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Research on Teaching Reform of Undergraduate Statistics Courses for Economics and Management Majors from the Perspective of New Liberal Arts

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Abstract: Driven by the demand for digital transformation, Statistics for Economics and Management, as a distinct application-oriented foundational course in university mathematics programs, requires ongoing exploration in its teaching reform. Against the backdrop of New Liberal Arts education, this study analyzes the current state of course teaching from both theoretical and practical perspectives and proposes teaching reform strategies from a New Liberal Arts viewpoint. The research aims to deepen reflection and exploration on the reform of statistics teaching, ultimately addressing the disconnection between traditional instruction and practical application, thereby providing insights for cultivating interdisciplinary talents in New Liberal Arts fields within economics and management disciplines.

Keywords: New Liberal Arts; Humanities and Social Sciences; Economics and Management; Statistics Course; Teaching Reform

1. Introduction

China is currently experiencing a golden age of digital economic development. Under the market demand for digital transformation, the demand for data analysis talents is becoming increasingly strong. According to the Big Data Industry Development Plan issued by the Ministry of Industry and Information Technology, China's big data industry is projected to face a talent gap exceeding 2.3 million by 2025, with data analysts proficient in Python core skills accounting for over 30% of this demand. Mastering data analysis capabilities, particularly expertise in Python, is becoming the "hard currency" of the digital era. In 2019, China's Ministry of Education introduced the concept of "New Liberal Arts" as part of its "Six Excellences and One Top Priority" Plan 2.0. In 2020, the New Liberal Arts Construction Declaration further clarified its core objective: breaking down disciplinary barriers to build an interdisciplinary knowledge network integrating "humanities + technology + society" and advancing the digital transformation of liberal arts education. By 2025, 29 new interdisciplinary majors, including "Artificial Intelligence Education", have been added to the national professional catalog, marking the formal entry of liberal arts education into a new phase of interdisciplinary and technological integration. The New Liberal Arts policy is reshaping the DNA of humanities education, empowering traditional humanities and social sciences to transform from "being disrupted" to "leading" amid technological waves. This injects fresh momentum—blending technological edge with humanistic warmth—into Chinese modernization.

The disconnect between traditional statistics curricula and their application in economic and management practices has become a core issue constraining the quality of talent cultivation in economics and management majors. From a theoretical perspective, the traditional statistics courses in these disciplines primarily focus on theoretical derivation and manual calculations. Teaching cases often utilize simplified data and lack analysis of current economic hotspots. From a practical standpoint, instructors generally lack industry experience, making it difficult for them to integrate statistical methods with real-world scenarios in finance, marketing, etc. Some teachers understanding of practical teaching is confined to laboratory operations and does not extend to analyzing real-world economic and social problems. The era of big data demands skills such as data mining and visualization; however, courses rarely include the analysis of cutting-edge data methods or the processing of unstructured data. Consequently, students knowledge systems lag

behind industry requirements[1]. Based on this, within the current context of higher education, the misalignment between educational provision and industry needs leads to this disconnect. Future curriculum reforms need to further integrate with digital technologies such as big data to cultivate versatile economic and management professionals equipped with both statistical thinking and industry insight.

The advancement of New Liberal Arts presents an excellent opportunity to address the disconnect between traditional statistics courses and economics/management practices. At the theoretical level, the core of New Liberal Arts lies in breaking down disciplinary boundaries and advocating for the integration of arts and sciences as well as the intersection of humanities and engineering. This requires statistics instruction to actively embed itself within the context and problem domains of economics and management disciplines. New Liberal Arts emphasizes addressing real-world, complex problems. Driven by typical issues in the economics and management fields, it guides students through the entire process—from problem definition, data acquisition and processing, method selection and application, result interpretation, to decision-making recommendations—cultivating their ability to solve practical problems. At the practical level, New Liberal Arts stresses the development of interdisciplinary case libraries. Cases must reflect multidimensional complexity encompassing economic, managerial, social, and technological factors, and incorporate a wealth of authentic or simulated economics/management scenarios into teaching. The New Liberal Arts concept encourages statistics teachers to engage deeply in exchanges, collaborative research with faculty and students across disciplines, and even participate in short-term corporate internships. This enhances their practical understanding and grasp of application scenarios within economics and management practice. Furthermore, interdisciplinary teaching teams should be formed to promote the renewal of faculty knowledge structures and the cultivation of cross-disciplinary collaboration skills.

Based on this, this paper explores the reform in both teaching and practical components of statistics courses for economics and management majors from the perspective of New Liberal Arts. It aims to address the disconnect problem between traditional teaching and practical application in current undergraduate education for these disciplines, thereby proposing training solutions for cultivating interdisciplinary talents in the New Liberal Arts field.

2. Analysis of the Current Teaching Situation of Statistics Courses

Statistics for Economics and Management is an applied, multi-disciplinary field serving domains such as economics, management, and finance. Its core lies in employing quantitative methods to collect, organize, analyze, and interpret data from economic and management activities, aiming to identify patterns, evaluate effectiveness, predict trends, and support decision-making. This discipline encompasses core methodologies such as descriptive statistics, inferential statistics, regression analysis, and time series analysis. It deeply relies on mathematical foundations including probability theory, mathematical statistics, linear algebra, calculus, and optimization theory, while increasingly incorporating computational science knowledge such as machine learning and data mining. Its knowledge system is extensive and complex, designed to provide a solid quantitative foundation and decision-making support for understanding complex economic phenomena, optimizing management processes, evaluating policy effectiveness, forecasting market dynamics, and managing financial risks. According to the characteristics of this discipline, integrating the New Liberal Arts concept requires overcoming the following issues in both theory and practice.

2.1 Current Status of Theoretical Instruction

Statistics is based on the needs of real-world problems, utilizing various analytical methods to interpret and analyze issues in real life according to observed data. From a theoretical perspective, the following three issues lead to multiple challenges at the theoretical teaching level.

First, teaching methods are singular and rigid, lacking interactivity and innovation. University teachers often rely on traditional lecture-based instruction, forming a fixed cyclical pattern of reviewing previous lessons, presenting new material, practicing consolidation, and assigning homework. However, this one-way didactic instruction neglects the student's role

as the main subject, resulting in insufficient student participation and low classroom interaction. The inadequacy of classroom discussions and case-based teaching forces students to passively receive knowledge. This not only fails to stimulate their critical thinking and data analysis literacy but also severely constrains the development of their innovative thinking and creativity. Furthermore, existing teaching content is generally lagging behind the times, becoming a core factor restricting teaching quality. Textbooks commonly overemphasize mathematical derivation while neglecting the essence of statistical thinking, prioritizing the proof of formulas over core conceptual thinking such as the logic of null hypothesis formulation. The examples used are outdated and disconnected from the background of economics and management disciplines, predominantly drawn from traditional manufacturing sectors and lacking application instances from emerging industries like online finance and e-commerce.

Second, students have a weak foundation in mathematics and science, and cognitive biases lead to insufficient learning motivation. The curriculum excessively emphasizes mathematical formulas and abstract theories while neglecting specific application scenarios. This makes it difficult for students to translate theoretical knowledge into the ability to solve practical problems. Students in business and economics generally have weak mathematical foundations, a problem particularly prominent in private undergraduate and applied institutions. The content system of statistics is vast and complex with no clear emphasis, leading to a prominent contradiction between "insufficient class time and abundant material". Simultaneously, when studying inferential statistics—such as parameter estimation, hypothesis testing, and ANOVA—learners face challenges including difficult-to-memorize formulas, hard-to-grasp methods, and overwhelming data complexity. This often traps them in the misconception of "rote memorization of formulas rather than understanding the underlying principles", creating a vicious cycle where students fail to comprehend the material, become unwilling to learn, and subsequently find it even harder to grasp. Insufficient student motivation further exacerbates the challenges of learning the subject. Although statistics is a core foundational course for business and economics majors, a considerable proportion of students have a vague understanding of its positioning within the curriculum and lack recognition of its importance within the professional knowledge system.

Third, the assessment mechanism suffers from structural imbalances, with ineffective evaluation of competencies that deviates from the educational objectives. Currently, statistics courses over-rely on closed-book examinations, where written test scores account for 60% to 80% of the final grade. The assessment content excessively emphasizes formula memorization and simple calculations, failing to authentically reflect students statistical thinking skills. This results in a pattern of "last-minute cramming before exams and quickly forgetting afterward". In terms of evaluation dimensions, there is a lack of effective assessment mechanisms for core competencies such as data collection, processing, and interpretation. Traditional assessment methods prove ineffective in evaluating students application abilities—especially comprehensive application skills—significantly deviating from the goal of cultivating application-oriented professionals.

2.2 Current State of Practical Teaching

Practical teaching is a crucial component of the statistics discipline for cultivating students application abilities. However, the current teaching system suffers from severe structural flaws, leading to a disconnect between students theoretical knowledge and practical skills. The teaching content is often detached from real-world demands and lacks professional specificity. This structural deficiency in the practical component stems primarily from the following three reasons: First, there is a severe shortage of dedicated practical class hours, coupled with flaws in the design of practical content. University statistics courses are divided into theoretical lectures and practical sessions. Yet, the allocation of class hours for practical sessions is typically very limited, or such sessions are not formally scheduled at all. Instructors often prioritize teaching foundational theoretical modules like parameter estimation and hypothesis testing. Most practical exercises are merely confined to operational demonstrations during the descriptive statistics section. The design of

practical content is flawed, predominantly consisting of low-level verification. experiments limited to simple tasks like drawing statistical charts and graphs. There is a lack of "elevated" design in problem sets. Furthermore, the various practical components exist in isolation and fail to form a systematic training chain[2]. Consequently, this fragmented practical design hinders the development of students' abilities to solve and analyze complex problems encountered in real-world scenarios.

Second, there is a disconnect between software operation and result interpretation. During the practical phase, the teaching of statistical software commonly faces the issue of emphasizing operation over interpretation. Although students master the methods, experimental steps, and procedures provided by the instructor, they lack the ability to interpret the output results. Teachers tend to focus on explaining operational steps and demonstrating workflows, leading students to merely imitate these operations to complete their tasks. However, there is a severe deficiency in interpreting the practical outputs and explaining their economic and statistical significance. This disconnect—prioritizing operation at the expense of interpretation—results in students only mechanically performing software operations without gaining the ability to deeply translate results into actionable insights for valuable decision-making[3].

Thirdly, there is a deficiency in practical projects and inadequate platform development. Teaching software construction for practical training platforms lags behind in most universities. While analytical tools like R and SAS hold greater advantages in big data scenarios, the coverage of such teaching software remains low. Additionally, there is a lack of comprehensive virtual simulation environments for complete data analysis processes. Current teaching rarely incorporates high-quality practical platforms, preventing students from receiving systematic training across the entire workflow—from problem identification and conceptualization to data collection, processing, computational analysis, and final decision-making. Consequently, the scarcity of practical projects and insufficient development of training platforms hinder students ability to develop systematic statistical thinking and practical statistical problem-solving skills[4].

3. Teaching Reform Plan Based on the New Liberal Arts Perspective

3.1 Teaching Reform Plan in Theory

Introduce problem-based and application-oriented learning approaches, abandoning the formula-derivation-first model. Guide students to encounter problem scenarios and basic data first, sparking inquiry, then gradually introduce necessary statistical concepts and methods. Cultivate and guide students to develop an applied analytical mindset. Statistics courses for economics and management majors will train students in statistical theory and professional econometric practices, enabling them to master data statistics and analysis methods, including the use of relevant software tools. This will equip them with the working abilities required for roles in government departments, enterprises and institutions, statistical information processing, management and consulting, and economic analysis and forecasting. By establishing an integrated curriculum system encompassing Mathematics, Statistics, Economics and Management, and Computer Science, a solid foundation will be laid for statistics majors in economics and management fields[5]. Furthermore, expand the class hours for foundational courses. Statistics is a fundamental discipline. We must not blindly increase class hours for popular courses like the digital economy while reducing teaching time for core foundational courses. Important training objectives and a complete curriculum system require sufficient teaching hours. The traditional setting of less than 50 class hours must be expanded to 70-80 class hours. This ensures in-depth explanation of core theories while also guaranteeing the basic allocation of time for practical components.

Highlighting the value of humanities disciplines. Reduce math anxiety and emphasize the purpose of statistical thinking training. The core of statistical thinking is using data as evidence for argumentation and understanding differences such as correlation versus causation. These cognitive skills are fundamental literacy for comprehending humanities and social phenomena. Extensively showcase classic and cutting-edge case studies where statistical methods have successfully deepened humanities and social science research, allowing students to perceive statistics as a powerful analytical

tool within their professional fields. Integrate ideological and political education. Build upon the characteristics of statistical methods and their economic application scenarios to highlight the value orientation behind the data. In case analyses, utilize policy datasets such as those on poverty alleviation and technological innovation, cultivating the ability to articulate China's narratives effectively using data. Integrate operational norms like the Statistics Law and the Data Security Law into the teaching process, emphasizing standardized requirements during data collection and processing, cautioning against academic misconduct and data fabrication, and fostering students' professional integrity based on seeking truth from facts. In the hypothesis testing module, emphasize the principle of "falsifiability" to cultivate critical thinking and avoid decision-making risks caused by data misuse.

Reform and Innovation of Assessment Mechanisms. Focus of Assessment: Shift the focus from testing calculation to evaluating comprehension and application, adopting diversified assessment and evaluation methods. Significantly reduce the proportion of pure calculation problems. The assessment emphasis should be placed on research design critique, result interpretation and analysis, and justification of methodological choices. Introduce process-based evaluation and reflective evaluation, valuing students performance in group discussions and research debates. Require students to write reflections on changes in their understanding of statistical concepts and insights into data ethics, incorporating these into the assessment system. Interdisciplinary Integration: Centered on economic statistics, extend into areas such as digital economy measurement and quantitative social science. Introduce methods like machine learning and causal inference into traditional economic problems to cultivate students' interdisciplinary thinking[6]. Establish vertically integrated undergraduate-postgraduate training pathways for cross-level projects, allowing undergraduates to take postgraduate courses. Establish supporting credit transfer mechanisms and joint faculty supervision mechanisms to integrate research elements into the assessment system. Integrated Curriculum Development and Resource Sharing: Integrate teaching, research, practice, competitions, and professional certification into cultivation modules, enhancing students comprehensive statistical literacy.

3.2 Practical Teaching Reform Measures

Enhanced Project-Based Application Practice: Establish a structured training framework focusing on developing competencies in basic operations, system modeling, and decision support. Basic operations cover the application of software tools like SPSS, Stata, and R. Training in system modeling methods includes inferential statistics and regression analysis. Decision-making skills are cultivated at the judgment level for students. Deep Integration of Theory and Practice. Immediately follow the introduction of key concepts with small-scale, contextualized hands-on exercises[7]. Practical content should not be isolated but form a coherent workflow centered around a core problem. Incorporating Competitions into the Practice Credit System. Integrate statistical modeling competitions and similar contests into the practical credit system. Participation allows students to experience the full cycle of questionnaire design, data cleaning, model debugging, results analysis, and report writing, providing comprehensive training in solving statistical problems. Developing a "Modular" Micro-Project Library. Design short-cycle practical micro-projects closely linked to various humanities and social science disciplines. Organizing Participation in Research Projects: Engage students in practical investigations and research projects to foster their understanding of the societal value of statistical work and strengthen a realistic data ethics awareness grounded in facts[8].

Commenting on Steps, Interpreting Output, and Drawing Conclusions. During practical teaching, students are required to write detailed notes and analytical annotations synchronously while operating software. They should understand what each step is doing, why this step is necessary, and what preliminary results are being revealed[9]. A dedicated practical session is then set up, focusing on the output of statistical results such as tables, graphs, and models. Here, the teacher guides students to extract key information from the output, identify potential issues, and analyze and interpret the findings using professional language. In data analysis, the ability to convey complex results to an audience in an intuitive

and understandable way is a crucial skill. The visual presentation of results goes beyond merely showing data; it requires students to use visualization tools to clearly communicate the meaning behind the data, the statistical results, and their significance.

Statistical Platform Resource Development. Develop an intelligent training platform and deploy a cloud-based economic database to support students in online access to macro/microeconomic data, utilizing statistical packages for data analysis, and automatically generating experiment reports. Embed an error diagnostic system within the platform to provide feedback and guidance when students encounter operational issues during practice. Develop an economic system simulation sandbox, integrating scenarios such as macroeconomic monitoring and market risk assessment. Collaborate with local statistics bureaus to co-create a teaching case library, bringing real-world projects like economic monitoring into the classroom. Establish a New Liberal Arts Statistics Workshop, creating not just a virtual space offering software and computing resources, but also fostering interdisciplinary collaboration, practical discussions, and results showcasing. The workshop will be staffed with teaching assistants or technical support personnel possessing interdisciplinary backgrounds[10].

4. Concluding Remarks

The reform of statistics courses for economics and management disciplines from a New Liberal Arts perspective entails not partial adjustments but systematic restructuring. Throughout this reform, the principle of upholding the fundamentals while breaking new ground must be upheld: it requires preserving the classic methodological framework—descriptive statistics, inferential statistics, and statistical applications—while enhancing practical, application-oriented teaching. It demands both solidifying students' mathematical foundations and cultivating their humanistic literacy. Under the New Liberal Arts framework, the ultimate measure of success lies in the transformation of students' thinking: shifting from merely understanding statistical methods to skillfully leveraging data to solve economic problems and interpret real-world phenomena; evolving from technical executors into strategic decision supporters.

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