

# Forecasting China's per capita living energy consumption by employing the DGM (1,1, $t\alpha$ ) model with fractional order accumulation

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## Abstract

The living energy consumption of residents has become an important technical index to promote the economic and social development strategy. In order to explore the future development trend of China's per capita living energy consumption, this paper establishes a novel grey model to predict China's per capita living energy consumption. Firstly, this article introduces the fractional accumulation operation and builds the discrete DGM (1,1,  $t\alpha$ ) model with fractional order accumulation model (abbreviated as FDGM (1,1,  $t\alpha$ ) model) on this basis. Secondly, the whale algorithm is introduced to solve the parameters of the FDGM (1,1,  $t\alpha$ ) model. Thirdly, the advantages of the FDGM (1,1,  $t\alpha$ ) model over the traditional grey models are illustrated by a real case. Fourthly, the metabolism mechanism is introduced into the FDGM (1,1,  $t\alpha$ ) model to enhance the prediction performance of the FDGM (1,1,  $t\alpha$ ) model. Finally, the FDGM (1,1,  $t\alpha$ ) model based on metabolism mechanism is used to predict China's per capita living energy consumption from 2018 to 2029.

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