

*14<sup>th</sup> Annual International Conference on Industrial Engineering and Operations Management  
Dubai, United Arab Emirates (UAE), February 12-14, 2024*

Publisher: IEOM Society International, USA  
Published: February 12, 2024

DOI: [10.46254/AN14.20240094](https://doi.org/10.46254/AN14.20240094)

# **A Calculation Method of the Dish Similarities Based on Ingredients and Seasonings for Automatic School Lunch Menu Creation**

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## **Abstract**

According to a survey conducted by the Ministry of Education, Culture, Sports, Science and Technology, 99.1% of elementary schools in Japan provide school lunches. Nutrition teachers prepare school lunch menus at monthly meetings. Because nutrition teachers need to consider a large number and variety of constraints, it requires a lot of time and effort to prepare menus. Therefore, it is highly significant to introduce an automatic menu creation model for school lunches. In the school lunch standards, nutrition teachers are expected to expose students to various foods. From the viewpoint of dietary education, nutrition teachers are also required to expose students to a variety of ingredients and tastes. Therefore, it is necessary to consider the dishes diversity in terms of ingredients and seasonings. For automatic school lunch menu creation, the similarities between dishes are important to provide an appropriate combination of various foods. There were previous studies that calculated dishes similarity considering ingredients and food groups and grouped similar dishes considering the main seasoning. In our previous study of automatic school lunch menu creation, the inter-dish similarities were calculated based on the categories and the gram amounts of ingredients and seasonings in each dish. Based on the inter-dish similarities, similar dishes were classified into the same group, and constraints on the frequency of serving were created for each similar dish group to create an automatic menu creation model. The issue of the previous study was that the grouping of similar dishes was based solely on the same ingredients and seasonings in the end. In other words, the results were not sufficiently based on human senses. For example, the main ingredients of two dishes are different for beef and pork, respectively, but are the same meat food group. In addition, if their seasoning combinations are very similar, humans may judge these two dishes as similar. Considering the food groups of main ingredients, the grouping is expected to become close to the human senses. The purpose of this study is to propose a calculation method of inter-dish similarity that considers the dishes similarities based on the food group of the main ingredients and combination of seasonings. In this study, the main ingredient in each dish was determined based on the number of ingredients in each dish and their gram amounts.

Specifically, ingredients with a gram amount of the ingredient larger than the threshold value were determined as the main ingredient. The threshold value was calculated by dividing the gram amounts of all the ingredients in a dish by the number of ingredients. The new inter-dish similarity was calculated by the cosine similarity using the food groups of the main ingredients and the combination of seasoning. As a result of the calculation using actual data from school lunch dishes, the proposed method calculated a large similarity value between the two dishes which are meat dishes seasoned with the combination of soy sauce and sugar. Since nutrition teachers evaluated these dishes as similar dishes, we succeeded in calculating the dishes similarities considering human senses.

### **Keywords**

School lunch menu planning, Cosine similarity, Inter-dish similarity, Extraction method of main ingredients, Mathematical optimization

### **Biographies**

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