Application of Combined Grey Model in Maize Yield Prediction

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Abstract: The yield of maize is the most concerned about the development of agriculture, ecological safety, ensure corn green, agricultural science and technology personnel responsibility, along with the population growth and economic development, to ensure the safety of the task will be more important to corn. The changes of maize production in Jilin province fluctuations, not single gray model describing the change rule and forecast the future trend prediction model of grey linear regression response equation and the composition of the sequence by using the linear regression equation and time obtained by the grey model, to make up for the lack of growth factors and trend index no linear grey model in linear regression model. The example shows that the prediction accuracy of the model is high.

Introduction

The increase of population, the decrease of cultivated land, the acceleration of urbanization and the improvement of people's living standard are one of the important factors that restrict the yield of crops. Thus ensuring the stability of crop yields, its political and economic significance is self-evident. Agricultural production is affected by crop varieties, cultivation techniques, soil and climate. High input will increase crop yield, but also brings the problem of environmental pollution, which requires us to study and establish the sustainable agricultural development, to do complex Agricultural Ecosystem Optimization and control is one of the important crops, forage crops and economic crops, agricultural production in our country in the development of national economy and occupy more and the heavier. Important position of maize. Therefore, the factors of maize production influence analysis, agriculture model and simulation research method can fast simulation and overall description of the agricultural system, and predict the future development trend of the corn yield, and to explore effective measures and Countermeasures to coordinate the contradiction between people and land, has a very important theoretical and practical significance. Different climate, different nitrogen dosages have effects on maize yield, and the grey model number of the sample volume is not too much, also do not need the typical regularities of distribution, less calculation, and there are no quantitative correlation results inconsistent with the qualitative analysis, for the future development of the agricultural development strategy. The decision-making of the government, provided a powerful means of land use and adjustment of planting industry.

Grey Linear Regression Combination Model

Grey prediction model has many advantages, such as less sample data, convenient operation, high accuracy of short-term prediction, and so on. Therefore, it has been widely used in agriculture, industry and other fields. The grey linear regression combination model is constructed by combining the grey model with the linear regression model, which can make up for the lack of linear growth trend in the linear regression model. The results show that the combination of grey model and linear regression model can overcome the defects of grey model and linear regression model. The modeling process is as follows:

Set the original data sequence:

X = (x (1), X (2),,, X (n)), X (I), i=1, 2,,,,, N

In order to increase the smoothness of the sequence, the X to do a cumulative generation: X = (x (1), x, 2),,, X (n)), from the gray time response can be obtained

(t+1) = (x (1) -b/a) exp (-at) +b/a (1)
Can be further recorded as

(t+1) =C exp (VT) +C (2)

The linear regression equation Y = aX+ B and exponential equation Z=a*exp (X) are used to fit the cumulative sequence X, so that the generated sequence can be written as:

(T) = C exp (VT) + C t+ (3)

Among them, the parameters V and C, C, pending.
In order to determine the above parameters, set the parameter sequence

Z (T) = x (t+1) - x (T) = C exp (VT) {exp (V) -1}+ C, t=1, 2,,, n-1 (4)
And set

(T) = Z (t+ m) - Z (T) = C exp (VT) - (EXP) - 1] (V) - 1] (5) (P) (Ex)

(t+1) / (T) = exp (V) (6)

Solution: v=In{(t+1) / (T)} (7)

V= (8)

L (T) = exp (T) (3) variable (9)

(T) = C 1 (T) + C t+ (10)
The estimated value of C1, C2 and C3 can be obtained by least square method.

There is x =AC (11)

Thus C= x (12)
The predicted value of the generated sequence is:

(T) = C exp () +C t+ (13)

The prediction of type a Iago can be obtained the original sequence value of $X^{(0)}$. It can be seen that, when C1= 0, the data generated by a cumulative sequence is a strict linear regression trend, when C2 = 0, the cumulative generated sequence for the gray model. The new model can improve the linear regression model without the exponential growth trend and the linear model without the linear factor.

Grey Linear Regression Combination Forecasting Model

As shown in Fig. 1, corn production in Jilin is not a steady increase from 2000-2007, especially after 2004, the growth rate of a single prediction model has been unable to accurately describe.
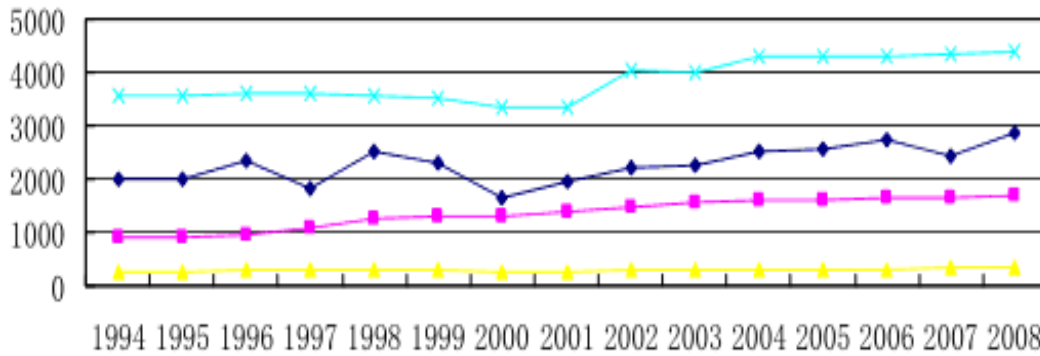
Figure 1.   Changes of grain yield, fertilizer and irrigation in Jilin

When collecting data, it is very difficult for the research work because of the abrupt change of the system behavior at a certain time point. Therefore, how to effectively fill the hole, naturally become the first problem encountered in data processing. There are many methods to deal with the abnormal data, the common method is to replace the original value with the mean value, and the other is to replace the original value with the predicted value. In 2003, due to continuous rain and flood disasters, the corn yield in Jilin was seriously reduced. In order to improve the fitting degree and the accuracy of the prediction model, to deal with the 2003 data, data modeling obtained using the above 2 methods, the model error is large, according to the growth trend of Jilin corn in 2001, 2002, 2004 3 years of production, calculate the 2003 corn yield two times instead of the actual output by using the interpolation method the graph is more smooth. As shown in Fig. 1, the final results are very satisfactory.

Table 1 1990 maize yield statistics from 2011 to 2008

No	Year	Maize yield （Kg/ha）	No	Year	Maize yield （Kg/ha）
1	1990	4840.95	12	2001	5704.40
2	1991	4938.65	13	2002	7154.59
3	1992	4769.15	14	2003	6689.65
4	1993	5135.20	15	2004	6754.07
5	1994	4963.75	16	2005	7505.05
6	1995	5599.30	17	2006	7475.23
7	1996	6373.55	18	2007	7530.42

According to different m, the use of (5) - (7) - (8) is derived from the estimated value of V = 0.31468955 by (10) estimates that C value of C= (4461.33838291.897, 2831.596) to a model through a variety of inspection to determine its reasonableness. Only by examining the model can be used to make predictions. The grey model can be tested by the following 3 methods: error test, correlation test and post test. These 3 methods are to judge the accuracy of the model by the residual error, the smaller the error requirements, the better the correlation E requirements, the better the mean variance ratio C the smaller the better. Under normal circumstances, the relative error is often used to test the index, given A, when the average error is less than A and the relative error at each point is less than A, the model for the residual eligibility model can be predicted. The test set is the average relative error a<0.05, the credibility of P>80%, the average relative error of the model is 2.099%, the average accuracy is 97.9%, the error is relatively small, smooth change. As can be seen from table 2, the relative error of 2000- is less than a in 2007, which proves that the fitting degree of the model is large and the simulation precision is high. The model can be used to predict.

Conclusion

From Jilin can scatter the total corn production, Jilin corn production not only accords with a certain trend, therefore, with the establishment of the linear regression equation and exponential equation and the new model, the new model not only has linear trend and growth trend index are in good agreement with the growth trend of JiLin rice production, so as to achieve accurate forecast. In this paper, the two interpolation method is used to improve the accuracy of the original data in the process of modeling the corn yield by using the Grey Combination model.

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