WHAT ARE THE MATHEMATICS HOUSES IN IRAN AND WHAT THEY HAVE DONE TO POPULARIZE STATISTICS?

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Here, we introduce Isfahan Mathematics House (IMH) which is a community center that aims to provide a learning environment and opportunities for students and teachers at all levels for experiencing deeper understanding of mathematical concepts and developing creativity through working on real-life problems by team work and cooperation. Also, we will present some of IMH activities, then we will discuss the necessity of popularizing statistics among the public by promoting and enhancing statistics education among the teachers and students. The last part will be devoted to what we have done at mathematics houses for this enhancement, and why we established a statistics house in Isfahan.

INTRODUCTION

As recalled in the 16th Study of ICMI, the origin of Mathematics Houses in Iran results from the creation of a high commission for the observance of the 2000-World Mathematical Year, set up in 1997 (Taylor & Barbeau, 2009). This commission took as a goal, the creation of Mathematics Houses. The first one opened in Isfahan in 1999, with the help of the municipality of Isfahan. The Houses are meant to provide opportunities for executing diversity of activities serving the general public, students at all levels and their families, teachers, university students, researchers and even university professors. Mathematics House is a lively and creative research center with the following goals; popularizing mathematics, developing mathematical awareness among the society, using mathematical sciences in all aspects of life and work, encouraging team working, promoting team working among young students and teachers, encouraging joint and collaborative research, encouraging interdisciplinary research, emphasis on incident learning, teaching the skills for a better understanding of mathematical concepts, teaching the skills for solving problems by using mathematical concepts and methods, investigating the history of mathematics, investigating the applications of mathematics, statistics and computer Sciences, developing information technology and expanding mathematical sciences among young students (Challenging Mathematics, 2012).

Professor Jan Hogendijk, professor of the history of mathematics at Utrecht University in an article wrote that, "A more modern secret in Isfahan is its House of Mathematics, which encourages mathematics awareness among high school teachers and university students work together with high school projects. The circumstances are sometimes difficult but this only seems to make the staff more enthusiastic and more inventive" (Hogendijk, 2008). Now, there are 45 Mathematics Houses throughout the country and two others in France and Belgium. In ICME-13 in Germany, an International Network of Mathematical Houses was established (Kaiser, 2016).

THE NECESSITY OF POPULARIZING STATISTICS

Why statistics is important?

Statistical sciences have enjoyed a unique position in the domain of knowledge. It has been a subject of special interest since its start in or around the 18th century. It has become a basic tool for all types of data analysis. The statistical science has the capability of transferring raw data to information; statistical tools have transferred information to knowledge, which is the core of decision making and planning. The statistical methodologies are getting popular for conducting cross-discipline research. In our data-centric world, statistics are everywhere and statistical literacy is essential. For example; questions such as "what is the margin of error in a political poll?" or "Is the finding from a study of a new cancer drug statistically significant?" are some of the examples which show the necessity of statistics in real life problems. According to the American Statistical Association's (ASA), Pre-K-12 GAISE framework report, "every high-school and college graduate should be able to use sound statistical reasoning to intelligently cope with the requirements of citizenship, employment, and family and to be prepared for a healthy and productive life". A

statistically literate citizen is proficient in basic numeracy involving data interpretation (e.g., rates, percentages, charts, and tables). A statistically literate citizen understands the strength of the scientific process and can critically analyze media reports on scientific findings by knowing the appropriate questions to ask about the study's design and conclusions (Franklin, Kader, Mewborn, Moreno, Peck, Perry & Scheaffer, 2007).

The roots of statistics as a subject are not in mathematics, but in other areas such as agriculture, social science, and astronomy (Box & Fisher, 1985). If we trace statistics back to its origins, the field was created to fill a need to solve real problems. We can view statistics as helping bring mathematics into the practical world of useful applications. So, statistics and mathematics are mutually supportive. It seems that what happened in the teaching of statistics is, at some point, the mathematics of statistics often overshadowed its problem-solving roots and this is a local point for us to think about changing the situation.

How everybody should understand the necessity of learning statistics?

We believe that through a good education, a student can understand and feel the essence of every science. Education has a main role in the sustainable development of a country; because one can consider it as a factory in which human beings are the products, but unfortunately this important role in not recognized by many countries. So, statistics should be learnt, understood and be loved by people through teaching it properly. We can achieve these goals by eliminating obstacles that we observed during years in teaching statistics. Therefore, at IMH we try to teach the students by letting them know its usefulness and understanding its methods carefully. Also, we believe that their teachers should believe in the subject and understand and have powerful skills in working with data in order to be able to teach them properly and make them believe on its usefulness and as usual we believe that this can be done through realistic mathematics, not teaching them only formulas and methods (Kindt, 2009).

HISTORY OF IMH STATISTICAL ACTIVITIES

In order to meet the goal of popularizing statistics, in our society at large, Iranian Statistical Society (IRSS) and the Iranian Association of Mathematics Teachers' Society (IAMTS), have convinced the Ministry of Education to include one statistics course in the national school curriculum (called "Statistics and Modeling", (Rejali, 1997)). Now, statistics and probability are included in mathematics books in all grades. Ali Rejali's talk at the 2nd Iranian Statistics Conference in Mashhad in 1973 was a source of inspiration for the curriculum developers to introduce a course on statistics and modeling for all high school students in Iran. Also, by the efforts of these organizations, the National University Entrance Examinations (which are very popular among students and their families) now include questions in the subject of statistics.

A) Teachers

In our data-centric world, sound statistical reasoning skills are needed by all students. The critical component for the successful implementation of the statistics standards and statistical literacy for all students is the statistical preparation of our teachers. These teachers are keys to disseminate the principle that statistical literacy is essential for all citizens. Teacher preparation in statistics must become a priority for our teacher preparation colleges and for professional development (Parsian & Rejali, 2011). Many teachers do not have any feeling for data. This philosophy should be noted that a teacher's beliefs about statistics may be more important than a teacher's knowledge about statistics, as these beliefs relate to helping students developing a healthy acceptance and understanding about the necessity of statistical literacy. Even when a teacher is uncomfortable with teaching the statistics contents, if the teacher believes that developing statistical reasoning skills is important for the student, he or she will be more likely to engage in practices that enable him/her to become a more effective teacher. Historically, the teaching of statistics has primarily been in mathematics courses, typically being very formula-oriented, with little emphasis placed on learning concepts or on the interpretation of findings. They have been focused on computations and not on statistical reasoning. The lack of accessible technology was a significant contributor to this situation, with the result being that statistics courses have often been taught as a laundry list of topics where students depended on rote memorization rather than conceptual understanding (Moore, 1993). It seems that proper ways to achieve the goals could be teaching statistical topics and reasoning skills, using technology and problem-solving-oriented

activities. Technology allows us to focus on analyzing data from real studies, often with large data sets, and to rely on simulation in the place of mathematical theory to understand why and how statistical methods work.

It was agreed that teachers should be familiar with statistical concepts and methods and have some experience with statistical problems. They should know the difference between statistical thinking and statistical methods and the difference between statistical reasoning and mathematical reasoning; of course, both types of reasoning are necessary in modern society, especially for understanding probability and the concept of chance. They should firmly believe that teaching statistics without the involvement of students in various projects does not help students to learn the art of statistical thinking. They should know that their students may know the importance of mathematics but are usually not aware of the importance of statistics; hence it is crucial to raise awareness of the importance of the subject. They should know the importance of using statistical software to do real statistical analysis and hence be familiar with at least one software package (Parsian & Rejali, 2008). Unfortunately, due to the lack of statistics specialists in the school system, most of the statistics teachers in schools have a mathematical background and are unfamiliar with statistical concepts, methods and reasoning. Many teachers do not have any feeling for data. Hence, to make a more significant and meaningful goal for statistics education clear to mathematics teachers who are teaching statistics, IMH in cooperation with IRSS, started to prepare mathematics teachers to teach statistics and proper teaching methods (Parsian & Rejali, 2011). Some of IMH activities for teachers are;

1- Since there was no proper in-service program for teachers who teach statistics, many of whom did not have a background in statistics, IMH developed a series of lecture notes for mathematics teachers to help them understand the statistical concepts and learn the methods of teaching these concepts at school level. These notes have been distributed among many mathematics teachers throughout the country (Parsian & Rejali, 2011).

2- IMH developed a program in continuing education for mathematics teachers who wanted to teach statistics in schools or are already doing so. This program was at first developed for mathematics teachers of Isfahan in cooperation with Isfahan Mathematics Teachers' Society (IMTS) and implemented in the summer of 2004 at IMH as a workshop. After observing the effect of the first workshop, IMH in cooperation with IRSS and the Iranian Association of Mathematics Teachers' Societies ran this workshop for volunteer mathematics teachers in eight other provinces of Iran in the summer of 2005 and has announced its readiness to run anywhere else. These workshops also included in teaching statistical software, e.g. Minitab (Parsian & Rejali, 2011).

3- During each Iranian Mathematics Education Conference (The first are organized by Ali Rejali and his colleagues in 1976 in Isfahan), there exists sessions on teaching probability and statistics for the teachers and some workshops and exhibitions on probability and statistics. Also some teachers got involved in real projects which needed statistical methods. Results of some activities were presented in mathematics education conferences or seminar on methods and issues in university entrance examinations organized by IMH (Proceedings of the seminar on methods and problems of university entrance examinations, 2002).

4- Since 2012, a new series of workshops in statistics teaching was developed and implemented in different cities of Iran and they are still running across the country. The purpose of these workshops is involving teachers in simple statistical practical problems and gives them statistical Insights. In these workshops, we simply work on multiple domains of teachers' knowledge including self confidence in understanding statistics and probability concepts, belief about the value and use of statistics, pedagogical contents, using examples and projects in which teachers should respond. This could be a role model for teachers to do similar work with their students. The items in some stages are discussed in these workshops. The first is providing the teachers to response the description of statistics and probability concepts and necessity of statistics including real examples. Some of the main areas and examples which we cover are; use of data to conclude on unknown issues, making decisions when there is uncertainty, the outcome of the Iranian presidential election in future, the ratio of students in mathematics to the whole student, the amount of rainfall in a specific city during a specific month, the area of a shape, when its bounds do not define as an integrable function (elementary Monte Carlo method), discovering a message when it comes with some noise (elementary Cryptology), lifetime of a fossil which has been

discovered, to see statistics is not just for the future, but helps us to understand the unknowns (Tanur, 1972). The main emphasis on these workshops is that statistical insight is the philosophy of learning and skill based on the following basic principles; all works in a system which is related, work as a process, there are variations in all processes, understanding change and reducing and controlling change is the key to success. At last, each team of participants does one of the presented projects and presents the results at the end. They have to try to make a hypothesis for each project and try to prove their hypothesis. Some of the projects are; "To conduct an election for selecting a person as the representative of the city's mathematics teachers", "Review the age of marriage among the mathematical teachers of the city", "Investigating the number of children in families of mathematics teachers in the city"," Determine the sample and calculate the probability of probable events for a coin", "Calculating probability using relative frequency for an uncertain coin". The subjects of these activities are; determine the population and sample, how to select a sample, what is the sample space, conduct election in the sample, calculate its probability by using the relative frequency, determine the sample and calculate the probability of probable events for a coin, calculating probability using relative frequency for an uncertain coin, explaining what has been done. According to the data which is being collected during the workshop from the participants which can be considered as a sample of the population, each team explains statistical hypothesis of their project.

B) Students

The students are not learning the concepts of statistics in schools properly and do not think that statistical knowledge is necessary, which is completely different from their attitude towards other mathematical subjects and only the last deciles of students choose statistics as their field of study (Borhan, Ellahi & Rejali, 2010). Motivating the students for studying a subject which they think is uninteresting is a big challenge toward having a positive feeling about it. The students do not give value to their knowledge about statistics; they think that statistics is an easy and worthless subject. Most of the societies simply ignore the fact that most students had never been given the opportunity to mentally develop and cultivate statistical thinking skills at the elementary, middle, and high school levels. As a result, most students were not exposed to statistical topics properly.

1- As a partial solution to the problem of lack of interest in students for studying statistics, IMH in cooperation with IRSS and IMTS started a statistical competition among high school students of Isfahan in 2006 using Ali Rejali's successful experience for establishment of mathematics competitions. IMH tries to make it as a national event in the country. It was a team competition, and the questions and projects required a good understanding of statistical concepts. The purpose of this activity was to increase the students' basic knowledge in statistics and acquaint them with some of its applications (Rejali, 2011).

2- Setting up a permanent statistical workshop for high school and junior-level students was another activity of the house. In this workshop, statistical concepts are being explained in a different way from what students learn in schools. The goals for establishing it were changing attitudes and the need for public awareness for the importance of statistics.

3- Encouraging students for doing team working research by paying the travel cost of students presenting papers in national and international scientific conferences or dedicating awards to teams of students writing articles in scientific magazines about statistics.

4- Entrepreneurship for university students by establishment of some working groups of students to produce educational CDs or statistical researches, consulting the research group of high school students and teaching the "Introduction to Mathematics" program for high school students at IMH.

5- Assisting the students of Isfahan University of Technology (IUT) in opening mathematics and statistics laboratories and an exhibition for software products in order to facilitate entrepreneurship for students.

6- Collaboration with the statistical research center of Isfahan University of Technology in order to make a connection between university faculties and industry for using the statistical methods in various industries and acquainting students with statistical methods which can be used in industry, were another activity of the house. (Experiences of Isfahan University of Technology at its "Statistics Research Center", made special ties between IMH and many industrial firms in the

country which provided some joint projects for IMH. Now IMH has a department devoted to statistics for industry which works closely with industry and Isfahan Medical School).

7- Organizing some lectures and seminars for the students was another activity of the house. Lectures and workshops were leaded by experts in the field of statistics and probability. Organizing public workshops, lectures and exhibitions for students, as well as encouraging statistical projects for yearly festivals of the house and other activities of the house, definitely had major influence on the improvement of statistics education in Iran.

8- IMH library is holding statistical books at different levels and some statistical software are also available at the library.

9- Allocating a portion of IMH site to public awareness of statistical sciences and literacy statistics in 2005, as an activity on statistics day's ceremony activity of the house.

10- Cooperation with the Iranian Statistical Society in preparing the draft for a Law of the Iranian Statistical Organization which is under reviewed at the Iranian parliament.

11- Collaboration with the Statistical Society of Islamic Countries for holding an education section in the 10th Islamic Countries Conference on Statistical Science, Egypt in 2010 (Rejali, 2010).

12- Organizing some summer science school programs at IMH, in collaboration with New Iranian Society of Development, Isfahan University of Technology and Isfahan University was involved some statistical lectures and exhibitions.

13- Holding a competition with the purpose of awareness among families about the importance of statistical sciences (on the eve of holding the Iranian population and housing census).

14- Setting up the mathematics statistics and probability research groups for students in the form of team groups, in different fields of statistics. A number of research articles on social issues, using statistical methods developed for the festivals of IMH.

15- Cooperation in film competition in the international year of statistics 2013.

16- Following the announcement of 20 Oct. 2010 as the "World Statistics Day, Official Statistics", by the United Nation, IRSS decided to celebrate this day. Since, 23rd October is recorded as "The National Statistics and Planning Day" in Iran, the IRSS decided to celebrate one week as statistics week (20-26 Oct. 2010). Iranian Statistical Society set up a committee headed by Ali Rejali, for celebrating this week. Running the celebrations for The "National Statistics and Planning Day" with the cooperation of universities and the Iranian Statistical Society has been one of the most important student activities of IMH in the past years. In these celebrations, in addition to the lectures delivered by invited university faculties, some Iranians working abroad and people involved in statistical activities, some institute (https://unstats.un.org/unsd/wsd/docs/Iran_wsd_report.pdf). Calling 2013 as the International Year of Statistics, urged IMH to host program items consisting of various activities, workshops, a one-day statistics and planning conference, statistics summer school and teacher's workshops (Newsletter: *International Year of Statistics, 2013, 2014*). Observing statistics days by university students at the house as well as a week program in the year 2012 for celebrating the international day of statistics and activities of IMH for the World Statistics Year (WSY 2013) had many fruitful results for the improvement of statistics education and awareness for the need of the subject in the society and popularization of statistics.

ESTABLISHMENT OF STATISTICS HOUSE

During celebration of the International Year of Statistics 2013, IMH proposed to establish a Statistics House in Isfahan, with the help of the Municipality of Isfahan. Isfahan Statistics House is a complex in the scientific city of Isfahan which works on various aspects of statistics with a view to spreading knowledge and improving statistical literacy among the youth in the society, students and teachers, educational and cultural goals. Some of their activities in 2015–2016 included (Ashofteh, 2017); publishing the first book of statistical literacy in Persian. This book is about statistical literacy in economics and social studies. The book is written in Persian/Farsi and electronic copies are available free of charge, from the Isfahan House of Statistics and the Iranian Statistical Society websites (www.stathouse.ir, www.irstat.ir), set up Isfahan statistics alumni group in order to develop the knowledge of statistics and providing statistical services, employing

graduates in the field of statistics, defending the rights of their career in various fields with in labor market and offer coordinated strategies, competition for high school students entitled "The best project in Statistics and Modeling course", research career for students of secondary school entitled "Introduction to Statistics and Probability", different workshops for students in all grades which was conducted with a lot of games and amusements, outdoor camping with some activities related to popularizing statistics, research projects on application of statistics in different sciences and industries, seminars for university students by some experts in statistics, teaching statistical concepts as part of a "Statistics and Modeling" course for high school teachers, holding meetings, festivals and conferences every year, execution survey for evaluation of school textbooks and training probability and statistics chapter of textbooks for the blinds through recording and production the devices. The performance of these activities is evaluated regularly and its impressive impact on the promotion of statistics is proven.

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