Prediction Of Household Waste Based On Grey Prediction and Multiple Linear Regression

Congling Liu

Shanghai University of Engineering Science, Shanghai 201620, China

844319273@qq.com

Abstract

In order to improve the living environment, the amount of household Waste is an important aspect. In this paper, by improving residents' dietary structure and using grey prediction, the number of residents' dietary in the next year is obtained. Through multiple linear regression, the relationship between the amount of amount of household waste and the dietary structure of residents is obtained, so as to obtain the amount of household waste in the future, which provides a basis for improving the ecological environment.

Keywords

Grey prediction, multiple linear regression, household waste.

1. Introduction

Nowadays, the amount of household waste is an important factor affecting the ecological environment. In order to improve the ecological environment and improve the quality of life of residents, it is necessary to establish a suitable method to predict the amount of household waste in the future. Grey prediction is a method that uses a small amount of known data to predict the future year[1]. By using the least square method and the grey prediction model, Yanping Li established a regression model for the output of household Waste [2]. Dongming Wang et al. obtained the waste output of liaoning province in the next year by grey prediction according to the existing data[3]. Annegrete Bruvoll et al. analyzed the influencing factors of garbage and predicted the amount of garbage by using the equilibrium model[4]. According to the existing literatures, this paper uses grey prediction to obtain the data of residents' dietary structure, and then carries out a regression analysis on the data of main dietary fiber that affects the volume of garbage clearance, and obtains the corresponding regression model.

2. Organization of the Text

2.1 Grey Prediction Model

Grey Prediction model uses the original discrete data column to generate a new and regular discrete data column through one accumulation to reduce the randomness. Then, by establishing the differential equation model, the approximate estimate of the original data generated by the solution at the discrete point is obtained, so as to predict the subsequent development of the original data [5].

$x^{(0)}=(x^{(0)}(1),x^{(0)}(2),\cdots x^{(0)}(n))$ is the original data column, the new generated data column is

$$x^{(1)}=(x^{(1)}(1),x^{(1)}(2),\cdots x^{(1)}(n)),x^{(1)}(m)=\sum_{i=1}^{m}x^{(0)}(i)\ ,m=1,2,\cdots n$$

The differential equation of the grey equation can be established $\frac{d\hat{x}^{(1)}(t)}{dt}+\hat{x}^{(1)}(t)=b$, The solution of the model $x^{0}(k)+az^{(1)}(k)=b$ can be obtained as:

$$\hat{x}^{(1)}(m+1)=\left[x^{(0)}(1)-\frac{b}{a}\right]e^{-am}+\frac{b}{a}\ ,m=1,2,\cdots,n-1$$

Finally, the residual and grade ratio deviation tests can be used to determine whether it meets the requirements.

According to the data of the residents' dietary structure in recent years, the data of the residents' dietary structure in the future years are obtained.

2.2 Multiple Linear Regression Model

This model take the average annual intake data of dietary structure, and make regression fitting with the amount of household waste. Based on the grey prediction of dietary structure data of future years and regression relationship, the amount of household waste in the future can be obtained. The formula is

$$N = an_1 + bn_2 + cn_3 + dn_4 + e$$

n_i(i=1、…5) is the independent variable data of the index of dietary structure, N is the dependent variable data of amount of household waste.

3. The example analysis

We use the average annual intake of coarse grains, salt, vegetables, fruits, meat in ShenZhen, China from 2013 to 2017 as indicators of dietary structure. The amount of household waste is taken as the index to evaluate the ecological environment. See Table 1. The grey prediction method is used to predict various dietary indicators from 2018 to 2020, and correlation test and multiple linear regression are conducted between the volume of household waste and various indicators of dietary structure in ShenZhen.

Table 1 Amount of dietary structure and the household waste

Indicators Year	coarse grains (kg)	vegetables (kg)	fruits (kg)	meat (kg)	household waste (Ten thousand tons)
2013	148.7	97.5	37.5	32.8	521.69
2014	141	96.9	38.6	33.6	541
2015	134.5	97.8	40.5	34.6	575
2016	132.8	100.1	43.9	35.2	572.28
2017	130.1	99.2	45.6	35.6	603.99

The grey prediction method was used to predict the per capita intake of vegetables, fruits, coarse grains, meat. The predicted results were shown in Fig. 1, Fig. 2, Fig. 3 and Fig. 4.

Fig. 1 Prediction of vegetables

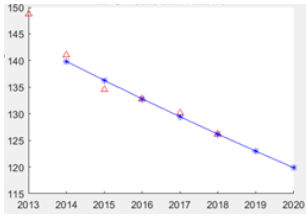

Fig. 2 Prediction of fruits

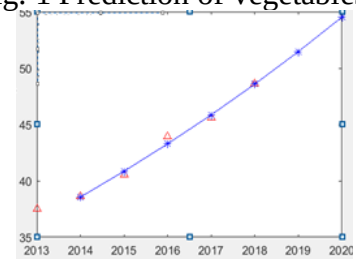

Fig. 3 Prediction of grains

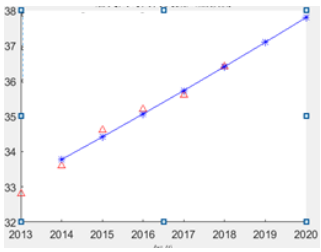

Fig. 4 Prediction of meat

We use SPSS software to analyze the correlation between the amount of household waste and the per capita intake of coarse grains, salt, vegetables, fruits, meat in the dietary structure of residents, and

factors that were relatively correlated were obtained. Then, Multiple linear regression analysis was used to obtain the relationship between various indexes of residents' dietary structure and the amount of household waste. The multiple regression results are:

$$N = 16.762n_1 - 22.664n_2 - 9.021n_3 + 180.491n_4 - 5342.614 \quad (1)$$

n_1, n_2, n_3, n_4 are per capita intake of coarse grains, salt, vegetables, fruits, meat, N is amount of household waste.

According to the grey prediction data and the multiple linear regression results of the household waste, the prediction amount of household waste in 2018-2020 is obtained, see Table 2.

Table 2 The prediction amount of household waste(Ten thousand tons)

Year	2018	2019	2020
household waste	619.671	643.551	670.472

4. Conclusion

The dietary structure of city residents can not only improve the health level of residents, but also affect the composition of household waste, so as to improve the whole ecological environment. Therefore, it is very important to establish a reasonable prediction model. In this paper, through correlation analysis, the factors that have a great influence on the total amount of household waste are obtained, and the relationship between the amount of household waste and the dietary structure of residents is obtained by using the formula of multiple linear regression model. In terms of future improvement, more factors of dietary structure can be taken into account to further predict the volume of garbage collection.

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