (PAL)	Minimum Cost (RM)	Recommended Food Type and Size (g)
≥ 18 - 29	Male	1.4	9.0253	38 g of Hard-boiled Egg, 156 g of Cucumber, 15 g of Brown rice, 37 g of Cooked Beef, 273 g of Fettuccine, 280 g of Orange, 2 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.6	10.521	34 g of Hard-boiled Egg, 186 g of Banana, 267 g of Cabbage, 57 g of Cooked Beef, 280 g of Fettuccine, 61 g of Orange, 1 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 13 g of Peanut, 8 g of Cooking Oil
		1.8	18.759	220 g of Cucumber, 236 g of Banana, 34 g of Sliced Cheese, 151 g of Grilled Chicken, 69 g of Cabbage, 42 g of Cooked Beef, 171 g of Fettuccine, 98 g of Rice Vermicelli, 164 g of Chickpea, 98 g of Catfish, 32 g of Saba Mackerel, 28 g of Peanut
		2.0	38.599	236 g of Banana, 340 g of Greek Yogurt, 132 g of Grilled Chicken, 430 g of Oyster Mushroom, 59 g of Cooked Beef, 250 g of Fettuccine, 28 g of Rice Vermicelli, 164 g of Chickpea, 63 g of Catfish, 96 g of Red Snapper, 28 g of Peanut
	Female	1.4	7.6955	42 g of Hard-boiled Egg, 156 g of Cucumber, 302 g of Brown rice, 20 g of Cooked Beef, 112 g of Fettuccine, 280 g of Orange, 4 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.6	8.3909	42 g of Hard-boiled Egg, 156 g of Cucumber, 35 g of Brown rice, 20 g of Cooked Beef, 261 g of Fettuccine, 280 g of Orange, 4 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.8	9.5884	39 g of Hard-boiled Egg, 102 g of Banana, 267 g of Cabbage, 36 g of Cooked Beef, 280 g of Fettuccine, 160 g of Orange, 3 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 13 g of Peanut, 8 g of Cooking Oil
		2.0	14.445	9 g of Hard-boiled Egg, 156 g of Cucumber, 236 g of Banana, 34 g of Sliced Cheese, 104 g of Grilled Chicken, 14 g of Japanese Pressed Tofu, 26 g of Cooked Beef, 280 g of Fettuccine, 138 g of Chickpea, 143 g of Catfish, 28 g of Peanut

Age Groups	Gender	Level of Physical Activity (PAL)	Minimum Cost (RM)	Recommended Food Type and Size (g)
30 - 59	Male	1.4	8.8796	39 g of Hard-boiled Egg, 156 g of Cucumber, 50 g of Brown rice, 36 g of Cooked Beef, 253 g of Fettuccine, 280 g of Orange, 3 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.6	10.21	34 g of Hard-boiled Egg, 96 g of Banana, 267 g of Cabbage, 54 g of Cooked Beef, 280 g of Fettuccine, 167 g of Orange, 1 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 13 g of Peanut, 8 g of Cooking Oil
		1.8	16.956	156 g of Cucumber, 236 g of Banana, 34 g of Sliced Cheese, 133 g of Grilled Chicken, 41 g of Cooked Beef, 224 g of Fettuccine, 50 g of Rice Vermicelli, 2 g of Bacon, 164 g of Chickpea, 124 g of Catfish, 14 g of Saba Mackerel, 28 g of Peanut
		2.0	35.008	236 g of Banana, 340 g of Greek Yogurt, 127 g of Grilled Chicken, 301 g of Cabbage, 140 g of Oyster Mushroom, 63 g of Cooked Beef, 61 g of Fettuccine, 197 g of Rice Vermicelli, 164 g of Chickpea, 75 g of Catfish, 82 g of Red Snapper, 28 g of Peanut
	Female	1.4	7.8961	41 g of Hard-boiled Egg, 156 g of Cucumber, 266 g of Brown rice, 23 g of Cooked Beef, 132 g of Fettuccine, 280 g of Orange, 4 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.6	8.6321	41 g of Hard-boiled Egg, 128 g of Cucumber, 49 g of Cabbage, 23 g of Cooked Beef, 280 g of Fettuccine, 280 g of Orange, 4 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.8	9.8994	38 g of Hard-boiled Egg, 192 g of Banana, 267 g of Cabbage, 39 g of Cooked Beef, 280 g of Fettuccine, 53 g of Orange, 2 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 13 g of Peanut, 8 g of Cooking Oil
		2.0	15.859	156 g of Cucumber, 236 g of Banana, 34 g of Sliced Cheese, 131 g of Grilled Chicken, 27 g of Cooked Beef, 256 g of Fettuccine, 23 g of Rice Vermicelli, 4 g of Bacon, 164 g of Chickpea, 143 g of Catfish, 15 g of Peanut, 7 g of Cooking Oil

Age Groups	Gender	Level of Physical Activity (PAL)	Minimum Cost (RM)	Recommended Food Type and Size (g)
≥ 60	Male	1.4	8.3329	40 g of Hard-boiled Egg, 156 g of Cucumber, 159 g of Brown rice, 28 g of Cooked Beef, 192 g of Fettuccine, 280 g of Orange, 3 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.6	9.273	38 g of Hard-boiled Egg, 267 g of Cabbage, 36 g of Cooked Beef, 280 g of Fettuccine, 280 g of Orange, 3 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.8	12.094	32 g of Hard-boiled Egg, 156 g of Cucumber, 236 g of Banana, 34 g of Sliced Cheese, 11 g of Grilled Chicken, 14 g of Japanese Pressed Tofu, 36 g of Cooked Beef, 280 g of Fettuccine, 2 g of Bacon, 138 g of Chickpea, 143 g of Catfish, 28 g of Peanut
		2.0	23.405	34 g of Cucumber, 236 g of Banana, 60 g of Greek Yogurt, 145 g of Grilled Chicken, 388 g of Cabbage, 48 g of Cooked Beef, 375 g of Milk, 250 g of Rice Vermicelli, 164 g of Chickpea, 119 g of Catfish, 18 g of Saba Mackerel, 28 g of Peanut
	Female	1.4	7.4647	43 g of Hard-boiled Egg, 156 g of Cucumber, 350 g of Brown rice, 17 g of Cooked Beef, 85 g of Fettuccine, 280 g of Orange, 4 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.6	8.1299	43 g of Hard-boiled Egg, 156 g of Cucumber, 94 g of Brown rice, 17 g of Cooked Beef, 228 g of Fettuccine, 280 g of Orange, 4 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		1.8	9.0464	40 g of Hard-boiled Egg, 267 g of Cabbage, 30 g of Cooked Beef, 280 g of Fettuccine, 280 g of Orange, 3 g of Bacon, 12 g of Butter, 90 g of Red kidney bean, 143 g of Catfish, 14 g of Cooking Oil
		2.0	12.304	29 g of Hard-boiled Egg, 156 g of Cucumber, 236 g of Banana, 34 g of Sliced Cheese, 36 g of Grilled Chicken, 14 g of Japanese Pressed Tofu, 23 g of Cooked Beef, 280 g of Fettuccine, 2 g of Bacon, 138 g of Chickpea, 143 g of Catfish, 28 g of Peanut

7.7 Nutrients Constraints Equations in Respective Age Group

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
< 18	Male	1.4	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2050	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 51	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 256.25	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 333.13	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 65	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 91	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		1.6	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2340	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 51	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 292.5	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 380.25	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 65	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 91	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
< 18	Male	1.8	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2640	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 51	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 330	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 429	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 65	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 91	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		2.0	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2930	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 51	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 366.25	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 476.13	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 65	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 91	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
< 18	Female	1.4	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1660	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 42	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 207.5	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 269.75	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 53	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 74	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		1.6	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1890	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 42	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 236.25	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 307.13	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 53	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 74	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
< 18	Female	1.8	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2130	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 42	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 266.25	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 346.13	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 53	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 74	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		2.0	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2370	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 42	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 296.25	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 385.13	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 53	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 74	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
≥ 18 - 29	Male	1.4	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1960	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 62	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 245	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 318.5	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 62	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 75	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		1.6	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2240	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 62	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 280	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 364	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 62	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 75	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
≥ 18 - 29	Male	1.8	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2520	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 62	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 315	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 409.5	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 62	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 75	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		2.0	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2800	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 62	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 350	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 455	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 62	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 75	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
≥ 18 - 29	Female	1.4	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1610	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 53	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 201.25	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 261.63	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 51	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 61	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		1.6	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1840	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 53	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 230	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 299	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 51	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 61	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
≥ 18 - 29	Female	1.8	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2080	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 53	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 260	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 338	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 51	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 61	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		2.0	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2310	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 53	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 288.75	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 375.38	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 51	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 61	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
30 - 59	Male	1.4	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1920	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 61	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 240	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 312	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 61	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 73	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		1.6	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2190	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 61	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 273.75	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 355.88	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 61	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 73	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
30 - 59	Male	1.8	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2470	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 61	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 308.75	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 401.38	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 61	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 73	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		2.0	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2740	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 61	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 342.5	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 445.25	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 61	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 73	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
30 - 59	Female	1.4	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1660	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 52	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 207.5	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 269.75	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 53	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 63	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		1.6	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1900	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 52	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 237.5	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 308.75	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 53	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 63	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
30 - 59	Female	1.8	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2130	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 52	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 266.25	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 346.13	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 53	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 63	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		2.0	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2370	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 52	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 296.25	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 385.13	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 53	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 63	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
≥ 60	Male	1.4	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1780	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 58	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 222.5	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 289.25	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 56	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 68	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		1.6	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2030	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 58	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 253.75	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 329.88	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 56	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 68	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
≥ 60	Male	1.8	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2280	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 58	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 285	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 370.5	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 56	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 68	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		2.0	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2540	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 58	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 317.5	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 412.75	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 56	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 68	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
≥ 60	Female	1.4	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1550	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 50	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 193.75	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 251.88	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 49	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 59	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		1.6	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1770	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 50	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 221.25	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 287.63	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 49	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 59	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

Age Group	Gender	Level of Physical Activity (PAL)	Min Cost Function	Nutrients Constraints								
				Calories	Protein	Carbohydrates - Lower Boundary	Carbohydrates - Upper Boundary	Fats - Lower Boundary	Fats - Upper Boundary	Cholesterol	Fibre - Lower Boundary	Fibre – Upper Boundary
≥ 60	Female	1.8	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 1990	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 50	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 248.75	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 323.38	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 49	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 59	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30
		2.0	0.87a + 0.25b + 0.28c + 0.77d + 0.73e + 0.78f + 0.7g + 5.73h + 3.26i + 0.33j + 1.58k + 0.21l + 2.14m + 0.52n + 1.68o + 3.5p + 0.47q + 1.61r + 3.54s + 4.25t + 1.47u + 0.49v + 2.9w + 1.46x + 0.92y + 5.3z + 0.54aa + 1.39ab + 0.3ac + 2.12ad + 1.49ae + 0.67af + 0.89ag + 1.7ah + 3.18ai + 1.57aj + 8.49ak + 0.76al + 0.29am + 0.09an	179.8a + 9b + 91c + 105d + 68.35e + 83.5f + 32g + 100.3h + 151i + 30j + 95k + 124l + 108.8m + 39.95n + 28o + 578p + 210q + 61r + 164.15s + 206.28t + 30u + 62v + 102w + 120x + 186y + 241z + 42aa + 99ab + 32ac + 269ad + 198ae + 113.5af + 70ag + 150ah + 202ai + 50aj + 218ak + 119al + 161am + 126an = 2220	14.59a + 0.4b + 4.4c + 1.3d + 4.04e + 1.12f + 0.4g + 17.32h + 30.54i + 1j + 0.5k + 2.8l + 22.23m + 5.44n + 2.8o + 9.05p + 7q + 3.2r + 6s + 6.38t + 2.5u + 1.2v + 0.6w + 4x + 3.9y + 21z + 3aa + 1.7ab + 0ac + 14.5ad + 10.4ae + 7.8af + 5ag + 26.4ah + 19ai + 10aj + 45ak + 0al + 7.3am + 0an ≥ 50	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≥ 277.5	1.3a + 2.2b + 15.5c + 27d + 0.36e + 3.91f + 7g + 6.12h + 0i + 8j + 25k + 25.8l + 0m + 4.34n + 5.2o + 0p + 42q + 4.8r + 6.11s + 8.44t + 5.9u + 15.4v + 27.1w + 22x + 41y + 0z + 0aa + 1.6ab + 0ac + 45ad + 26.2ae + 20af + 12ag + 0ah + 0ai + 1aj + 0ak + 0al + 4.6am + 0an ≤ 360.75	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≥ 49	12.76a + 0.1b + 1.3c + 0.4d + 5.67e + 7.5f + 1.6g + 0.68h + 3.2i + 0j + 0.3k + 1l + 2.3m + 0.09n + 0.4o + 59.5p + 1q + 3.3r + 14.18s + 18t + 0.3u + 0.2v + 0.2w + 1x + 0y + 16.7z + 3aa + 9.8ab + 3.6ac + 4ad + 6.3ae + 0.5af + 0ag + 4.1ah + 14ai + 1aj + 2.9ak + 14al + 14am + 14an ≤ 59	432.68a + 0b + 0c + 0d + 16.5e + 0f + 0g + 8.5h + 104i + 0j + 0k + 0l + 48.45m + 0n + 0o + 80.75p + 0q + 10r + 0s + 0t + 0u + 0v + 0w + 0x + 0y + 82.5z + 9aa + 28.6ab + 9.7ac + 0ad + 13ae + 0af + 0ag + 103ah + 0ai + 25aj + 80ak + 0al + 0am + 0an ≤ 300	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≥ 20	0a + 0.3b + 2.2c + 3.1d + 0e + 6.8f + 2.2g + 0h + 0i + 2j + 4.4k + 1.6l + 0m + 0n + 0o + 0p + 2q + 0r + 12.5s + 11.8t + 2.3u + 3.1v + 5.5w + 3x + 0y + 0z + 0aa + 0ab + 0ac + 12.5ad + 8.7ae + 6.7af + 4ag + 0ah + 0ai + 0aj + 0ak + 0al + 2.4am + 0an ≤ 30

7.8 Food Group Constraints Equations in Respective Age Group

Age Groups	Gender	Level of Physical Activity (PAL)	Food Groups										
			Poultry/ Meat/ Egg -LB	Poultry/ Meat/ Egg -UB	Vegetable -LB	Vegetable -UB	Grains -LB	Grains -UB	Fruit	Milk & Milk Products	Fish	Legumes	Fats /oils
< 18	Male	1.4	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
		1.6	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
		1.8	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
		2.0	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 6$*	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
	Female	1.4	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
		1.6	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
		1.8	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
		2.0	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
≥ 18 - 29	Male	1.4	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
		1.6	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
		1.8	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$
		2.0	$a+i+p+z+aa \geq 1$	$a+i+p+z+aa \leq 2$	$b+g+j+o+u \geq 3$	$b+g+j+o+u \leq 5$	$c+l+q+x+y \geq 3$	$c+l+q+x+y \leq 5$	$d+f+k+v+w = 2$	$e+h+r+ab+ac = 2$	$m+ah+ai+aj+ak = 1$	$n+ad+ae+af+ag = 1$	$s+t+al+am+an \leq 1$

* Grain upper boundary for Male age 16-17 with PAL of 2.0 is adjusted to 6 to obtain the optimal solution.

Age Groups	Gender	Level of Physical Activity (PAL)	Food Groups										
			Poultry/ Meat/ Egg -LB	Poultry/ Meat/ Egg -UB	Vegetable -LB	Vegetable -UB	Grains -LB	Grains -UB	Fruit	Milk & Milk Products	Fish	Legumes	Fats /oils
≥ 18 - 29	Female	1.4	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.6	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.8	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		2.0	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
30 - 59	Male	1.4	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.6	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.8	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		2.0	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
	Female	1.4	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.6	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.8	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		2.0	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1

Age Groups	Gender	Level of Physical Activity (PAL)	Food Groups										
			Poultry/ Meat/ Egg -LB	Poultry/ Meat/ Egg -UB	Vegetable -LB	Vegetable -UB	Grains -LB	Grains -UB	Fruit	Milk & Milk Products	Fish	Legumes	Fats /oils
≥ 60	Male	1.4	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.6	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.8	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		2.0	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
	Female	1.4	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.6	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		1.8	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1
		2.0	a + i + p + z + aa ≥ 1	a + i + p + z + aa ≤ 2	b + g + j + o + u ≥ 3	b + g + j + o + u ≤ 5	c + l + q + x + y ≥ 3	c + l + q + x + y ≤ 5	d + f + k + v + w = 2	e + h + r + ab + ac = 2	m + ah + ai + aj + ak = 1	n + ad + ae + af + ag = 1	s + t + al + am + an ≤ 1