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Summer Camp of Mathematical Modeling in China

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The Summer Camp of Mathematical Modeling in China is a recently created experience designed to further Chinese students' academic pursuits in mathematical modeling. Students are given more than three months to research on a mathematical modeling project. Researchers and teams with outstanding projects are invited to the Summer Camp to present their findings and techniques. These projects are based on real-world problems and train students to apply their mathematical knowledge into practice. Students communicate their research ideas with experts, peers, and practitioners of relevant fields during the weeklong Camp. This paper will illustrate the Summer Camp of Mathematical Modeling's origin and motivation, organizational structure, development, sponsorships, and activities and modeling tasks.

Keywords: mathematical modeling, weeklong, summer camp, China

Introduction

The Chinese proverb, "Tell me, I'll forget; show me, I'll remember; involve me, I'll understand," portrays how mathematical modeling activities benefit students' learning mathematics in China.

Mathematical modeling activities for Chinese undergraduate students have flourished and been well received in the past twenty years (Ye, 2011). Mathematical modeling courses have been designed and heavily researched (Li, 2011). Universities of all kinds have emphasized teacher training and development in mathematical modeling (China Undergraduate Mathematical Contest in Modeling [CUMCM] Committee, 2009). Chinese students' enthusiasm for mathematical modeling can be seen in Chinese national competitions, such as CUMCM, and international competitions, such as the Mathematical Contest in Modeling (MCM) sponsored by Consortium for Mathematics and its Applications (COMAP); and this enthusiasm has amazed mathematical modeling practitioners and educators in the United States (Pollak & Garfunkel, personal communications, Oct. 14, 2013). In recent years, Chinese mathematicians, mathematics educators, and policy makers have been advocating a new approach to enrich students' experience in mathematical modeling—the Summer Camp of Mathematical Modeling.

Origin and Motivation

With 10 years of development as of 2001, the CUMCM has become very well recognized among teachers and students. Though the well-designed modeling problems in CUMCM provide students with the experience of solving problems by mathematical modeling, the time limit restriction of the competition—three days—impedes students from obtaining the in-depth experience of tasting the authentic, real-world problem solving process. For instance, as a competition, CUMCM problem designers have to take problem difficulty into consideration so that satisfying results by students can be achieved within the time constraint. Contestants are also challenged for their competency in solving problems collaboratively without human aid from outside of the team. Thus, the sources with which relevant information could be obtained are limited.

Although the CUMCM benefits students to some extent, mathematical modeling in the real world is not necessarily constrained by competition rules. As a result, experts and practitioners of mathematical modeling thought of a new approach to provide mathematical modeling enthusiasts access to real research problems.

The Summer Camp of Mathematical Modeling in China was first conducted in 2001 as part of the celebration for CUMCM's 10-year anniversary. In the "2000 NetEase Cup CUMCM awarding ceremony and conference" held in December 2000, representatives across competition divisions

discussed favorable activities to celebrate the 10-year anniversary of CUMCM in 2001. Haiying Du, director of Higher Education in the Department of Education of Hubei Province, along with the experts on the CUMCM committee suggested that a Summer Camp of Mathematical Modeling be held at the National Undergraduate Internship and Social practice Base at the Three Gorges Project site. The suggestion received unanimous approval from the representatives. In this way, an opportunity arose to provide students and their advisors with problems suggested by authentic research questions (CUMCM Committee & Higher Education Office of Department of Education in Hubei Province, 2004, p. 10).

Organization of the Camp

Before February of every year, mathematical modeling tasks are solicited from people in different fields. In mid-April, the National Committee for the CUMCM finalizes and posts four mathematical modeling problems for the Summer Camp on its website http://en.mcm.edu.cn. Interested students may form a team not exceeding three members and choose one of the four listed problems. Members of teams can be undergraduate students, graduate students, or a mix of both, as long as all members attend the same school. Advisors are optional for the teams. Considering that the Summer Camp is not a competition, teams are strongly encouraged to consult teachers and experts in the relevant fields, and use any materials that would be useful to the modeling task. The final research thesis can also be completed collaboratively with teachers and experts. The practical and societal benefit of the modeling tasks is of great concern to the Summer Camp (CUMCM Committee, 2013b).

Approximately two months after the initial release of the modeling tasks, the participating teams are asked to submit their research papers to the Camp's provincial organizers. Each provincial organizer then conducts a preliminary assessment and decides on one best paper for each problem. These four best papers for the four posed problems from each province are then submitted to the National Committee for further assessment. Experts, including problem proposers, are invited by the Committee to make a final evaluation. Approximately 20 of the best papers are selected for each problem. At the beginning of July, the National Committee announces the invitation for teams that are eligible for the Summer Camp to join the on-site Summer Camp activities. Modification and improvement of the research papers are encouraged prior to the Summer Camp's commencement.

The Summer Camp is usually held in late August, with a one-week (five days) duration. Talks, academic exchanges, and industry visits comprise the activities at the Camp. The Summer Camp begins with one-day talks given by well-known experts and practitioners of relevant fields. Experts

are invited to the Camp to share with participants their cutting-edge research and pertinent practices in industry. Past experts and practitioners include academicians of the Chinese Academy of Science, professors of a variety of fields, and individuals from promising and renowned technology companies (CUMCM Committee, 2011, 2012, 2013a; Shenzhen News, 2012, 2013)

The subsequent three days are allocated for academic exchange. An exchange session is created for each posed problem. In the one-hour sessions allocated for each team, the participating team takes roughly 30 minutes to give presentations of their modeling results and 30 minutes for a subsequent discussion. During the 30-minute discussion, the audience actively raises challenging questions to the presenting team regarding their methods and process, while the team defends their results and methods in their best capacity. Finally, the chair, one of the experts for the presented problem, concludes the discussion by summarizing the strengths and weaknesses of the presenting team's solution. As a result of this discussion, both presenters and audience significantly benefit, which is indicated by the feedback collected from the participants after the Camp (CUMCM Committee & Higher Education Office of Department of Education in Hubei Province, 2004).

The problems reflect the hot issues or projects undergoing at regional or national levels in China. For example, the optimization designs for the side ramps of the Three Gorges Projects, city traffic analysis and management, and mammary cancer diagnosis, have all been used as questions for the Camp. In addition to students' own research on the problems, Camp organizers have provided students with insider opinions by means of guided tours at actual problems' sites and settings—such as the Three Gorges dam, and cities with traffic problems, during the Camp.

One-day industry visits are provided to all the participants. In the past, students have been given guided tours of technology-intensive companies, research institutes, and policy-making bureaus. These experiences further reinforce students' recognition of the bridging effect of mathematical modeling connecting real-world practice and mathematics. The concrete examples given by the practitioners provide excellent motivation for students to apply mathematics in practice.

Development of the Camp

When the first Summer Camp of Mathematical Modeling was initiated, there was no clear plan for further development of this event. It was considered as a special event for the 10-year anniversary of the CUMCM. An identical situation applied, when, in 2006, the second Summer Camp of Mathematical Modeling was held as part of the celebration

activities for the 15-year anniversary of CUMCM. Starting in 2011, the Summer Camp has become an official annual modeling fest for students, named "'Shenzhen Cup' Summer Camp of Mathematical Modeling," which is collaboratively held by the CUMCM committee and Shenzhen Science and Technology Association. At this time the number of modeling tasks posed for the Summer Camp also increased from three problems in 2001 and 2006 to its current four-problem format.

Beginning in 2013, undergraduate and graduate students from all over the world have been welcomed to submit their solutions for the posed mathematical modeling tasks and join the Summer Camp activities (CUMCM Committee, 2013d). As of 2013, five Summer Camps of mathematical modeling have been held successfully, and more are expected in the future.

The time frame of the Summer Camp has been modified several times based on participants' suggestions. In the 2001 Summer Camp, the modeling tasks were not announced until the end of June, and the Camp was held in early August. Participants complained about the lack of time for research. As a result, the 2006 Summer Camp released the modeling tasks at the end of May. In recent Summer Camps, the release time of the modeling tasks has been moved further back to April. As of this writing the National Committee anticipates that the 2014 release time be shifted even earlier, to March, and for the Camp to continue to be held in late August, as it was in 2013. Students are thus provided with additional time for the modeling tasks before the Camp begins.

Sponsorship of the Camp

The success of the Summer Camp of mathematical modeling, just like other mathematical modeling activities, cannot prosper without the support of forward-looking sponsors. The CUMCM modeling committee, as the main organizer, reaches out to experts in the fields for stimulating questions that appeal to students, thus providing a foundation for the rewarding modeling experience for students. Leaders in the higher education sectors of the provincial and city departments of education, as well as science and technology associations have provided both

financial and political support for promoting and ensuring the Summer Camp modeling experience. Technology companies have offered technical support and education on software that is useful to mathematical modeling. The Camp would not have enjoyed success without its sponsors' generosity and hard work (CUMCM Committee, 2011, 2012, 2013a; CUMCM Committee & Higher Education Office of Department of Education in Hubei Province, 2004; Ye, 2007)

Examples of Modeling Tasks

18 problems have been posed for the Summer Camp as of 2013. The topics have incorporated a diverse range of practical problems and can be viewed in Table 1.

Summary

The Summer Camp of Mathematical Modeling is an extension of the China Undergraduate Mathematical Contest in Modeling. The Summer Camp enables students and teachers to further involve themselves in the in-depth research

Table 1.

2001 A	The optimization design for the side ramps of the Three Gorges Projects
2001 B	City traffic analysis and management, and mammary cancer diagnosis
2001 C	Mammary cancer diagnosis
2006 A	The market research, evaluation, and prediction methods for textbook publishers
2006 B	Train dispatching for Beijing-Shanghai line considering the process of speeding up trains
2006 C	Tourism demand prediction
2011 A	Garbage classification and disposal
2011 B	Water resource shortage risk evaluation
2011 C	Automatic division of sequence stratigraphy using well logs
2011 D	The analysis on Shenzhen's traffic based on the GPS data in the taxis
2012 A	The prediction of the relationship on population and medical demand in Shenzhen
2012 B	Accurate recognition model for mobile users
2012 C	Environmental friendly computer lab design
2012 D	The improvement of production efficiency for hole punchers
2013 A	Food safety random inspection data analysis
2013 B	Traffic jam investigation and administration
2013 C	Quantitative analysis of society and individuals on garbage classification
2013 D	Investigation of natural disaster insurances

(CUMCM Committee, 2013c, 2004, 2007; CUMCM Committee & Science and Technology Association of Shenzhen, 2013a, 2013b)

of authentic real-world problems. The time allowance of a three-month preparation period, combined with its flexible manner of human and non-human information exchange, allows for the Summer Camp modeling experience to mirror the way practical problems are solved in real life. The national committee of CUMCM is determined to further develop the Summer Camp of Mathematical Modeling and make it a rewarding experience for both teachers and students, and bring new forces of promising candidates to research and industry.

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