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优化离散灰色幂模型及其应用

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Optimized Discrete Grey Power Model and Its Application

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摘要 考虑已有的灰色预测模型主要能对指数型发展系统或幂函数型发展系统进行模拟预测,本文构建了一种不仅能够模拟指数型和幂函数型的发展系统,并且能够体现出二者之间的相互作用关系的离散灰色幂模型;并针对初始条件对离散灰色幂模型模拟精度的影响,首先给出了离散灰色幂模型的建模步骤,然后以平均相对误差最小化为目标、参数之间的关系为约束条件,构建了离散灰色幂模型初始条件的优化模型,实现对离散灰色幂模型初始条件的优化。结果表明,优化的离散灰色幂模型使得平均相对误差在理论上达到了最小化,其模拟精度和预测精度都高于传统模型。最后,通过中国网络购物人数数据预测和仿真数据分析,说明了本文优化方法的有效性和适用性。

关键词： 灰色系统　离散灰色幂模型　参数优化　网络购物

Abstract : A large number of practical systems have the characteristics of incomplete information, it is prevalent in the real world of the small sample, and the uncertainty of poor information system provides a very rich resource for the study of gray system theory. Grey prediction model has provided a useful tool for the small sample data predict. But, the existing research suggests that grey forecasting model can better simulate exponential function changes system and power function system, but the existing prediction model cannot better reflecting the exponential and power function combined effects to the system, so it is difficult to apply these model to predict the small sample data which effect by complex multifactorial impact. Based on this consideration, a new grey forecasting model-discrete grey power model is proposed.The new model add one time power function in the existing discrete grey model, and it also allows the power parameters by endue any value. So, the time-responsive features of this model can reflect the exponential and power function changes system, and includes the interaction characteristics of power function and exponential changes in the system. Based on the new model, taking into account the effect of the initial condition in the discrete grey power model, two optimization models are constructed with the objective of minimum average relative error, the constraints of relationships between parameters in order to optimize the initial condition. The example of online shopper from 2006 to 2012 in China is used to compare the simulation and prediction results of GM(1,1) model, discrete GM(1,1) model and the new method, the results show that the optimized model has better simulation and prediction accuracy than other two grey models. Additionally, in order to test adaptive of the new model, under the conditions of a given power exponent, six kinds of situations data Low-growth data、Medium-growth data、Rapid-growth data、Volatility data、Disturbance-growth data and Attenuation data are genercated by using randomly generated method, and the new model is used to simulate and predict the rand data, the results also show that the new model has better stability, which is further illustrated the validity and applicability of the new model. Therefore, the new prediction model constructed in this paper not only enriches the theory of grey forecast model system, but also provides a more rich set of tools for the prediction of small sample system under the combined effects of multiple factors.

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引用本文:

.优化离散灰色幂模型及其应用[J] 中国管理科学, 2016,V24(2): 162-168

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