Indian Agricultural Statistics Research Institute (IASRI): A Student's Experience

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I congratulate IASRI on its golden jubilee celebrations! Throughout its history, the statisticians at IASRI played a crucial role in Indian agricultural research by developing important designs for conducting experiments and surveys. Some of the pioneering works in the areas of *Design of Experiments, Sample Surveys and Statistical Genetics* were conducted by the statisticians at IASRI. I consider myself to be very fortunate that I was trained by some of these outstanding researchers and teachers. It is indeed an honor for me to write this short note recounting my academic experiences at IASRI while I was a student there.

Training at IASRI

I never had a course in Probability or Statistics prior to joining the M.Sc. program and hence everything was new and challenging during the first trimester. It took me a while to appreciate the inductive logic of statistics - drawing inferences about a population using a random sample from the population. However, I was very fortunate that during first trimester I was taught by Professors Aloke Dey, V. K. Gupta, S. C. Rai and U. G. Nadkarni, who laid the foundations in matrix algebra, statistical theory and data analysis. After the first trimester I started to enjoy statistics very much and things started to click and make sense. A unique feature of the statistics program at IASRI was that almost every *theory course* was accompanied by a *practical class (or lab)* where we analyzed real data from agriculture. Not only did these practical classes reinforce the relevance of statistical theory and methodology for solving practical problems, they also taught us some of the important computational algorithms. In those days we used mechanical computing machines and not electronic calculators or computers, although IASRI had two "state of the art" computers (IBM 1620 and Burroughs 4700). These punch-card generation mainframe computers were typically used for research purposes only and not for class-room projects. Since the mechanical computers were physically demanding, we had to learn clever ways of using them, which made us to think deeply about the algorithms we were using.

Although I did not take a course taught by every member of the training unit, the general consensus was that members of the training unit were dedicated researchers and committed teachers. They had a serious "no-nonsense" approach to teaching with very high expectations from their students. Several of my professors were also very prolific in publishing papers, and that served as a motivation for me to do Ph.D. in statistics and follow in their footsteps. In fact I discovered research problem for my Ph.D. dissertation while taking a course on statistical genetics taught by Professor V. K. Bhatia. While analyzing a genetics data in the practical class taught by Professor Bhatia, my classmates and I independently obtained a negative estimate for the variance of a random effect term in a linear mixed model. Our initial reaction was that perhaps we were all using a wrong formula or we were making an error in our calculations

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(recall that we were not using electronic computers or even an electronic calculator but simple mechanical computing machines). We did not recognize that this could happen with a positive probability when using an Analysis of Variance (ANOVA) based estimator. During the next lecture Professor Bhatia explained to us that an unbiased estimator of the variance component can take a negative value with a positive probability. I found it to be very intriguing and decided that for my Ph.D. dissertation I would work on the problem of non-negative estimation of variance components. That is exactly what I did three years later in my Ph.D. under Professor C. R. Rao at University of Pittsburgh.

In my view, the M.Sc. program at IASRI (in 1970's) was already years ahead of many graduate programs around the world. It was a very inter-disciplinary program, a popular theme these days at many universities in the US. In our M.Sc. program we were required to take a broad spectrum of courses in statistics and agriculture. In all I took about 70 credit hours of course work, which included 50 credit hours of statistics courses (a few of which were math courses) and the remaining were courses in various disciplines of agriculture, such as genetics, agronomy, plant pathology, entomology, soil science, etc.

In addition to the course work, we were required to do a thesis project in our major area, which was Design of Experiments for me. My thesis advisor was Professor P. N. Soni, a remarkably kind man who was very nice to work with. For my thesis, I worked on response curves for fertilizer trials. Although it was an applied project, I learnt a lot about basic data analysis. Through the course work and my thesis work I appreciated the importance of statistics and mathematics for solving real world problems. The training I received at IASRI continues to have a major impact on my research program and my passion for developing appropriate statistical methods for solving real world scientific problems in a wide range of topics.

The M.Sc. program at IASRI was a well rounded program. In addition to taking a broad range of courses and doing a thesis project, students were required to give seminar lectures on a regular basis. These seminars were well attended by all students and faculty. Furthermore, on a regular basis, we had speakers from all over the world visiting the institute to give seminars. By giving seminars and listening to seminars on a regular basis, I learnt a good deal about how to communicate. It made me a good communicator and helped me as a teacher here in the US. In 1985, I was nominated for teaching excellence award at Central Michigan University and I largely attribute this nomination to the training I received at IASRI.

I am grateful for all the wonderful experiences I had at IASRI. In particular, I am very indebted to all my professors for laying the foundations of my academic career.

Present and the Future of IASRI

Faculty

Since leaving the institute in 1980, I have tried to keep in contact with my Professors at IASRI, and got updates on the changes and progress made at the institute. Several faculty members I used to know when I was a student have now either retired or moved to other places. The remaining faculty provided important leadership and direction, and consequently the institute continues to enjoy its key position on the international stage. Furthermore, they hired several very impressive statisticians who are making their mark and keeping the tradition of IASRI alive. Not only that IASRI continues to enjoy a great international reputation in the traditional fields of *Design of Experiments, Sample Surveys and Statistical*

Genetics, but they are also developing strong programs in *Biometrics and Statistical Modeling, Forecasting, Statistical Computing*. I congratulate each member of these divisions for conducting outstanding research consistent with IASRI tradition.

Statistical computing and software

I am very impressed to see that IASRI has developed useful statistical packages such as, Statistical Package for Block Designs (SPBD 1.0), Statistical Package for Agricultural Research (SPAR1 and SPAR2), Statistical Package for Factorial Experiments (SPFE 1.0), Statistical Package for Augmented Designs (SPAD), etc. To a large extent these packages reflect the research work conducted by the researchers at IASRI. I also visited the Design Resources Server (www.iasri.res.in/design/) developed by the scientists at the institute. It is a very impressive website with all kinds of important tools and resources for a researcher. The layout of the page is very nice and I congratulate the staff maintaining the website. By developing these software packages and web tools, the scientists of the institute are demonstrating that their research work is not only of theoretical value, but has important practical relevance.

Genomics and environmental health

During my last visit to IASRI in 2007, I was delighted to see that the institute is actually positioning itself very well for the age of genomics by hiring brilliant young scientists such as Dr. Rajender Parsad, and Dr. Rao. The Indian agriculture would greatly benefit by expanding IASRI's research program in the area of genomics by adding more faculty and developing strong collaborations with IARI scientists and others within India and outside India. Perhaps they could conduct workshops and conferences on various topics related to bioinformatics by bringing statisticians, bioinformaticians, computer scientists and biologists together. On the methodological front, this institute has the unique expertise to develop new experimental designs that are suitable for experiments relating to the study of plant genome. I am not sure if theory of optimal designs for high throughput experiments such as microarrays, has been developed yet. Perhaps IASRI may want to take the lead research in this area, if they are not already doing so.

Students of IASRI

Since the inception of its training program about five decades ago, IASRI enjoyed a great tradition of producing strong students who had (or having) successful careers all over the world. During my last visit I had the opportunity to meet with the next generation of scientists who are being trained at IASRI. I am sure these students are having the same positive experiences as I did when I was a student. I am sure each of them will succeed in their careers. I wish them all the best.

On a personal note

This summary of my experiences at IASRI would not be complete if I did not pay tribute to a very important person in my life, namely, my father (late) Professor P. Prabhakara Rao, who served ICAR for about 30 years and was a member of the training unit at IASRI. Both my parents were regarded as outstanding teachers at their respective institutions, so a career in teaching and research was the obvious one for me. My father was the main source of inspiration for me to consider a career in statistical science. I never regretted that I chose the field and profession he loved so much. I hope some of his passion for the field rubbed off of me as well. I am eternally grateful to him.