Analysis of Drug Use based on Grey Prediction Model

Yingai Chen¹, Yanyan Zhao², Jinhan Chen², *

¹College of Civil Engineering, Hainan University 570228, Haikou City, Hainan Province
²College of Information Science and Technology, Hainan University 570228, Haikou City, Hainan Province

*Corresponding author: vj162774@163.com

Abstract. The morbidity and mortality related to the use of opioids have not decreased significantly. At present, the main measure to solve the crisis of opioids is to prevent the use of recreational drugs. However, addiction to medical drugs is also an important cause of the crisis. In this paper, the related prediction and analysis of these drug use problems are carried out. In view of the many socio-economic factors provided, First of all, MATLAB is adopted for grey relational analysis. Through the ranking of socio-economic factors and the total number of drug reports, the ten factors with the highest correlation degree are obtained. And then we're sifting through all of these socio-economic factors to determine the nine most numerous factors. Finally, the prediction results of the model are given.

1. Introduction
The United States is experiencing a national crisis, the opioid crisis. Heroin is a highly addictive alternative to opioids. When drug addicts have difficulty in obtaining opioids or become resistant to long-term opioid therapy, they will switch to heroin and therefore drugs. In different continents, the number of drug-related crimes has different trends. If the rising continents do not strengthen control, they will spread to the surrounding areas as a central point, which will have a serious adverse impact on the U.S. economy and society. If opioids spread across all the cross-sections of the United States, they will affect people of different jobs and ages, thus further jeopardizing the social and economic development of the United States.

2. The Grey System Model
Grey forecasting includes grey time series forecasting, seasonal catastrophe grey forecasting, system grey forecasting and topological grey forecasting. Grey time series forecasting is a forecasting method which constructs the dynamic model of grey forecasting by observing the time series reflecting the characteristics of the forecasting objects, so as to predict the characteristic quantity at a certain time in the future. It is a forecasting method for the numerical value of the main behavior characteristic quantity of the system. Grey system theory holds that time series contains abundant information and all other variables involved in the dynamic process of the system. Grey time series forecasting is based on the study of discrete time series, fully exploiting and utilizing the explicit and implicit unknown information in limited data to establish discrete data dynamic model for forecasting.
The grey model is generally described as GM (n, h). n and h are respectively the order and the number of variables of the grey differential equation established. Usually, when n < 3, the accuracy is not necessarily reliable, because of the high order and large amount of calculation. When h > 1, the grey model is only used to analyze the relationship between factors, not to make grey prediction. Because the behavior of any intrinsic grey system is affected by many factors, if all the relevant factors are included in the model, there will be no practical model. GM (1,1) model is the most widely used grey prediction model. It belongs to the first-order linear dynamic model of single sequence and is suitable for the modeling of monotone change sequence.

If \( X^{(0)} \) has n years of observed value, then \( X^{(0)}(1), X^{(0)}(2), ..., X^{(0)}(N) \). Carry out first-order accumulation processing on \( X^{(0)} \):

\[
\begin{align*}
X^{(0)} &= \{ X^{(1)}(1), X^{(1)}(2), ..., X^{(1)}(n) \} \\
X^{(1)}(1) &= X^{(0)}(1) \\
X^{(1)}(t) &= \sum_{i=1}^{t} X^{(0)}(i) \quad (t = 2, 3, ..., n)
\end{align*}
\]

According to sequence \( X^{(1)} \), the gray differential equation for predictive models:

\[
\frac{dX^{(1)}}{dt} + aX^{(1)} = \mu
\]

The discrete form and prediction formula are as follows:

\[
\Delta^{(1)}(x^{(1)}(k+1)) + a(x(k+1)) = \mu \quad \hat{x}^{(1)}(k+1) = [x^{(1)}(1) - \frac{\mu}{a}]e^{-\frac{a}{\mu}} + \frac{\hat{x}}{a}
\]

3. Analysis of Drug Identification Threshold Levels Change

Drug threshold definition: Cut off Level Threshold. The defined concentration of an analysis in an employee drug test specimen at or above which the drug test is called positive and below which it is called negative. (This concentration is usually significantly greater than the sensitivity of the assay.)

After the use of opioid prescription drugs, there will be a certain amount of residues in the body. When the concentration of drug in plasma drops to the lowest level, the concentration of drug in plasma will be the threshold. Excessive residues will lead to the rise of the threshold. When the threshold reaches a certain concentration, it will affect the body and lead to sequelae.

If the opioid prescription drugs are taken excessively, drug dependence will easily occur, and the drug residues in the body increase the possibility of inducing drug abuse. The threshold of drug concentration in drug users is generally higher than that in other people. When the threshold of drug concentration accumulates to a certain amount again, people become more dependent on drugs physiologically and even psychologically. When drug abuse lasts too long and there are too many residues in the body, it will cause permanent damage to the body, and this stage is extremely easy to trigger vicious incidents of drug crime.

Based on the above analysis, we divide the drug concentration threshold into the following four stages:
Security stage: At this stage, most of the residual opioids in the body can be discharged out of the body with the passage of time, and the drug concentration threshold will return to a lower level after a certain period of time.

Induction stage: Induction stage refers to the period during which drug residues accumulate in the body after overuse of opioids. At this time, drug dependence is easy to occur, which increases the possibility of inducing drug abuse.

Early stage of addiction: The stage of addiction refers to the threshold of drug concentration in the early stage of drug abuse, which leads to the physiological dependence of people on drugs.

Middle and Late Stage of Addiction: The middle and late stages of addiction refer to excessive drug residues, permanent physical damage and psychological dependence on drugs caused by long-term consumption of drugs, which can easily trigger vicious incidents of drug crimes.

4. Prediction Result Analysis of the Model
Figure 2. Prediction Result of the model

As shown in the figure, the number of drug reports of KY and OH showed an increasing trend with the increase of time, while the number of drug reports of WV and VA showed a decreasing trend with the increase of time. This shows that WV and VA are well controlled in the security phase. However, KY and OH are characterized by the initial stage of addiction, and corresponding measures should be taken to control them.

5. Conclusion

Among the overdose population, there are a certain number of people who are addicted to drugs because of medical treatment. They will seek alternatives to opioids after their routine access to drugs is blocked or their physical resistance increases. Therefore, cheap and effective heroin has become their first choice. In this paper, the related prediction and analysis of these drug use problems are carried out. The number of drug reports of KY and OH showed an increasing trend with the increase of time, while the number of drug reports of WV and VA showed a decreasing trend with the increase of time.

References

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