Research on the "Integration of Competitions and Teaching" Training Model and Practical Pathways for Postgraduate Students in Applied Statistics

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Abstract: *This paper proposes a new "Integration of Competitions and Teaching" training model for professional master's students in Applied Statistics, which systematically integrates the disciplined training of academic competitions into the entire process of postgraduate education. Firstly, it analyzes the necessity and value of this integration, elaborating on its significant importance in enhancing students' practical abilities, innovative capabilities, teamwork skills, and professional competitiveness. Subsequently, it systematically constructs a theoretical framework for the "Integration of Competitions and Teaching" training model from five dimensions: the reshaping of training objectives, the restructuring of the curriculum system, the reform of teaching models, the development of the teaching faculty, and the innovation of the evaluation system. Finally, the paper discusses in detail the practical pathways for the implementation of this model, including the systematic integration of competitions into curriculum teaching, the creation of a "dual-qualified" supervisor team, the establishment of a tiered and progressive competition practice platform, the development of a dynamic incentive and process management mechanism, and the deepening of collaborative education through the integration of industry and education. These are illustrated with specific case studies, aiming to provide a reference for the training reform of postgraduates in Applied Statistics and related disciplines in China.*

Keywords: *academic competitions; integration of competitions and teaching; Applied Statistics; practical abilities; training model*

Introduction

The education of professional master's students in Applied Statistics aims to cultivate application-oriented, inter-disciplinary high-level talents who master the fundamental theories and methods of statistics and can skillfully use statistical tools to solve practical problems in various fields of economy and society. Currently, China is in a critical period of economic transformation, upgrading, and the pursuit of technological self-reliance and self-strengthening. As a new type of production factor, data's value relies on powerful statistical analysis capabilities. However, an examination of the existing training system reveals that it still, to a certain extent, follows the training approach for academic master's students, exhibiting a tendency to "emphasize theory over practice" and "prioritize knowledge transmission over capacity building." When faced with real-world, unstructured, and complex data problems, graduates often show deficiencies in modeling capabilities, programming implementation skills, communication and expression abilities, and the capacity for interdisciplinary knowledge integration[1].

At the same time, various high-level academic competitions at home and abroad, such as the National Statistical Modeling Competition for College Students, the National College Students Market Survey Competition, the China Post-Graduate Mathematical Contest in Modeling, the "TipDM" Data Mining Challenge, and the Kaggle Data Science Competition, have become important arenas for honing students' practical and innovative abilities due to their real-world business contexts, open-ended problem settings, intensely competitive environments, and comprehensive skill requirements. The process of participating in competitions is essentially a complete scientific research training process of "problem identification - problem analysis - problem solving," which is highly consistent with the training objectives for professional degree postgraduates[2].

Therefore, exploring a new "Integration of Competitions and Teaching" model that deeply integrates academic competitions into the postgraduate training process for Applied Statistics, breaking

the traditional boundaries of the classroom, and promoting the organic unity of knowledge acquisition, ability development, and value formation holds significant theoretical value and practical relevance for enhancing the quality of professional master's degree education and meeting the demands of national strategies and industrial development.

2. The Connotation and Value of the "Integration of Competitions and Teaching" Training Model

The "Integration of Competitions and Teaching" model is not simply about treating competitions as extracurricular activities or additions. Rather, it refers to the systematic integration of the concepts, content, methods, and evaluation systems of academic competitions into the entire process and all aspects of postgraduate training, with the talent cultivation goals at the core. This forms a positive interactive ecosystem of "promoting teaching, learning, innovation, and reform through competitions"[3]. Its main value is reflected in the following aspects.

2.1 Academic competitions serve as a practical training ground for cultivating students' abilities and stimulate their innovative thinking

Competition problems, often derived from real-world projects in enterprises or scientific research institutions, or simplified scenarios based on them, require students to comprehensively apply skills such as statistical models, machine learning, programming, and data visualization to solve practical problems. This significantly compensates for the overly idealized nature of many classroom teaching cases, enabling a leap from "solving textbook problems" to "solving real-world problems." Without standard answers, these competitions encourage participants to propose novel solutions. This openness greatly stimulates students' exploratory spirit and innovative awareness, compelling them to consult cutting-edge literature, experiment with different algorithm combinations, and optimize model performance. It serves as an effective pathway for cultivating innovative thinking.

2.2 Academic competitions can exercise students' teamwork and communication skills

Most competitions are conducted in teams, simulating the project team model found in future workplaces. In the process of team formation, task division, discussion, integration, report writing, and defense preparation, students rigorously hone their teamwork, leadership, communication, expression, and academic writing skills. Achieving outstanding results in high-level competitions serves as strong proof of a student's comprehensive abilities and is highly valued by employers. Furthermore, the competition experience enables students to encounter real-world industry problems earlier, clarify their career development direction, accumulate project experience, and significantly enhance their employment competitiveness[4].

2.3 Through academic competitions, the knowledge system can be integrated and expanded

To meet the challenges of competitions, students must actively break down course barriers, integrating and achieving mastery in knowledge from courses such as Advanced Mathematical Statistics, Regression Analysis, Machine Learning, Time Series Analysis, and Big Data Processing Technology. Furthermore, they need to acquire new knowledge and tools through self-study as required, thereby achieving the active construction and dynamic expansion of knowledge. The process of mentoring for competitions compels teachers to closely follow industry trends and technological frontiers, update teaching cases, and reflect on teaching methods, thereby promoting the continuous reform of course content, teaching approaches, and evaluation systems, and enhancing the overall quality of instruction[5].

3. Construction of a Theoretical Framework for the "Integration of Competitions and Teaching" Training Model

To construct a systematic "Integration of Competitions and Teaching" training model, it is necessary to start from the top-level design and systematically restructure the traditional training system.

3.1 Reshaping Training Objectives and the Curriculum System

Based on the original training objectives, competencies related to competitions should be explicitly

incorporated. These include, for example, "the ability to apply statistical theories and methods to solve complex, practical data problems through teamwork," "the capability to implement, optimize, and evaluate data mining and machine learning models," and "the proficiency to write academic reports and deliver oral presentations effectively." This integration establishes competition-related skills as formal requirements of the talent cultivation specifications. The curriculum system restructuring focuses on a "competition-oriented" transformation of core courses. In core courses such as Statistical Modeling, Data Mining, and Machine Learning, classic competition problems from previous years or simplified versions of real-world corporate cases are introduced as major assignments or course design projects. The teaching approach shifts from a "knowledge logic" to a "problem logic," with theoretical explanations and tool instruction centered around these projects. The establishment of elective modules with a "competition focus" involves offering short-duration, practice-intensive elective courses such as Advanced Statistical Modeling in Practice, Data Science Competition Analysis and Simulation, and Big Data Visualization and Storytelling. These courses concentrate on imparting practical skills, including competition strategies, cutting-edge algorithms, code optimization, and report writing. Furthermore, the recognition of competition outcomes for course credits should be facilitated. This involves exploring pathways where high-level competition awards or completed high-quality competition project reports, after undergoing a defined evaluation process, can be converted into credits for relevant practical courses or professional internships, or can partially substitute for certain graduation requirements.

3.2 Reform of Teaching Models and Development of the Teaching Faculty

The implementation of project-based teaching is advocated, driven by competition projects, where student teams, under the guidance of instructors, experience the complete project lifecycle. The teacher's role transforms from a "lecturer" to a "coach" and "mentor." Blended online and offline teaching is promoted. Online platforms are utilized for resource sharing, code collaboration, discussion, and Q&A, while offline classroom sessions focus on in-depth discussions of difficulties, solution reviews, and mock defenses. Workshops and lectures should be introduced, with regular invitations extended to competition winners, corporate data scientists, and experienced judges to hold experience-sharing sessions, technical lectures, or short-term workshops, thereby broadening students' horizons. The teaching faculty should be developed by enhancing their "dual-qualified" qualities. Teachers are encouraged to mentor competitions, and this work is incorporated as a bonus point in teaching evaluations and professional title promotions. Furthermore, teachers are supported in undertaking temporary assignments at enterprises to gain first-hand practical experience. The formation of interdisciplinary mentoring teams is crucial. Given the interdisciplinary nature of competitions, joint guidance groups composed of faculty from statistics, computer science, and relevant fields such as economics, biology, and engineering should be established to provide multi-faceted advice. Industry mentors, including data experts from well-known internet companies, financial institutions, and consulting firms, should be appointed. These mentors can directly participate in competition problem-setting, judging, and guidance, injecting cutting-edge industrial perspectives into the process.

3.3 Innovation in the Evaluation System: The adoption of process-oriented evaluation and value-added evaluation

The traditional result-oriented approach should be changed, with greater emphasis placed on students' performance, effort, and value-added growth in abilities during the processes of competition preparation, teamwork, and solution iteration. Multi-subject evaluation should be adopted, where evaluators include not only course instructors but also competition judges, industry mentors, and team members, thereby forming a diversified evaluation system. Students' performance and achievements in competitions serve as important references for determining scholarships, selecting outstanding graduates, and recommending candidates for internships and employment.

4. Practical Pathways for the "Integration of Competitions and Teaching" Training Model

The implementation of the theoretical framework requires concrete and operable practical pathways as support.

4.1 The Systematic Integration of Competitions into the Entire Process of Curriculum Teaching

In lower-level courses (first semester), such as introductory courses like Foundations of Statistics

and Programming, basic and engaging small-scale competitions or challenge problems can be introduced to stimulate students' interest and lay a solid foundation. In intermediate-level courses (second and third semesters), within core professional courses, medium-scale course projects can be used to simulate the competition process. For example, in the Regression Analysis course, students could complete a complete predictive modeling project report, participating in a competition to forecast future trends. In advanced-level courses (third and fourth semesters), students can be guided to form stable teams to participate in national and international high-level academic competitions, such as the National Postgraduate Statistical Modeling Competition and the Mathematical Modeling Contest, treating this participation as the core content of the comprehensive practice component. Furthermore, graduation project topics and thesis selections are encouraged to be derived from in-depth research on competitions or related practical problems.

4.2 Build a Team of "Coach-Type" and "Dual-Professional" Mentors, Establish a Practice Platform, and Improve the Management Mechanism

An "Applied Statistics Competition Guidance Center" should be established, led by experienced teachers passionate about competition guidance, responsible for the organization, training, selection, and daily guidance of competitions. A normalized discussion mechanism for mentoring teachers should be established to share mentoring experiences, analyze competition trends, and conduct collective lesson preparation. The implementation of the school-enterprise "dual-tutor" system should be ensured, guaranteeing that each participating team has at least one academic mentor from the university and one industry mentor from an enterprise. A tiered and progressive competition practice platform should be built. A basic training platform should be established, utilizing course management systems and online assessment systems to provide basic skills training question banks and automated assessments.

Build a simulated practice platform, cooperate with enterprises to introduce desensitized real business datasets and problems, establish an internal simulated competition platform, and regularly hold university-level and college-level competitions. Build a high-end competition platform, actively organize students to participate in authoritative subject competitions at home and abroad, and provide supporting support such as registration fees, server resources, and material purchases. Encourage the consolidation of outstanding proposals and algorithms generated from competitions to form technical reports, software copyrights, or academic papers, promoting the transformation of achievements. Establish a dynamic incentive and process management mechanism, set up special funds and awards, provide travel and material subsidies for participating students, and offer both material and spiritual rewards to winning teams and their supervising teachers. Implement a "Competition Credit Bank" system, formulate detailed rules to convert participation and awards in competitions at different levels into credits that can be deposited in the "credit bank" and used to redeem elective course credits or practice credits. Strengthen process management and guidance, develop a detailed competition preparation schedule, regularly organize progress checks, mid-term defenses, and simulation exercises to identify problems in a timely manner and provide assistance.

4.3 Deepen the Integration of Industry and Education for Collaborative Talent Cultivation

Establish a "Competition-Internship-Employment" chain jointly built by the university and enterprises; cooperate with well-known enterprises to set up corporate-named competitions or special competition topics, using the competitions as a preliminary step for enterprise talent selection. Award-winning students can be given priority for internship opportunities or eligibility for fast-track recruitment. Use competition cooperation as an entry point to jointly build a Joint Data Science Lab with enterprises, making it a permanent base for competition training and research and development. Enterprises should provide real data cases, computing resources, and technical tools, such as commercial software licenses and expert lectures, to enrich teaching and competition resources.

5. Conclusion and Prospects

The "Integration of Competitions and Education" is an effective strategy to meet the demand for high-level talents in applied statistics in the new era and to address the shortcomings in practical innovation ability within professional degree graduate education. It is not a simple superposition of teaching and competitions, but a profound transformation of training concepts, systems, and methods. The training model framework constructed in this paper, guided by goal reshaping, centered on curriculum reconstruction, keyed by faculty development, guaranteed by evaluation innovation, and

supported by diverse practical paths, provides a systematic solution for the reform of professional master's training in applied statistics.

In the future, the deepening of the "integration of competitions and education" will require continuous exploration in the following aspects: one is to further deepen the reform of the evaluation mechanism and establish a more scientific value-added assessment system for capabilities; two is to strengthen the design of competitions and their integration into teaching in the cross-disciplinary field of "Artificial Intelligence + Statistics"; three is to promote the radiation of the "integration of competitions and education" experience from applied statistics to a wider range of professional master's programs in engineering and management; four is to leverage information technology to build a virtual simulation competition environment, breaking down barriers to data acquisition and sharing. Only through continuous iteration can the "integration of competitions and education" training model be forged into a brilliant hallmark of high-level professional degree postgraduate education with Chinese characteristics.

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