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THE THEORY OF KM_2O-LANGEVIN EQUATIONS AND ITS APPLICATIONS TO DATA ANALYSIS (III): DETERMINISTIC ANALYSIS

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Abstract. A technique is given for detecting deterministic dynamics in time series. Some stochastic difference equations, called KM_2O-Langevin equations, are extracted directly from given data. We can find deterministic dynamics in time series by evaluating the magnitude of innovation part of the KM_2O-Langevin equations. We can further find chaotic dynamics in time series by predicting it from the viewpoint of the theory of KM_2O-Langevin equations.

We apply our method to the data of measles and chicken pox, which are also treated by G.Sugihara and R.M.May in [1]. The result of numerical experiments indicates that there seem to exist some deterministic dynamics in both time series. It also suggests, however, that the data of measles seems to be chaotic while that of chicken pox not, which corresponds to the result of G.Sugihara and R.M.May.

§1. Introduction

There are a lot of systems in the world, whose behavior as a whole is never understandable if we only view their components separately. Such systems, called complex systems, arise from a variety of origins of complexity such as stochastic structure, deterministic chaos and so on. This feature of complex systems has the result that a priori parametric statistical models (e.g. ARMA model, linear regression model) may fail to catch the underlying structure arising from the complex systems which lies behind the data.

Therefore, we must check the validity of the preconditions that is assumed before data analysis. We call such an approach toward data analysis *a qualitative approach* in contrast to quantitative approaches such as parametric statistical models. One of the authors has presented a precondition-

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