Customized consumption intention and influencing factors of pre-made dishes of Fotiaoqiang in Guangzhou

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Abstract. At the beginning of 2023, pre-made food was written into China's No.1 central document for the first time, releasing the signal of agricultural emphasis. In particular, the consumption boom of Fotiaoqiang pre-made dishes has given rise to the rapid growth of Fotiaoqiang products, but the existing products in the Chinese market are many but similar and can hardly adapt to diversified usage. In this paper, the researcher use statistical model to analyze the data with web crawler text mining and questionnaire data to understand the issues of Fotiaoqiang pre-made dishes market, and explore the current situation in Guangzhou, so as to explore the market potential of Fotiaoqiang pre-made dishes customized mode to meet the different needs of consumers for ingredients, price,and usage, and help the restructuring of pre-made dishes enterprises. Finally, the researcher concluded for product packaging, taste, and customized content, and made recommendations to promote the industry's development.

Keywords: Fotiaoqiang, Pre-made dishes, Customization, Text machine learning, Data mining.

1. Introduction

At the beginning of 2023, prepared dishes were written into China's No. 1 central document for the first time, pointing out that the development of prepared dishes has become a trend and high-quality development should be carried out, releasing a strong signal of emphasizing agriculture and strengthening agriculture. The market size of China's prepared dishes reached 419.6 billion yuan in 2022, an increase of 21.3% year-on-year, and the market size is expected to reach 1072 billion yuan in 2026. It has the ability to achieve multi-industry chain linkage and is an important carrier for rural revitalization to promote the integrated development. In the international market, the development of prepared dishes in Europe, America, Japan and Korea has become mature, and traditional staple food and traditional dishes prepared dishes are the most mature categories of development.

2. Literature Review

Consumers are increasingly choosing prepared foods. Customized seafood preparations fill the void left by traditional preparations that are challenging to personalize and customize while also satisfying the instant desire for delectability.

2.1 Issues in the prepared food industry

From the catering sector to the retail industry, there are still certain issues with the pre-prepared dish market. Concerns about food safety issues, the substantial nutritional value of prepared foods, microbial contamination, potentially toxic byproducts of processing, and packaging materials ingested along with the meal should all be addressed seriously, according to Huang, L. (2015). Second, An, J (2023) noted that the problem of transportation, the storage and transportation of prepared vegetables are primarily room temperature, refrigerated and frozen methods, and the cold chain technology is directly related to the freshness, nutritional value and appearance of the dishes, such as some seafood prepared vegetables, from fishing and landing to storage and transportation after processing need to be carried out at low temperature, and the enterprise   Government regulation and industry standardization, in relation to the growth of prepared vegetables in industrialized nations in

Europe, are equally important to the industry's long-term development. The prepared vegetable industry's growth is directly influenced by consumers, who are the market's compass. The foundation for ensuring food safety is stringent regulation and high standards.

2.2 Customized services and pre-prepared dishes combined thinking

As the digital economy has grown quickly, customers' preferences for consumption have increasingly shifted from mass to personalized, with customized consumption eventually becoming a consumption hotspot. The production of food enterprises is evolving from mass production to mass customization, according to Milton Shan's (2009) proposal, and the factors affecting competition among food enterprises are also changing from production scale and efficiency to speed, integration, and innovation aspects. According to Wang, E (2020), for processed foods, customers place more emphasis on quality cues such as food brand and origin, and consumers are prepared to pay for product qualities such as organic certification, information traceability, and HACCP certification. In the face of the current industry pain point that the pre-made dishes products are crowded, starting from the food source safety and transparency, and the customization service that the dishes support custom setting, may dispel the consumers' concerns about the food source and promote the consumers' acceptance of the pre-made dishes.

2.3 Future Vision of Prepared Dishes

During the JD Fresh Food New Year Festival in 2022, the keyword search frequency for the Buddha Jumping Wall gift box exceeded 100,000, according to JD data. Buddha jumping wall caters to the current quality and healthy diet consumption trend with its opulent ingredients, which include abalone, shark fin, sea cucumber, and other nutrient-rich aquatic ingredients. However, due to the variety of ingredients, the cooking process is more complicated, time-consuming, and challenging to carry out. As a result, pre-made dishes that may be quickly and conveniently prepared are a wise choice. With the anti-epidemic strategy optimized, offline food and beverage consumption will experience a rebound, and both the B-side food and beverage business and C-side consumers' demand for seafood pre-prepared dishes is likely to increase. Aquatic prepared dishes will remain popular, according to Zhang X (2022), because to the rise of restaurant chain rate, demographic shift, and concern for health and wellness. In order to continue maturing, Zhao, F. (2022) argued that businesses must build internal theoretical frameworks and practical foundations based on their own food attributes as soon as possible, rationalize external upstream and downstream relationships, and positively engage with national policies.

3. Survey design and sample size determination

3.1 Sampling method and scheme

In this survey, the survey targets the Guangzhou citizens, mainly investigating three aspects: basic consumer information, the current situation of the pre-made food market and customized consumption preferences. In the final survey, a multi-stage sampling method was adopted to ensure the accuracy (1) The first stage: PPS unequal probability sampling was adopted to construct a primary sampling frame with 11 urban areas in Guangzhou, and the primary sampling units were sampled using the random number table method; (2) The second stage: stratified proportion sampling was adopted, stratified by the sampling jurisdiction, and a secondary sampling frame was constructed with the streets under the jurisdiction of the sampling jurisdiction, and each stratum was selected according to the weight of each stratum is the proportion of the sampled jurisdictions to the total population of the sampled district. (3) The third stage: simple random sampling was adopted to construct a three-stage sampling frame with all the resident population in the sampled streets, and the questionnaire survey was conducted using a combination of online and offline methods.

3.2 Sample size determination

In determining the sample size, the sample size should follow the principles of sample size determination, control the sampling error.

$$n_0 = \frac{1}{\left(\frac{1}{N}+\frac{d^2}{\mu_{\alpha/2}}\right)} = \frac{N\mu_{\alpha/2}^2 PQ}{Nd^2+\mu_{\alpha/2}^2 PQ} = \frac{N\mu_{\alpha/2}^2 P(1-P)}{Nd^2+\mu_{\alpha/2}^2 P(1-P)} \qquad \text{Formula (1)}$$

The data of the seventh census of Guangzhou in 2020 shows that the resident population is 18676605 (N=18676605), the fixed confidence level is 1-α= 95%, the absolute error limit is d=3%, and the p-value is 0.5.

$$n_0 = \frac{18676605*1.96^2*0.5*0.5}{18676605*0.03*0.03+1.96^2*0.5*0.5} \approx 1067.05 = 1067 \qquad \text{Formula (2)}$$

Predicted response rate $r = 0.90$, so adjusting the sample size to

$$n_1 = \frac{n_0}{r} = \frac{1067}{0.9} \approx 1185.56 = 1186 \qquad \text{Formula (3)}$$

Since this survey uses a multi-stage unequal probability sampling PPS, which causes some bias in the sampling efficiency. Therefore, taking the design effect $(efgg) = 1.30$, the total sample size of the survey in Guangzhou area is

$$n_2 = n_1 \times deff = 1186 \times 1.30 = 1541.8 \rightarrow 1650 \qquad \text{Formula (4)}$$

Considering the complexity of the market research and taking into account various factors, 1650 questionnaires were finally distributed.

4. Latent Dirichlet Allocation text topic analysis

Using the pyLDAvis package for visualization, the investigator finally identified three themes to be extracted, and the results are shown in Figure 7. In this regard, the circle area on the left side represents the importance of each theme in the whole corpus, and the distance between the centers of the circles indicates the similarity between each theme. For each topic, the histogram on the right side lists the top 28 most relevant words, and the light blue color indicates the frequency (weight) of the word in the whole document, while the dark red color indicates the weight of the word in the topic. In Topic 1, for example, the most relevant words are "food safety", "freshness", "ingredients", "quality", "packaging", and so on, The most relevant words are "food safety", "freshness", "ingredients", "quality", "packaging", etc. Based on the meaning of these words, Topic 1 is defined as "product".

The weights of keywords are different under different topics. Therefore, by ranking the order of occurrence and high probability of high frequency words under each topic and defining the topics, the results are as follows:

Table 1 Definition of topics

Number	Topic	Key words
1	Product	Food safety; Quality; Packaging; Health; Ingredients; Freshness
2	Price	Cost-effectiveness; Popularity; Universality; Using scene
3	Promotion	Quality; Cost-effectiveness; Reservation; Promotion; Diversity; Convenience; Portion; Flavor
4	Transport	Fresh; Shipping; Origin; Storage; Transportation; Cold chain

The investigators made suggestions for the current Fotiaoqiang pre-made dishes through the theme.

First, under all the themes, the word food safety and product quality is contained in the description, so Fotiaoqiang pre-made dishes should focus on the issue of product quality and increase quality and safety control.

Second, as an important means to improve user satisfaction and consumer experience, Fotiaoqiang products should not only focus on product quality, but also give consumers a cost-effective consumer experience to prevent the product from being too high and too low to reach the public's table. In improving the cost performance, company can implement preferential activities, high strength of the discount can attract many consumers to try or repurchase.

Thirdly, many users do not know about Fotiaoqiang pre-made dish products, and even less heard of Fotiaoqiang pre-made dish customization. The current exposure rate of Fotiaoqiang products is relatively low, so that many users have not found the deliciousness.

Fourth, a safe and efficient transportation chain is the last step essential to meet the above three key words. Cold chain transportation can ensure the taste of the product, and the short transportation time also allows the food to reach consumers quickly.

5. Data Analysis

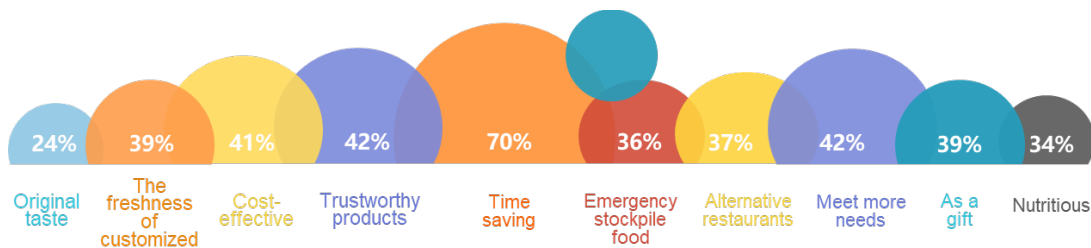### 5.1 Why choose customization

Figure 1 Reasons why consumers are willing to choose customized

Through the analysis of the reasons for consumers to choose Fotiaoqiang pre-made dishes, time saving is the primary factor for consumers to choose Fotiaoqiang customized pre-made dishes, accounting for 70%. Secondly, the trustworthy products and meeting more needs are also the important reason to promote consumers' willingness to buy, accounting for 42%. In addition, consumers choose Fotiaoqiang pre-made dishes of secondary factors are emergency food reserves, reduce the frequency of going to restaurants.
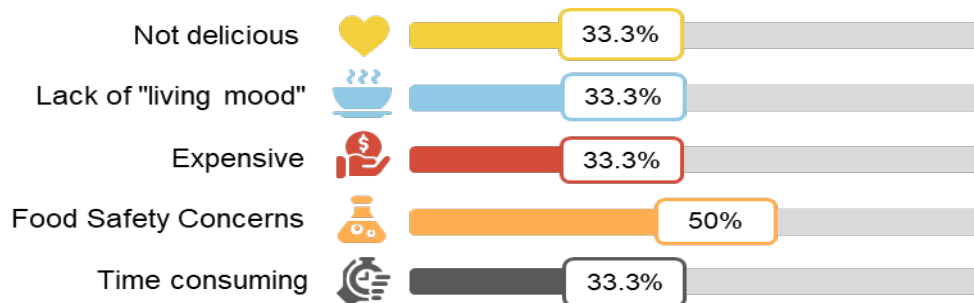
5.2 Why not choose customization

Figure 2 Reasons why consumers are unwilling to choose customized

From Figure 2, consumers choose customized Fotiaoqiang pre-made dishes mainly considering the time saving, product cost performance and meeting the needs of multiple consumption scenarios, meanwhile, food safety hazards and price threshold as well as the difference in taste with freshly made dishes are the factors that discourage most consumers. When providing customized services for Fotiaoqiang, proper attention needs to be paid to price positioning, food safety assurance and other product attributes.
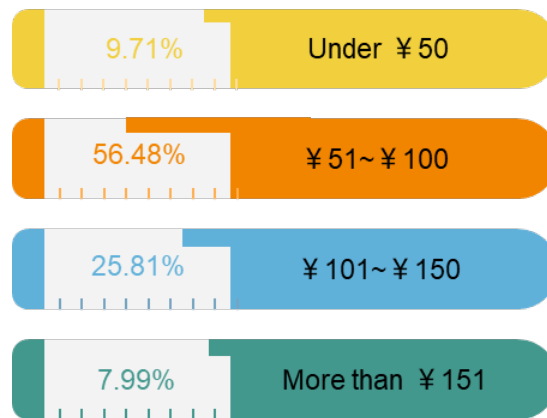
5.3 Customized budget

Figure 3 Customized budget

The budget range of one serving (250g) of Fotiaoqiang pre-made dishes is concentrated in 51-100 RMB, and the budget ratio of 101-150 RMB is relatively small. 7.99% of the respondents said that the budget of one serving of Fotiaoqiang pre-made dishes is 151 RMB or more, which indicates that consumers' pursuit of quality is higher than the pursuit of price, but the overall price setting should be moderate to meet consumers' demand for cost performance.
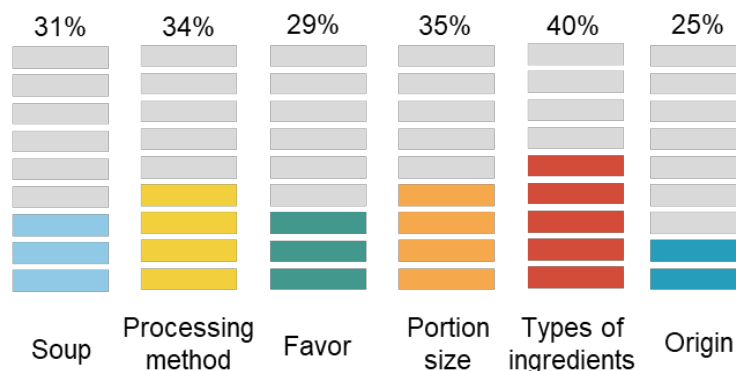
5.4 Customized preferences

Figure 4 Customized preferences

As shown in Figure 4, when consumers customize the pre-made dishes of Fotiaoqiang, the types of ingredients and food portions account for 40% and 35% respectively, while the stock, pre-made cooking method and taste account for 31%, 34% and 29% respectively, and the attention to the origin of ingredients is low, accounting for only 25%. When providing customized solutions to consumers, priority is given to the type and quantity of ingredients, followed by the choice of stock, cooking method and taste, and the origin of ingredients may not be considered.

5.5 Marketing strategy

5.5.1 Online or offline

Choosing online APP order customization of 21% of respondents, offline store order customization of 27% of respondents, 52% of respondents said both, it can be seen that consumers tend to offline store customization.
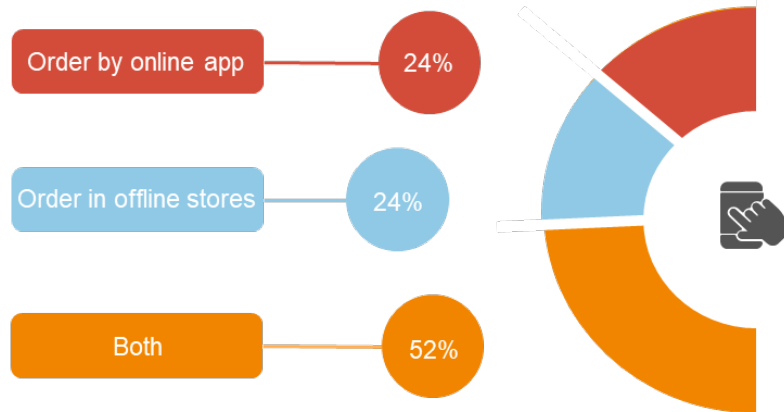
Figure 5 Sales model

5.5.2 Promotion strategy

Consumers are more willing to choose small trial packs, accounting for 75.38%, while discount sales are also more popular with consumers, accounting for 70.77%. It can be seen that improving the product cost performance and increasing the price advantage is more likely to promote consumer purchasing power.
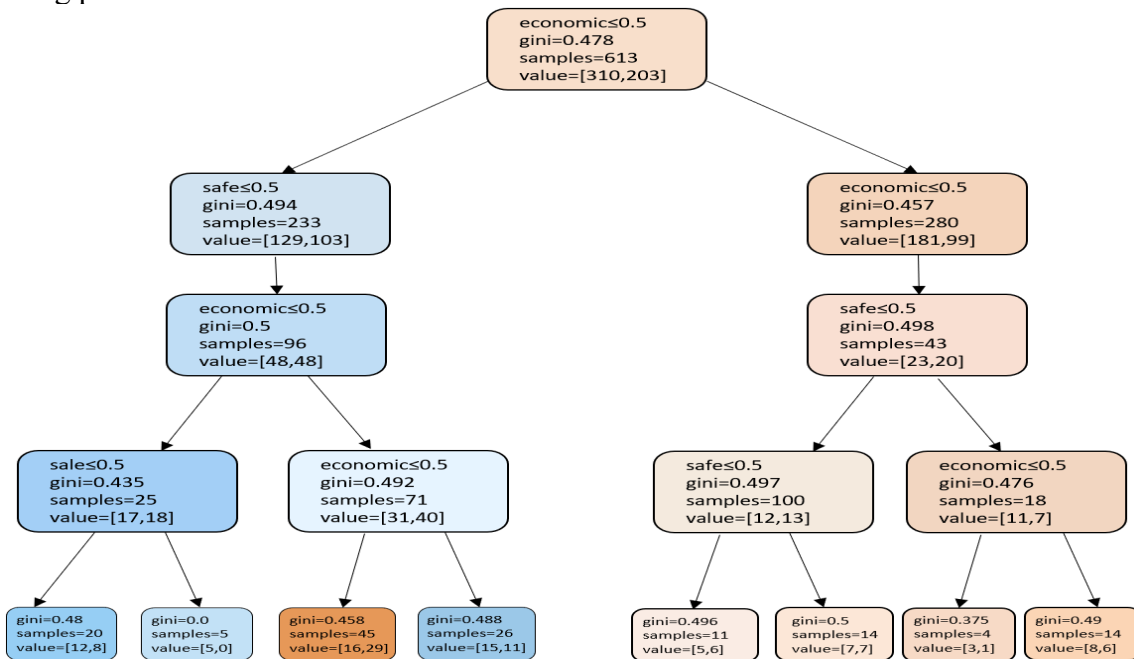

Figure 6 Promotion strategy preference

6. Customized content tendency analysis based on decision tree model

6.1 Type of ingredients

Through the analysis of the decision tree, it can be concluded that in the group of respondents with above-average scores on food safety and economic factors, and below-average sales patterns, the custom content preference is raw material type. This group of people has a better economic base and higher requirements for quality of life. Therefore, when customizing Fotiaoqiang pre-made dishes, they pay more attention to the type of raw material customization service. The results are shown in Figure 7:
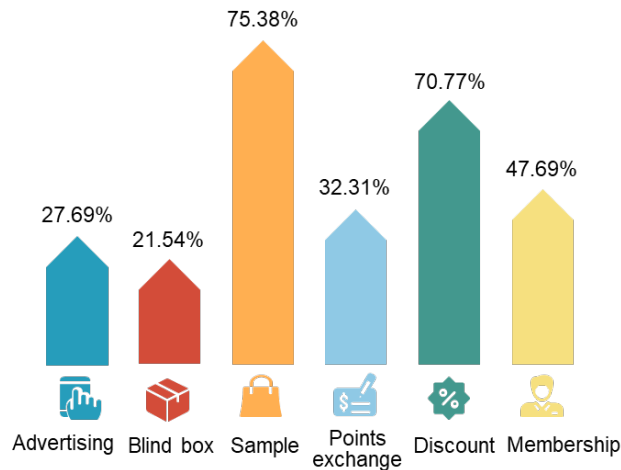
Figure 7 Decision tree model prediction based on raw material types

6.2 Food portion and stock

Through the analysis of the decision tree, it can be concluded that among the respondents with below-average economic factors and above-average sales pattern and food safety, the preference of customized content is food portion and soup base. This group of people has an average economic level and pursues the cost performance of the products, so they pay more attention to the quantity and taste of the products when they customize their consumption. The specific results are shown in Figure 8:
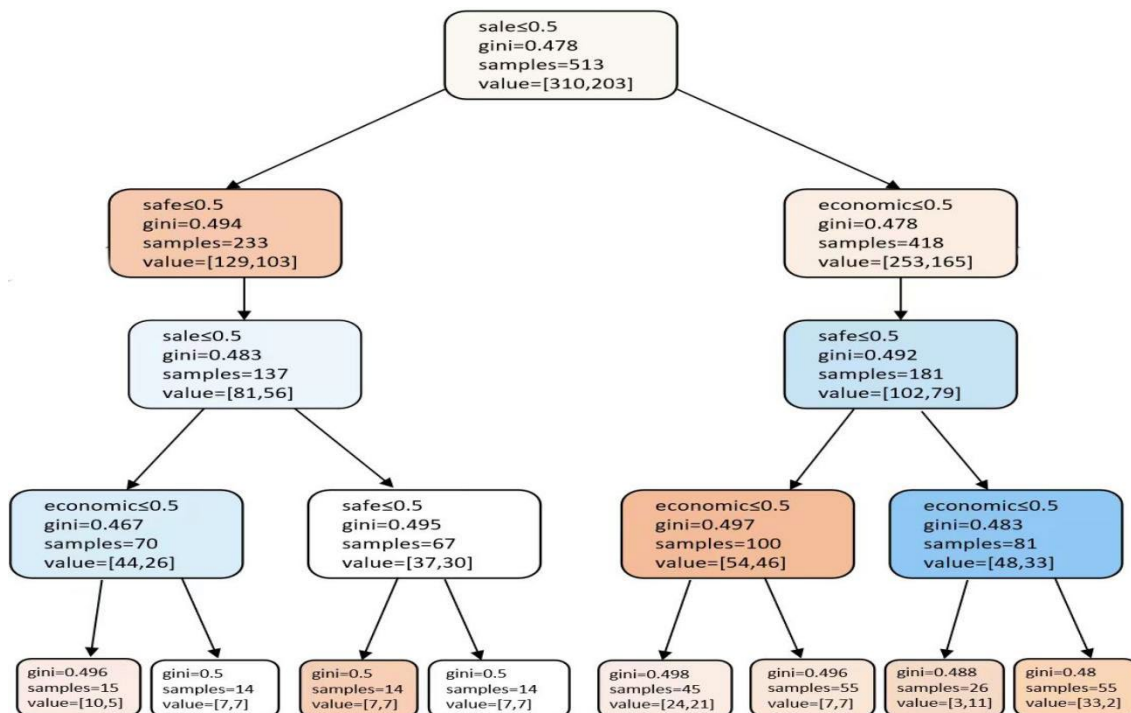
Figure 8 Decision tree model prediction based on food portion and soup base

7. Consumer behavior intention prediction based on BP neural network model

7.1 Model establishment

This paper establishes a neural network model based on consumers' purchase intention for the customized consumption mode of Fotiaoqiang pre-made dishes, and analyzes the main factors influencing purchase intention from 19 consumption factors.

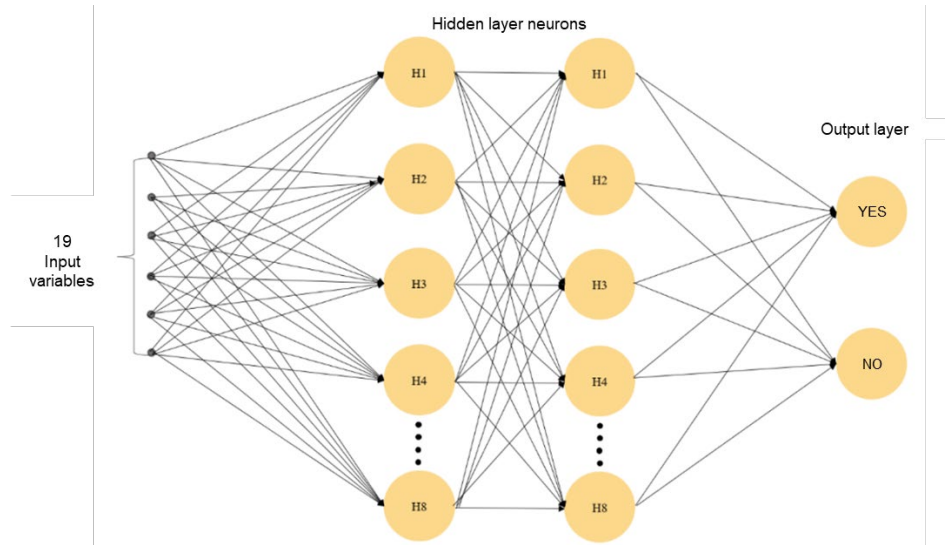The structure of neural network model building is shown in Figure 9:

Figure 9 Neural network structure model of purchase intention

7.2 Model evaluation and testing

After building the neural network model, the model effectiveness is evaluated to determine the model availability. The accuracy of the prediction model is shown in Table 2. The accuracy of the training set is 80.2% and the accuracy of the test set is 79.5%, which is as expected. The model has a strong predictive ability for the samples.

Table 2 Neural network model accuracy evaluation

	Accuracy	Recall	Precision	F1
Train	0.802	0.802	0.802	0.802
Test sets	0.795	0.795	0.798	0.795

The investigators plotted the curve of the model and used it to visually represent the performance of the classifier.
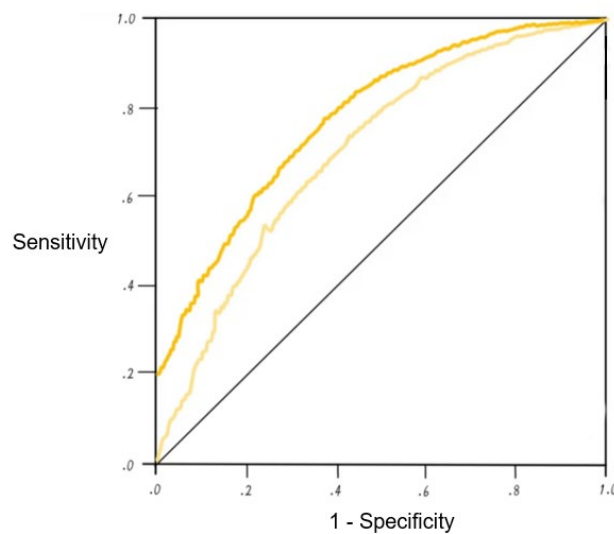

Figure 10 Neural network model ROC curve

The area under the ROC curves for both orange and light yellow categories is the AUC, and both have an AUC of 0.832 > 0.75, which is much better than the random classifier.

7.3 Model results and importance ranking

When training the model, each time a feature column is acquired it is randomly shuffled, and the model is used to predict it and obtain the loss value, and the loss value corresponding to each feature column is the importance of the feature, and the greater the loss, the greater the influence of the feature on this neural network model. This results in the importance of the respective variables for the dependent variable, as shown in Figure 11.
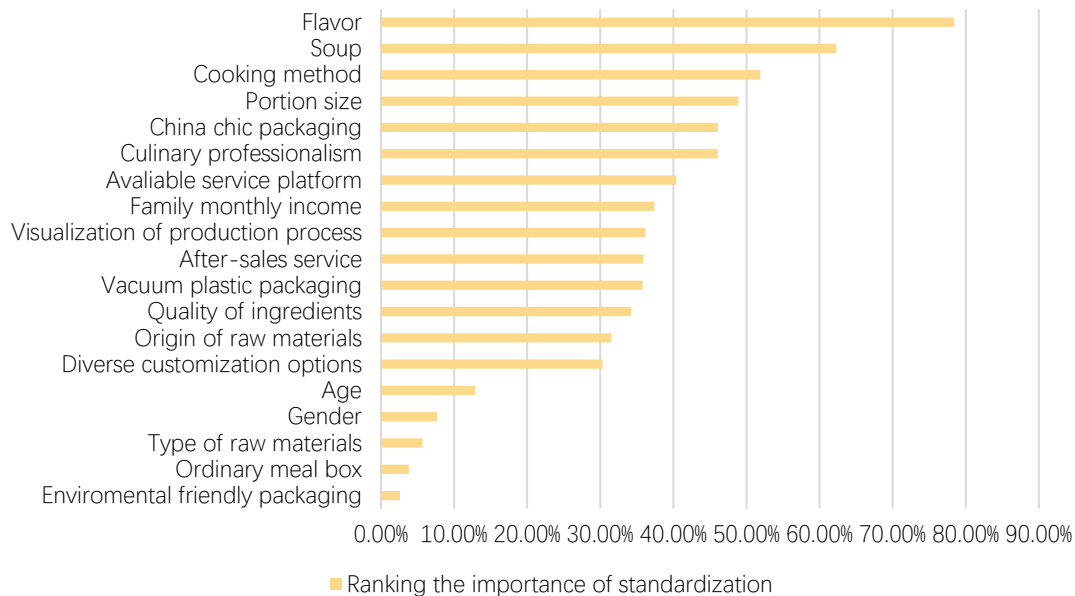

Figure 11 Neural network influence factor ranking

In the customized consumption of Fotiaoqiang pre-made dishes, taste ranks first, with the development of the times, people's demand for food taste turns out to be higher and higher, and consumers pay more attention to the experience of enjoying the product. Next is the custom soup, cooking method and food portion of Fotiaoqiang, which shows that consumers' demand for product customization content is always ranked in the forefront. The choice of national trend packaging ranked third, consumers are more inclined to customize the packaging rich in cultural heritage. Embracing the national trend will attract consumers' eyes and goodwill, and take the form of combining online and offline to broaden sales channels.

8. Conclusion

8.1 The orientation of customized pre-made dishes is not clear

Most consumers are willing to try to buy customized pre-made dishes for the convenience. Regarding the factors that consumers are more concerned about, they prefer to customize the Fotiaoqiang pre-made dishes (250g) with the price of 51-100 RMB; they expect to customize the "food portion", " stock base", " flavor " The subjective reasons from consumers' reluctance to buy customized pre-made dishes of Fotiaoqiang are more than the shortage of the product itself. From the perspective of eating habits, Guangzhou consumers prefer finished products from restaurants, and believe that Fotiaoqiang pre-made dishes are neither as safe and secure as making it by themselves, nor as fast and delicious as finished Fotiaoqiang products from restaurants, which leads to ambiguous positioning of customized consumption mode.

8.2 Consumers are most satisfied with convenience and have concerns about safety and health

In this survey, most of the respondents are young working people who have just entered the workplace, and convenience is the feature that consumers are most concerned about at present. Consumers generally believe that the safety of Fotiaoqiang pre-made dishes is relatively poor, and

there are also problems of taste deviation; the perception of pre-made dishes mostly stays in the popular taste of pre-made dishes, and the understanding of Fotiaoqiang pre-made dishes customized consumption mode is low and the trust is insufficient, and they believe that such products have "imperfect transportation and cold chain" and "processing environment is not up to standard", "unknown origin", etc. They prefer to enjoy Fotiaoqiang in restaurants because it is healthier and more hygienic.

8.3 Consumers value the product packing, the current packaging design needs to be strengthened

At present, consumers attach great importance to the packaging of such products, however, most of the packaging on the market at present is mainly vacuum packaging, there is a simple design, not easy to store, cannot effectively stimulate consumers' appetite and desire to buy, there is a big gap between foreign products.

9. Recommendations

9.1 Increase diversified customized product lines

Get rid of the association of Fotiaoqiang pre-made dishes only limited to the category of seafood ingredients, and update consumers' inherent impression through the improvement of customized production services and processing lines. Priority is given to the customization of ingredient types and portions, followed by the selection of stock base, cooking methods and flavors.

9.2 Add exclusive activities for holidays

Catering to the consumer demand for concentrated consumption on holidays, create offline stores for customization of Buddha jumping wall pre-made dishes, and launch small portions of the trial set selection of discount sales and other marketing tools to provide more choices for the consumption of pre-made dishes in the holiday scene. According to consumer demand to produce products that better meet the current market of prepared dishes, word of mouth so that customers understand the reliability of the "seafood Huang" brand, more conducive to attract new consumer groups.

9.3 Development of national trend packaging, get rid of a single scene dependence

Different product packaging on the one hand gives different consumer groups different reasons to buy, on the other hand, to improve the added value of the product. With the classic vacuum bag to meet the daily consumption scene of the product; the senior gift box packaging gift as to meet the diversification of the product workplace social gift; in the collectible delicate packaging into the consumer groups favorite national trend and retro elements, gradually improve the cultural attributes of the product packaging, to meet the requirements of consumers for packaging visual and creative appeal, to achieve the purpose of increasing sales.

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