

Discussion on the Teaching Reform of the Undergraduate Course "Time Series Analysis" in the Age of Digital Intelligence

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Abstract: Time series analysis is a very important compulsory course for statistics majors, and the arrival of the era of digital intelligence has brought a profound impact on the teaching concept and teaching mode of this course. In the age of digital intelligence, the implementation of online and offline hybrid teaching mode can achieve very good teaching effect. This paper introduces the teaching reform practice of time series analysis course, in order to provide certain reference for the teaching reform of similar institutions.

Keywords: Time Series Analysis; Hybrid Teaching Model; Teaching Effectiveness.

1. Introduction

Time series analysis is a very important compulsory course for statistics majors, which is the only course that studies how to build statistical models for longitudinal data among all the courses offered in statistics majors and has a very wide range of applications. With the development of science and technology and economy, time series analysis is becoming more and more important. Anhui University of Finance and Economics (AUFE) offered time series analysis as a compulsory course for undergraduates majoring in statistics as early as 2001, and it is one of the early financial colleges and universities that offered the course of Time Series Analysis in the teaching of undergraduates majoring in statistics. In many years of teaching practice, we have continuously adapted to the new situation, actively carried out teaching reforms, and endeavoured to explore the new mode of teaching time series analysis.

At present, digitalization, networking, big data, artificial intelligence has become an important feature of the development of human social change, and college education is also experiencing an unprecedented transformation of digital intelligence. This transformation is not only the upgrading of hardware and facilities, but also a profound change in educational concepts, teaching methods and students' learning styles. In the era of digital intelligence, teachers' offline lectures are no longer absolutely dominant, and the implementation of online and offline blended teaching mode, combining classroom teaching and online learning to provide students with more flexible and personalized learning methods, has become an important direction of educational innovation. In order to better play the main role of students and the leading role of teachers in the teaching activities of time series analysis, promote the intelligent development of teaching activities, and enhance the sense of the times and attractiveness of teaching activities. Our school's time series analysis course with the help of network teaching platform, the implementation of the online and offline hybrid teaching mode, the implementation of practical and innovative reform measures in teaching, this paper intends to discuss the teaching reform of the time series analysis course practice, in

order to provide reference for the teaching reform of similar institutions.

2. Highlighting the Teaching Concept of Cultivating Students' "Modelling" Ability

Time series analysis courses are offered in both statistics majors (statistics, applied statistics and economic statistics) and non-statistics majors, and for different majors, the teaching objectives, teaching content and teaching methods of time series analysis courses should be differentiated. Combined with the requirements of the era of big data for students majoring in statistics, we believe that for students majoring in statistics in finance and economics colleges and universities, we should not only pay attention to the mastery of basic knowledge, but also emphasize the basic application, and more importantly, we need to cultivate the modelling ability of the students to address the practical problems, and we need to use the idea of "modelling" to teach the time series analysis, and we should start from the practical problems and practical data, through the teaching of time series analysis, and then teach time series analysis in the course. Start from the actual problem, actual data, through the time series analysis method to reveal the intrinsic regularity of the data. Specifically, the teaching of time series analysis course should highlight the modernization of the teaching content, pay attention to the elaboration of statistical ideas, weaken the derivation of mathematical proofs, take the statistical software as the support, and emphasize the application of actual cases. Through the teaching of time series analysis, students should master the basic concepts, principles and methods of time series analysis, have the ability to use time series analysis methods to solve practical problems, understand the latest development of time series analysis methods, and have the ability of lifelong learning.

3. Selection of Textbooks and Reconstruction of Teaching Content

There have been many classic works and teaching materials about time series analysis abroad, but they are more suitable

for graduate students or young scholars who take time series as their research field, and there are no time series analysis teaching materials especially suitable for undergraduates. In recent years, a number of time series analysis textbooks for undergraduates have been published in China, however, some textbooks focus on the theoretical part, with less description of the specific application process, and some textbooks focus on the application, but with less or less rigorous elaboration in the theoretical part. Comprehensive financial colleges and universities majoring in statistics, we chose Renmin University of China Wang Yan's "Time Series Analysis - Based on R (2nd Edition)", which is a concise textbook that takes into account not only theoretical rigor and penetration of statistical ideas, but also the application of practical cases, and it is written based on the free and open source software R, reflecting the fact that time series analysis can be applied to a variety of applications. The textbook is based on the free open-source software R, which reflects the advancement with the times and is conducive to the cultivation of students' programming ability and knowledge updating ability.

We position the content of the undergraduate time series analysis course as the content of classical univariate linear time series analysis (ARIMA), and introduce the content of non-smooth and multivariate time series analysis in an appropriate outline. Specifically, it includes: introduction and basic concepts of time series analysis, statistical properties of ARMA model, model identification, parameter estimation, diagnostic test, model selection and model forecasting, modeling of non-stationary time series (ARIMA model) and unit root test, SARIMA model, ARIMAX model, cointegration and error correction model, Granger causality test, etc. In addition, taking into account the needs of students' practical applications, we have added a "choice module" to the teaching content to give students a more personalized learning experience. The optional module includes more in-depth contents such as autoregressive conditional heteroskedasticity model (GARCH model), autoregressive distribution lag model, threshold autoregressive model, etc., as well as practical application cases, which make full use of various technical means of the online course platform to push all kinds of course resources to the students for students who have the ability to learn selectively, which helps to cultivate students' independent learning ability and practical innovation ability.

4. Adhere to the Teaching Method of Combining "Classroom Lectures, Case Studies, Experimental Teaching and Course Papers".

The main feature of the course "Time Series Analysis" is that both theory and practical application should be emphasized, not only to highlight the students' understanding and mastery of the theoretical basis of time series analysis methods, but also to focus on cultivating the students' ability to use time series analysis methods to model in practice. The traditional classroom teaching of Time Series Analysis pays more attention to the mathematical derivation process; however, this teaching method is difficult to mobilize students' learning enthusiasm, and it is difficult to solve the contradiction between the large amount of information in the course of Time Series Analysis, the large amount of content and the small amount of class time. Therefore, under the condition of a certain number of hours, it is necessary to

simplify the mathematical derivation process of the model and focus on the statistical ideas and application level of time series analysis methods. Some important theoretical derivation processes can be uploaded to the teaching platform by recording micro videos for students' self-learning. Some important theoretical conclusions, such as the statistical properties of ARMA model, can be presented visually in the classroom through Monte Carlo simulation to deepen students' understanding.

Case teaching is an important part of the teaching of Time Series Analysis course. In traditional case teaching, the data set provided by the textbook is usually used to show the time series modelling process, however, the data set provided by the textbook is the data that has been processed and organized, that is, the so-called "second-hand data", and it is not easy to cultivate the students' ability to solve practical problems. For this reason, in the classroom teaching process, when introducing each model and method, we try to introduce current real data or hot issue cases to show students from the collection of raw data, pre-processing, and the specific modelling process, so as to stimulate students to think and inspire their interest in learning. The specific method is to demonstrate the collection and processing of real data to students in the classroom at the beginning of the lecture. For example, the monthly time series of China's railroad passenger traffic can be downloaded from the China Statistics Database. The data is then used repeatedly throughout the semester, including the R software to read the series and plot the trend graphs to show the trend, seasonality, outliers and other characteristics and causes of the series, the pre-processing of the series such as differentials, seasonal differentials, the identification of the model, parameter estimation, diagnostic tests and model preference, and the process of forecasting for the next few months. When the semester is coming to an end, the prediction results will be compared with the latest data in the database, and the students will be guided to pay attention to the influence of the spring factors and outliers in the time series of monthly railroad passenger traffic on the prediction accuracy of the model, and the students will be provided with relevant references, and the students who are interested in it will be encouraged to learn to use different methods of modelling and prediction.

Experimental teaching is an indispensable and important part of the time series analysis course. Students can not only deepen their understanding of the ideas, methods, tools and other aspects of Time Series Analysis and sublimation through on-line experiments, but also train and cultivate their hands-on ability and practical application ability. Learning time series analysis, only the personal use of statistical software for data processing, in order to achieve the purpose of learning to use. In the process of experimental teaching, we encourage each student to combine the course of study, choose a problem or topic (or actual case), independently establish a time series model to analyse and study the actual problem, and complete the "course paper". Through the course paper, students can learn and understand the whole process of modelling, including topic selection, data collection, methodology learning, model selection, estimation and testing, economic interpretation and so on. Students will experience the practical application of time series analysis methods by themselves, trying to cultivate students' ability to acquire knowledge independently, innovation ability and problem-solving ability.

5. Carrying out Various Forms of Mixed Teaching Mode, Connecting before, during and after the Class Organically.

The offline course of Time Series Analysis utilizes the deep integration of modern information technology and classroom teaching, focuses on offline teaching and is supplemented by online teaching, and organically connects the teaching activities before, during and after class by carrying out various forms of mixed teaching modes. Before each lesson, teachers release relevant teaching resources and teaching content preview notifications through the online teaching platform, and students understand the learning tasks in advance, conduct pre-course study and complete relevant online tests. In the classroom teaching activities, teachers teach key points and difficulties, answer students' questions and assign homework after class, and students cooperate with teachers to complete teaching tasks and solve difficult problems. In the after-school teaching activities, teachers use the teaching platform to release the after-school homework and set up homework mutual evaluation, so that students can learn from each other and self-reflection. Students complete online homework on the basis of reviewing relevant knowledge. Teachers check the background data through the online teaching platform to understand the completion of students' homework and master the learning effect of students. In addition, with the help of the learning platform, students can repeatedly watch the relevant videos after class to master the content that is not fully understood in the classroom. Students who can learn can also selectively learn the content of the selected modules, so as to expand their knowledge beyond the classroom content.

6. Emphasizing the Principle of Equal Emphasis on Process Assessment and Result Assessment, and Promote the Improvement of Students' Academic Results

Course assessment is an important part of teaching reform to improve teaching quality and test teaching effectiveness.

The traditional course assessment focuses on the evaluation of results, while the new "Time Series Analysis" course teaching mode pays attention to the principle of equal emphasis on process evaluation and result evaluation and carries the course assessment through the whole process of course teaching. The final examination of the course assessment accounts for 60% of the weight, mainly examining and assessing the students' mastery of basic knowledge, basic theory and basic skills. The process assessment accounts for 40% of the weight, mainly examining students' usual attendance, online learning, classroom participation, homework, and tests, etc., and its results are automatically calculated by the online teaching platform. This assessment method stimulates students' enthusiasm for learning, enlivens the classroom atmosphere, and promotes the improvement of students' academic results. According to our teaching practice of implementing the hybrid teaching mode of Time Series Analysis in statistics majors in the past three years, students' satisfaction with the reform of the teaching mode and the excellent rate of the final examination results have increased substantially compared with those before the reform.

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