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Application Analysis of Financial Time Series in Stock Market

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Abstract: Time series analysis is a basic tool in number investing. The time-series sequence is a sequence of variables measured in a fixed section sequence over some time. The fluctuation of stock price affects all aspects of social and economic life, so effectively predicting the trend of stock price changes has great economic and social value. Based on the existing research results on time series, this paper takes the stock market as an entry point, and sorts and summarizes the literature from the application fields and application methods of time series. The research results show that the application fields of time series involve the stock market, enterprises, macro economy, etc., among which the application of the stock market is the most commonly used and the most extensive. The research based on time series mainly innovates and corrects the research methods. The research in this paper can provide a theoretical reference value for further research on time series.

Keywords: time series, finance, forecast, stock market

1. Introduction

1.1. Research Background

Time series analysis has a wide range of applications in almost every field. However, in individual research activities, it is mainly used for predictive data and R language exercises. Definition of time series data: there's a given ordered sequence of observations of well-defined data items at fixed time intervals. Time series analysis (TSA) uncovers hidden, shadowy patterns in time series data and obtains subjective and useful insights. It is useful in predicting future values or detecting unexpected variants in various application areas. Historically, TSA has been scattered into time-domain frequency-domain methods, which used an autocorrelation function, while frequency domain methods used the Fourier transform of the autocorrelation function. Today, these differences are perhaps not as valued to us as they once were. Engineers use these methods to help solve financial problems. Although most TSA methods come from classical statistics, artificial neural networks have not been used since before the 1980s. However, these methods are just as ineffective if they are not backed by sufficient data financial time series analysis requires a certain stratum of modern pure-math knowledge. Particularly with some of the more modern models, continuous stochastic processes, state space models, etc., require a high level of mathematical

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proficiency. As a result, financial time series analysis is undoubtedly seen by many as prohibitive due to the thick veil it carries. However, if learning aims to know the character of time- series, become familiar intended to make financial time series analysis, therefore, use linear but really practical models (such as ARMA models) to forecast financial time series and develop quantitative strategies from them, then these objectives can be achieved with a simple foundation in statistics.

1.2. Research Significance

Firstly, deep studying information networks are intended to spontaneously contemplate and extract features from unprocessed inferior data a time series is a measure of how something varied each time. In a time series which is not only a politics. In the contrast, its main axis is in a two-dimensional image (from a two-dimensional graph of the time series data) [1]. This time dimension shows the opportunities and constraints of time series data as it gives us a source of subsequent information, however, the time series problem is facing a challenge as it requires specialized processing of the data. In addition, this modern structure can take other information that calculators must deal with, with this data and seasonality, to make time-series easier to model with other old methods. In problems related to time series forecasting, neural networks can be used to reduce the amount of feature engineering, data scaling processes, and differencing operations on smooth data. In real-world time series cases, the forecasting of some streaming-based IOT devices (similar to geo-information sensors), there are often non-fixed modern structures, losing data, heavy noise, and complex relationships between varied changes that impose a limit on old prediction methods [1,2]. These techniques often require clean, complete data sets to work better: and missing data values, outliers, and other flawed features are often not supported. Secondly, time series data accumulates very quickly and ordinary data are not made to handle that size, relational databases compare poorly with very giant data sets, NoSQL databases perform better at scale but can still excel with databases that are carefully tuned for time series data, compared to time series databases that dispose of scale by draw into efficiencies that are only TSDBs also contain features commonly used in time series data analysis, continuous queries, flexible temporal aggregation, etc. Even if you don't need to consider scaling it now, these functions are still available to a wider range of users [3]. This is why calculators are increasingly adopting time series databases for use in different areas.

1.3. Paper Organization

The general purpose of this essay is to sort out the existing time series processes and to give an outlook on time series. Therefore, this thesis will consist of collating the literature.

2. Literature Review

2.1. History of the Time-series

The oldest time series analysis dates can be traced back to 7,000 years in ancient Egypt which created a time series by recording the conditions of the Nile - high or low tide - daily [4]. By observing this time series over a long period, they made an important discovery that the Nile was rising and falling in a very regular manner. As a result of this discovery, the economy, culture, and agriculture of ancient Egypt began to break through at an unprecedented rate. This means of acquits patterns from the observed series is known as descriptive analysis. In the development of time series analysis methods, applications in the fields of economics, finance, and engineering have an ongoing role in propulsion progress in the development of time series analysis, then each step in the

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development of time series analysis is tied to the application. This model, with the MA (Moving Average) model and the ARMA model proposed by the British statistician G.T. Walker in 1931, Contributed to the roots of time series analysis, which is still widely used and studied today [5]. These three models are mainly applied to univariate, homoskedasticity smooth series. Subsequently, Box and Jenkins' 1927 book Time Series Analysis: Forecasting and Control are regarded as a basic part of the growth of time series analysis. The ARIMA model, also known as the Box-Jenkins model, is a linear model with univariate, homoskedasticity applications. The model can handle non-stationary series. The main idea is to first differential the non-stationary series into a stationary series and then fit the differenced series with an ARMA model. The AR model, MA model, ARMA model, and ARIMA model described earlier all require the time series to be univariate, homoscedastic linear models. About a time series analysis has developed, it has been found that these expectations do not support in some situations, for example, Moran's modeling of Canadian bobcat data revealed odd features in the data where the residuals of sample points were bigger than the mean-value were smaller than those of sample that not more than the mean [6,7]. As a result, one is increasingly relating heteroskedasticity, multivariate, and nonlinear time series. The basic idea of the ARCH model is to assure that the white noise violates a mean of zero simultaneously, that the varied number is a time-varied quantity and that this time-varied variance is a linear combination of the squared values of a finite number of past series (i.e. autoregressive). As a new principle, the ARCH model has evolved dramatically recently and has been broadly applicate to validate regularity descriptions in financial theory and for forecasting and decision-making in financial markets. The model is also contemplated to be the most crucial innovation in the latest financial econometrics developments. However, ARCH models are only in point to short-run autocorrelation processes of heteroskedasticity functions, and for this reason, Bollerslev extended ARCH to generalized autoregressive conditional heteroskedasticity (GARCH) models, which better reflect the long-term memory nature of the actual data [8,9]. GARCH model by Engle and the exponential generalized autoregressive field heteroskedasticity (EGARCH) model by Nelson, among others [10].

2.2. Analysis and Collecting Several Methods

For the multivariate case, the former idea is to broaden the analysis of one-dimensional time series to multiple dimensions. Thus, former methods for analyzing multidimensional time series often required each series to be stationary. Common models include vector ARMA models, vector autoregressive models (VAR), etc. The development in this area was relatively slow as there were many problems and trouble to be overcome, including the identification, forecast, and interpretation of the model, as it could not be directly generalized from the one-dimensional autoregressive sliding average model to the multivariate case. In co-integration theory, each series was definitely non-stationary, however, linear combinations are stable, and the theory can further account for the long-term stable equilibrium relationships between such variables. Cointegration methods have become one of the most important tools for analyzing quantitative relationships between non-linear smooth series. For the case where there is a non-linear adjustment mechanism between the series, Balke and Fomby proposed the Threshold Cointegration method [11]. For example, in the stock trading process, asymmetric adjustment of stock prices can occur due to factors such as transaction costs and trading policies; national monetary policies can also have asymmetric adjustment behavior on inflation rates due to institutional reasons.

For the non-linear case, Tong and Lim stated the Threshold Autoregressive model, which assumes that this pattern has A region in the state space has the same linear form and the

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circumstance of the state space is usually assured by an independent variable, and the model is parametric. In the last two decades, more attention has been paid to non-parametric models of time series, such as non-parametric autoregressive (NAR) models and non-parametric autoregressive heteroskedasticity (NARCH) models.

Another breakthrough in time series analysis methods is in the area of Spectroscopic analysis. For example, by time series, the information in the time can be changed to the frequency domain by Fourier variation, i.e., classical spectral analysis methods, such as periodogram spectroscopy, etc. Burg proposed the maximum entropy spectrum in his work on the analysis and processing of seismic signals, and its integration of the concept of information entropy into signal processing, sometimes called time-series spectral analysis methods, was the beginning of the modern spectral analysis. capon proposed minimum variance spectral estimation. Together, these two methods laid the foundation for modern spectral estimation. This was followed by Shore and Johnson, who proposed the minimum cross-entropy method. The theory proves that the maximum entropy spectral analysis method is only a special case of the minimum cross-entropy method. When a priori information is present, the minimum cross-entropy method can achieve much better resolution than the maximum entropy method. However, the disadvantage of the minimum cross-entropy method is that the operations are too cumbersome. In general, classical spectral estimation has good spectral estimation performance for long data series, but for short data series, classical spectral analysis has the fatal weakness of poor resolution, while modern spectral estimation methods have excellent performance.

3. Conclusion

With the in-depth study of both the theory as well as application of time series analysis, the scope of application and prescribed values of time series analysis has been increasingly expanded. At present, it has been involved in natural science fields such as astronomy, geography, biology, physics, chemistry, etc., image recognition, and other engineering technology fields, national economy, a market economy, production management, whole world population, also socio-economic fields, and has achieved many important accurate consequences.

Although there has been some progress in the research of time series analysis theory and promising achievements in the field of analytical forecasting, analytical forecasting is a puzzle and complex task. The results are greatly affected by the inherent shortcomings of existing models. Therefore, to further deepen and expand, this paper believes that to further deepen and expand the research of time series, we can carry out research and innovation work in the following aspects:

Forth, a lot of time series data control algorithms are proposed in the research of time series data control digging, but the prediction effect of the algorithms is relatively weak. The performance and effectiveness of the algorithm may be improved if the features of the time series can be extracted from each type of time series and introduced into the algorithm to form a dedicated mining algorithm for each type of time series. With the development of modern advanced technology related to artificial intelligence, machine making as well as learning, and other disciplines ordinary base-stem regression models clustering models, and statistical model mining techniques need to be combined with artificial intelligence technology to give more and more efficient data mining techniques to better support decision-making for large-scale non-linear systems. Current research on data mining in the study of uncertainty in data mining is becoming a new goal in data mining, and most of the research in this area is now mainly noticed on association rule mining about time. The major part of this research in this industry is now focused on association rule mining and research on time series fuzzy mining is yet to be carried out.

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Although a large number of prediction methods have been developed in recent years, none of them has been able to perform best in all cases. Although "sound" theoretical support does not always produce satisfactory results in practice, the plain approach has proved with the unexpected success that plain is not. It does not mean simplicity. Both the theoretical and practical results require that we consider the forecasting strategy correctly. At present, there is thousands of predicting methods in practical application, however, how do face it? The practical problem facing forecasters is how to correctly evaluate the efficacy of forecasting methods and models, and to choose the right forecasting model and method according to the specific reality.

The problem of how to properly evaluate the effectiveness of forecasting methods and forecasting models, and choose the right forecasting model and method according to the actual situation, is also a practical problem for forecasters.

In conclusion, after reading the articles of many experts and scholars, future research of this paper on time series tends to develop in the following two directions. Most of the time series data are not stationary, and their trait factors and math distributions change over time. Temporal data to precisely predict the later time as people demand more and more accurate and in-depth discussions of real problems, making it possible to use in practical forecasting modern time series methods of time-varying parametric models and adaptive forecasting techniques has become inevitable.

References

[1] *Wikimedia Homepage, https://en.wikipedia.org/, last accessed 2022/9/21.*

[2] *TechTarget Homepage. https://www.techtarget.com/, last accessed 2022/9/21.*

[3] *Frank, R. J. , N. Davey , and S. P. Hunt . "Time Series Prediction and Neural Networks." Journal of Intelligent & Robotic Systems 31.1-3,91-103(2001).*

[4] *N. I. Sapankevych and R. Sankar, "Time Series Prediction Using Support Vector Machines: A Survey," in IEEE Computational Intelligence Magazine, 4(2), pp. 24-38, (2022).*

[5] *Gooijer, Jg De , and R. J. Hyndman . "25 years of time series forecasting." International Journal of Forecasting 22(2006).*

[6] *Barreto, G. A. . "Time Series Prediction with the Self-Organizing Map: A Review." (2007).*

[7] *Webby, Richard, and Marcus O'Connor. "Judgemental and statistical time series forecasting: a review of the literature." International Journal of forecasting 12(1),91-118 (1996).*

[8] *Ahmed, Nesreen K., et al. "An empirical comparison of machine learning models for time series forecasting." Econometric reviews 29:5-6,594-621 (2010).*

[9] *Chatfield, Chris. Time-series forecasting. Chapman and Hall/CRC, (2000).*

[10] *Brahim-Belhouari, Sofiane, and Amine Bermak. "Gaussian process for nonstationary time series prediction." Computational Statistics & Data Analysis 47.4,705-712 (2004).*

[11] *Verleysen, Michel, and Damien François. "The curse of dimensionality in data mining and time series prediction." International work-conference on artificial neural networks. Springer, Berlin, Heidelberg, (2005).*