Optimeal Open Access

User Guide

Better Food. Better Health. Better World.

About us

Mérieux NutriSciences | Blonk is a leading international expert in food system sustainability, inspiring and enabling the agri-food sector to give shape to sustainability. Our purpose is to create a sustainable and healthy planet for current and future generations. We support organizations in understanding their environmental impact in the agri-food value chain by offering advice and developing tailored software tools based on the latest scientific developments and data.

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1. Getting started: access & files

1.1 How to obtain access

Access to Optimeal Open Access requires an account and a license. To request access, please fill out the request form at https://blonksustainability.nl/optimeal-open-access/license-form. In the form, briefly describe how you intend to use Optimeal Open Access (e.g., academic research, consultancy work, or internal analysis), provide a short overview of the research or project context, and indicate the status of your data readiness. Once approved, you will then receive a license agreement to review and sign. After the agreement has been signed, you will be sent your account details and instructions to activate access, including setting up two-factor authentication (2FA).

You can log into your account at https://optimeal.blonksustainability.nl/.

1.2 Files you will need

Optimeal Open Access provides an empty template and a demonstration template. If you are using Optimeal Open Access for the first time, download and open the demonstration template. The following descriptions will be working with this template as an example. Download and fill in the empty template with your own data once you've read through this user guide.

2. Preparing your data

2.1 Data requirements

To run an optimization, you must have the following four elements:

1) Decision variables (Food items)

Decision variables are the food items that the model can adjust during optimization. Each food item represents a variable whose intake level can increase or decrease within defined constraints.

2) Diet composition (e.g. Reference diet)

The reference diet describes the starting point for the optimization. It typically reflects current or observed consumption patterns, expressed in grams per person per day, typically derived from food consumption surveys.

3) Food-level properties

Food-level properties describe the characteristics of each food item. These properties are used to calculate diet-level outcomes. Examples include nutritional properties (e.g. energy, protein, micronutrients); environmental indicators (e.g. greenhouse gas emissions, land use); economic properties (e.g. price); qualitative classifications (e.g. food groups)

4) Constraints

Constraints define the rules the optimized diet must follow. They restrict the solution space and ensure that results remain meaningful and realistic. Constraints can be applied to diet-level properties or food-level intakes.

2.2   Optimeal template explained

To use Optimeal, you must first process and format your data using the Excel template and upload the completed file into the tool. Diet optimization relies on structured, internally consistent data. After you first log in, you will see two links to download the empty template or the demo template. The demo template is a pre-filled Optimeal template, based on a hypothetical diet. The template has three worksheets, the first of which is an introduction. The two worksheets that require user input are described below.

2.2.1 Worksheet 1. Properties

This worksheet defines the diet-level properties and constraints used in the optimization. This section explains how to enter these inputs correctly and how they are used in the model. An example of diet-level properties can be seen in Figure 1, from the demo Optimeal template.

Property name	Property type	Property unit	Minimum (per day)	Maximum (per day)
Energy	Amount	kcal	2000.00	2500.00
Protein	Amount	g	50.00	
Fiber	Amount	g	25.00	
Saturated fat	Amount	g		20.00
Greenhouse gas emissions	Amount	kg CO$_2$eq		6.00
Food group	Category			
Vegetables	Amount	g	150.00	
Fruit	Amount	g	150.00	
Meat	Amount	g		100.00

Figure 1

- **Property name**: Enter all diet-level properties you want to include in the analysis (e.g. nutrients, environmental indicators, cost, food groups). These properties can be used to set constraints (e.g. at least 25 g fiber per day) or to monitor outcomes during the optimization. Property names are automatically copied to Worksheet 2.

- **Property type**: Select the property type from the dropdown. This helps the model interpret how the property should be handled during optimization and in the results.

    o   Amount: quantitative properties expressed as a number (e.g. nutrients, environmental impacts)

    o   Category: qualitative properties (e.g. food group classifications)

- **Property unit** (amount-type properties only): Select the appropriate unit from the dropdown list. All amount-type properties must have a unit. Units are used to document the meaning of each property and to help ensure consistency when interpreting inputs and results.

- **Minimum and maximum values per day** (amount-type properties only): Use these columns to define diet-level constraints:

    o   Minimum values must be lower than maximum values

    o   If a fixed value is required, set minimum and maximum slightly apart (e.g. difference of 0.0001)

    o   Leave cells empty if no minimum or maximum constraint applies

If you want to apply constraints at the food-group level, e.g. minimum of 150g vegetables per day), define food groups as amount-type properties and specify minimum and/or maximum values for these properties. Category-type properties are recommended but are used only in the output, to support grouping, analysis, and interpretation of results, and cannot be used to set constraints.

2.2.2 Worksheet 2. Food products

This worksheet defines the food list, reference diet, and property values. A snapshot of the demo template can be seen in Figure 2.

- **Product name**: Enter all food products included in the reference diet. Additional products may be added if needed, even if reference diet intake is 0 g/d.
- **Reference diet and intake constraints**: Enter the reference intake (grams per person per day), as well as any minimum or maximum consumption constraints for each product.
- **Food-level properties**: All properties defined in Worksheet 1 will appear as columns:
    - For amount properties, enter values per 100 g of food product
    - For category properties, enter the category name for each product (e.g. dairy, vegetables, fruit, etc.).

Product name	Minimum (gram per day)	Maximum (gram per day)	Reference diet (gram per day)	Energy (kcal)	Protein (g)
Bread	0.00		120.00	240.00	8.00
Rice	0.00		60.00	130.00	2.70
Potatoes	0.00		100.00	80.00	2.00
Vegetables	0.00		250.00	40.00	2.00
Fruit	0.00		200.00	50.00	0.50
Legumes	0.00		40.00	120.00	8.00
Milk	0.00		200.00	45.00	3.40
Cheese	0.00		40.00	400.00	25.00
Eggs	0.00		30.00	155.00	13.00
Chicken	0.00		70.00	165.00	31.00
Red meat	0.00		80.00	250.00	26.00
Vegetable oil	0.00		25.00	900.00	0.00

Figure 2

If you define food groups as amount-type properties, you must quantify each food's contribution to the relevant food group per 100 g of food. For example, chicken contributes 100 g to the Meat food group, as shown in Figure 3. For composite foods, contributions should be split across food groups according to their composition (e.g. a mixed dish apportioned to vegetables, grains, and protein components).

Product name	Food group	Vegetables (g)	Fruit (g)	Meat (g)
Bread	Grains	0.00	0.00	0.00
Rice	Grains	0.00	0.00	0.00
Potatoes	Vegetables	100.00	0.00	0.00
Vegetables	Vegetables	100.00	0.00	0.00
Fruit	Fruit	0.00	100.00	0.00
Legumes	Legumes	0.00	0.00	0.00
Milk	Dairy	0.00	0.00	0.00
Cheese	Dairy	0.00	0.00	0.00
Eggs	Eggs	0.00	0.00	0.00
Chicken	Meat	0.00	0.00	100.00
Red meat	Meat	0.00	0.00	100.00
Vegetable oil	Fats	0.00	0.00	0.00

Figure 3

2.3 Uploading the template

Once you have saved your template, upload the file in the upload section highlighted in Figure 4.
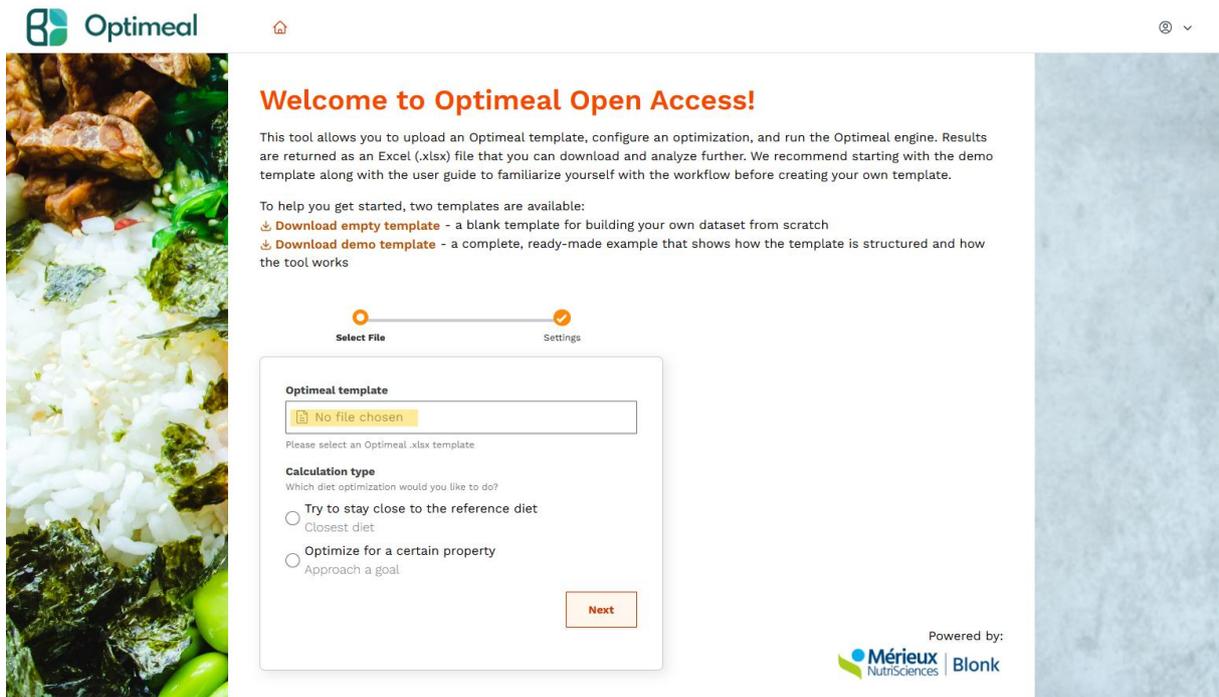
Figure 4

2.4 Avoiding errors

Template errors typically become apparent after uploading the file and selecting the optimization type, as described in the next section. If an error occurs, it must be resolved before you can proceed.

When working with larger datasets, errors may occur and can sometimes be difficult to trace. Common issues that can lead to errors include:

- Minimum and maximum constraint values being accidentally swapped
- Non-numeric entries in amount-type properties in Worksheet 2-
- Copied formatting that is not supported by the template

If an error occurs, start by checking constraint columns for inconsistencies, verify that all amount-type properties contain only numeric values, and remove any copied formatting by pasting values only.

3. Running an optimization

On the home page (Figure 4), below the prompt to upload your template, you will find the **Calculation type** options. These define the **objective function** used in the optimization.

3.1 Staying close to the reference diet

Selecting *Try to stay close to the reference diet* minimizes deviation from the starting diet. When this option is chosen, you can select the **deviation function**:

- **Linear programming** tends to concentrate changes in a smaller number of foods, resulting in larger shifts for those items.

- **Quadratic programming** penalizes large deviations, leading to smaller changes distributed across a broader range of foods.

The deviation function determines how "closeness" to the reference diet is defined in the model.

3.2   Optimizing for a specific property

Selecting *Optimize for a certain property (approach a goal)* allows you to:

- Choose whether to minimize or maximize a diet-level property, and

- Select the specific property to optimize.

3.3   Running the model

Once your selections are complete, submit the optimization. The results will be automatically downloaded as an Excel file.

4.   Working through the results

4.1   Results export explained

The results export closely mirrors the template you uploaded, with the addition of two new worksheets containing the optimization results. The introduction worksheet describes the contents of these results sheets, along with the **user-defined configuration settings** used for the optimization (including the selected optimization approach).

4.1.1 Worksheet 3. Optimized diets

This worksheet lists all food products included in the optimization, together with:

- The **reference diet** (grams per person per day), and

- The **optimized diet** (grams per person per day)

This enables a direct, food-level comparison between the starting diet and the optimized solution.

4.1.2 Worksheet 4. Optimized properties

This worksheet reports diet-level results, including:

- The list of **diet-level properties** used in the model

- The **reference diet values** for each property

- The corresponding **optimized diet values**

These results summarize how the optimized diet performs relative to the reference diet across all defined properties.

4.2   Interpretation of the results

Optimeal produces one optimal solution per run, based on the selected objective function and the constraints defined in the template. Results should always be interpreted in the context of the input data, constraints, and modeling assumptions used.

The output worksheets are designed to support further analysis. You can work directly in these worksheets to calculate absolute and relative changes in both diet-level properties and food quantities between the reference and optimized diets.

To gain deeper insight into the results, food-level data from Worksheet 2 can be combined with the outputs:

- If you have defined food group category-type properties, you can map these classifications from Worksheet 2 to the food products listed in Worksheet 3. This allows you to calculate food-group-level quantities for both the reference and optimized diets.

- Using the food-level property data in Worksheet 2 together with the optimized quantities in Worksheet 3, you can also derive food-group-level nutritional composition, environmental impacts, or other aggregated indicators.

This type of post-processing helps clarify which foods and food groups drive changes in the optimized diet and how these changes relate to the defined constraints and objectives.

4.3   Blank export

If your results export is blank, this indicates that no feasible solution could be found. This typically occurs when constraints are too restrictive and/or when the food list does not provide sufficient flexibility to meet all requirements.

Resolving this usually requires an iterative approach, such as relaxing certain constraints, adjusting targets, or expanding the food list. When adding new food products, consider that, from a consumer acceptability and realism perspective, introducing foods that are not part of the reference diet may be less appropriate than adjusting quantities of foods already consumed.

5.   Support and citation

Optimeal Open Access is provided as an expert tool and does not include built-in user support or guided workflows. If you encounter a technical issue or have questions that are not addressed in this user guide, please contact info@blonksustainability.nl.

For questions related to methodology, data preparation, or the use of Optimeal Open Access in research or applied projects, please check the FAQ section at https://blonksustainability.nl/optimeal-open-access. We also welcome you to reach out to discuss potential collaboration.

When using Optimeal Open Access in publications or reports, please ensure appropriate citation. Citation guidance and recommended references are provided with the license agreement.