

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

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**Abstract:** A new "Integration of Competitions and Teaching" training model for professional master's students in Applied Statistics is put forward in this paper, and systematic cultivation of academic competitions at all levels of postgraduate education is carried out. First, consider why such integration is necessary and what good effects will be achieved in developing students' application abilities, innovative thinking, cooperation and communication, etc. Based on the above, the theoretical foundation for the "Integration of Competitions and Teaching" training model will be systematically laid out in the five areas listed below: revision of training goals, restructuring of the curriculum system, reform of teaching models, development of teaching staff, and innovation of the assessment system. Finally, this paper will present some particular information on the implementation plan for the model, such as the systematic inclusion of competitions in curriculum teaching, the construction of a "dual-qualified" supervisor team, the building of a tiered and progressive competition practice platform, the development of a dynamic incentive and process management mechanism, and the enhancement of collaborative education through the integration of industry and education. The following are some particular cases that can be taken as a reference for the training reform of postgraduates in Applied Statistics and related fields in China.

**Keywords:** academic competitions, integration of competitions and teaching, applied statistics, practical ability, training

## Introduction

The purpose of teaching professional master's students in Applied Statistics is to nurture application-oriented, interdisciplinary high-level talents who have mastered the basic theories and methods of statistics and can skillfully use statistical tools to solve practical problems in all areas of economics and society. China is going through a period of rapid economic development and reform now, and it seeks technological self-reliance and independence. Data are a new type of factor of production, and there is a large amount of statistics. Based on the current training system, it can be seen that although it is somewhat in line with the model for training academic master's students, it tends to give more weight to theory and focus on knowledge transmission rather than capacity building. Graduates generally do not have the skills to build models, program, communicate and present ideas, nor do they have the ability to apply interdisciplinary knowledge to solve real-world, unstructured and complex data problems<sup>[1]</sup>.

At the same time, many excellent academic competitions have also been organised around the world and in China to promote students' practical and innovative abilities, such as the National Statistical Modelling Competition for College Students, the National College Students Market Survey Competition, the China Post-Graduate Mathematical Contest in Modelling, the "TipDM" Data Mining Challenge and the Kaggle Data Science Competition. These competitions are popular because they have real business cases, open-ended problem designs, high competition, and all sorts of skill requirements. The process of participating in a competition is, in fact, a complete scientific research training process of "problem identification - problem analysis - problem solving", and it is highly in line with the training goals for professional degree postgraduates<sup>[2]</sup>.

Therefore, we need to explore a new "Integration of Competitions and Teaching" model that deeply integrates academic competitions into the postgraduate training of Applied Statistics, breaks through the traditional boundaries of the classroom, promotes the organic unity of knowledge acquisition,

ability development and value formation; this will help to improve the quality of professional master's degree education and meet the demands of national strategies and industrial development.

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

The model of "Integration of Competitions and Teaching" is not to introduce competitions at the end of class. Instead, it refers to the whole-system integration of the concepts, contents, methods and evaluation mechanisms of academic competitions at all times and in all places in postgraduate education to achieve the goal of talent cultivation. It is a good interaction ecosystem that promotes teaching and learning, innovation and reform through competitions<sup>[3]</sup>. The main purposes of the above are as follows:

### ***2.1 Academic competitions are good ways to promote the all-round development of students and motivate them to study***

Competition problems are often based on real-life projects at enterprises or research institutions, or they are simplified scenarios derived from these; therefore, all kinds of skills, such as statistical models, machine learning, programming and data visualisation, need to be applied by students to solve all sorts of practical problems from all sides. This can help to solve the problem of over-idealisation in many cases of classroom teaching, move away from "solving textbook problems" to "solving real-world problems", offer all kinds of solutions without a single correct answer, and thus motivate participants. Therefore, the students have started to learn about new ways on their own initiative and have been experimenting with various combinations of algorithms to improve the performance of models. It will help foster a spirit of innovation among the students.

### ***2.2 Academic competitions can promote the all-round development of students***

Most of the competitions are in teams, and they will simulate the project team model in the future workplace. In the process of forming a team, dividing tasks, discussing, coordinating, writing a report and defending it, students improve their teamwork, leadership, communication, expression and academic writing skills. Doing well in the top-level competitions is a good sign that a student has all-round abilities and is popular with employers. Competition experience will expose young people to actual problems in the industry earlier, help them decide on a career path, gain some work experience, and so on<sup>[4]</sup>.

### ***2.3 Academic competitions will be held to spread and promote the knowledge system***

To meet the demands of the competition in the current era, students need to break free from the traditional limits of courses and integrate knowledge from various courses, such as Advanced Mathematical Statistics, Regression Analysis, Machine Learning, Time Series Analysis, Big Data Processing Technology, etc. They should be able to learn new knowledge and tools independently when necessary, and actively build and extend their own knowledge bases. Teachers need to keep up with the changes in the industry and technology during the mentoring of competitions, update teaching materials and cases, consider all kinds of teaching methods, continuously revise course content, teaching methods and assessment strategies, and thus improve the overall quality of education<sup>[5]</sup>.

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

To build a regular "Integration of Competitions and Teaching" training model, we need to start with a general plan and organise the old training system in an orderly way.

### ***3.1 Reshaping Training Objectives and the Curriculum System***

In line with the original training goals, competencies for competition will be added to the curriculum. For example, one can use statistical theory and methods to solve practical problems with data in a team; one can build, improve and evaluate data mining and machine learning models; and one can write academic papers and give oral reports. Therefore, the ability to compete is now considered one of the qualities of good students. The reform of the curriculum system will be competition-oriented

in the main courses. For the core courses of Statistical Modelling, Data Mining and Machine Learning, classic competition problems from previous years or simplified versions of real-world corporate cases will be used as the main assignments or course design projects. The mode of teaching by teachers has changed from "knowledge logic" to "problem logic", and theoretical explanations and tool instruction are now based on such projects. Add some competitive and application-oriented short courses to the list of short and application-oriented elective courses, such as "Advanced Statistical Modelling in Practice", "Data Science Competition Analysis and Simulation", and "Big Data Visualization and Storytelling". Some practical skills in competition, new algorithms, code optimisation and report writing will be covered in the course. Offer course credits for good performance in a competition. Find a way to recognise excellent achievements in competitions or high-quality competition project reports, officially evaluate them, and then award credits for related practical courses or professional internships, or even partially meet some graduation requirements.

### ***3.2 Reform of Teaching Models and Development of the Teaching Faculty***

Project-based teaching will be employed, and competition projects will be organised so that students can experience all the stages of a project under the guidance of teachers. The teacher is no longer a "lecturer" but a "coach" and "mentor", and blended online and offline teaching has begun to be implemented. Internet is used to share materials, cooperate on code development, have discussions and ask questions, and the offline class time is for in-depth problem-solving, reviewing solutions and mock defenses. Regularly organise workshops and lectures, invite competition winners, corporate data scientists, experienced judges, etc., to hold experience-sharing sessions, technical talks or short-term workshops and expose the students to all kinds of fields. The teaching staff need to be improved in terms of "dual qualifications". Teachers will be motivated to lead the competition, and this achievement will be added to the bonus points for their teaching evaluation and professional title. Teachers will be allowed to work at a company temporarily and gain some practical knowledge. A Group of Interdisciplinary Mentors will be formed. Given that there are many aspects to the competition, a joint guidance group of teachers from statistics, computer science, economics, biology, engineering, and so on, should be established to offer comprehensive guidance. Invite leaders from all sides, such as data scientists at top internet companies, banks, consulting firms, etc. These teachers will help set the problems for the competition, grade the students' answers and give specific feedback, etc.

### ***3.3 Innovation in the Evaluation System: Introduction of Process-Oriented Evaluation and Value-Added Evaluation***

The old results-oriented mode should be changed; instead, more attention needs to be paid to students' performance, effort and growth in abilities during the process of competition preparation, teamwork and solution iteration. Many people should be included in the evaluation, such as course teachers, competition judges, industry mentors and team members, to form a comprehensive evaluation system. The results and achievements of the students in the competitions will be used to select scholarship recipients, outstanding graduates and recommend them for internships and jobs.

## **4. Practical Paths for the "Integration of Competitions and Teaching" Training Model**

There should be some particular and practical application cases based on the theory.

### ***4.1 Systematic Integration of Competitions at All Stages of Curriculum Teaching***

In the lower-level courses in the first semester, such as the introductory courses for Foundations of Statistics and Programming, basic and interesting small-scale competitions or challenge problems can be organised to arouse students' interest and provide a solid foundation. In the intermediate courses (the second and third semesters), medium-sized course projects can be organised in a competitive manner for the main professional courses. For instance, in the class of Regression Analysis, students can carry out all the steps of building a prediction model and take part in a competition to predict future changes. In the advanced-level courses (third and fourth semesters), students can be led to form stable teams and participate in national and international high-level academic competitions, such as the National Postgraduate Statistical Modelling Competition and the Mathematical Modelling Contest; their participation will be counted as one of the main sections of the overall practice components. The subjects of the graduation projects and theses should also be based on the results of competitions or

related practical problems.

#### ***4.2 Build a team of "coach-type" and "dual-professional" mentors, create a training base, and improve the management system***

An "Applied Statistics Competition Guidance Centre" should be established, led by experienced teachers who are enthusiastic about competition guidance, to take charge of organising, training, selecting and supervising the competitions. An organised discussion group will be established for the new teachers to share their mentoring experiences and talk about teaching problems. The school-enterprise "dual-tutor" system shall be established, and it is required that each participating team has at least one academic mentor from the university and one industry mentor from the enterprise. Organise competitions at all levels and various difficulty grades. Build a simple training platform, add course management and an online test system, build a bank of basic skills training questions, and set up automatic tests.

Build an artificial training platform, cooperate with enterprises to obtain desensitised real-world business data and problems, set up an internal simulated competition system, and regularly organise university-level and college-level competitions. Create a good competitive environment, have students participate in famous subject competitions at home and abroad, and provide support for registration fees, server resources and material purchases. Motivate the students to collect the excellent proposals and algorithms from the competition and turn them into technical reports, software copyrights, etc., to spread the results. Build a dynamic incentive and process management system, set up a special fund and awards, provide travel and material subsidies for the participating students, and give both material and spiritual rewards to the winning team and its supervising teacher. Build a "Competition Credit Bank" system in accordance with the regulations, and convert the participation and awards at all levels of the competition into credits that can be deposited in the "credit bank" and used to exchange for elective course credits or practice credits. Strengthen the organisation and leadership of the process; develop a detailed competition preparation timetable, regularly monitor the progress, hold mid-term reviews and mock tests, and promptly deal with any problems and offer support.

#### ***4.3 Strengthen the Integration of Industry and Education for Collaborative Talent Cultivation***

Work with the university and companies to build a "competition-internship-employment" chain, invite well-known enterprises to organise corporate-named competitions or special competition topics, and use these competitions as the first stage of enterprise talent selection. Award-winning students will be selected first for the internships or given favourable treatment in recruitment. Competition cooperation should be taken as the starting point to jointly build a Joint Data Science Lab with enterprises and make it a permanent base for competition training and research and development. The company can provide real-life case studies, computing facilities, other technical support, commercial software licences, expert lectures, etc., to supplement the teaching and training materials.

### **5. Conclusion and Outlook**

"Integration of Competitions and Education" is a good way to meet the demand for outstanding talents in applied statistics in the new era and to address the lack of practical innovation ability among professional degree graduates. It is not the addition of teaching and competition; rather, it is an all-round reform of training concepts, systems and methods. The framework of the training model in this paper is based on goal reshaping, and at the core of this is curriculum reconstruction; faculty development is the key, evaluation innovation provides support, and all-round practical paths offer help, together providing an all-round solution to the reform of professional master's training in applied statistics.

In the future, as we continue to promote the reform of the "integration of competitions and education", the following directions will be taken. First, we will strengthen the reform of the evaluation system to build a good and scientific assessment system for abilities. Second, we will improve the design of competitions and integrate them into teaching in the cross-disciplinary area of "Artificial Intelligence + Statistics". Third, the experience of "integration of competitions and education" will be extended to all kinds of professional master's programs in engineering and management. Fourth, we will use information technology to build a virtual simulation competition environment and solve the problems of data collection and sharing. Only through continuous improvement can the training model

for integrating competitions and education be developed into an excellent feature of high-level professional degree postgraduate education in China.

### **Fund Projects**

2024 Heilongjiang Provincial Postgraduate Excellent Course Construction Project Project Number: 2024-074

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