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Quantum Statistical Machine Learning and Quantum Time Series

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Abstract : Minimizing a constrained multivariate function is the fundamental of Machine learning, and these algorithms are at the core of data mining and data visualization techniques. The decision function that maps input points to output points is based on the result of optimization. This optimization is the central of learning theory. One approach to complex systems where the dynamics of the system is inferred by a statistical analysis of the fluctuations in time of some associated observable is time series analysis. The purpose of this paper is a mathematical transition from the autoregressive model of classical time series to the matrix formalization of quantum theory. Firstly, we have proposed a quantum time series model (QTS). Although Hamiltonian technique becomes an established tool to detect a deterministic chaos, other approaches emerge. The quantum probabilistic technique is used to motivate the construction of our QTS model. The QTS model resembles the quantum dynamic model which was applied to financial data. Secondly, various statistical methods, including machine learning algorithms such as the Kalman filter algorithm, are applied to estimate and analyses the unknown parameters of the model. Finally, simulation techniques such as Markov chain Monte Carlo have been used to support our investigations. The proposed model has been examined by using real and simulated data. We establish the relation between quantum statistical machine and quantum time series via random matrix theory. It is interesting to note that the primary focus of the application of QTS in the field of quantum chaos was to find a model that explain chaotic behaviour. Maybe this model will reveal another insight into quantum chaos.

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