

Innovative Strategies for Incorporating Consulting into Graduate Education

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Abstract

UMBC, a small public university of 9,000 undergraduate and 3000 graduate students, has gained recognition for significant growth in interdisciplinary research in the last decade and a half. The Center for Interdisciplinary Research and Consulting (CIRC) is a joint venture between the Applied Mathematics and Statistics graduate programs at UMBC. A unique feature of CIRC is that it promotes the idea of graduate students themselves forming teams of fellow graduate students from other departments and proposing interdisciplinary projects and lining up faculty help. This has resulted in publications with graduate students from different departments as co-authors. This experience in business development has not only created attractive résumé entries but also has helped the graduate students develop contacts on and off campus. CIRC has formed a strong alliance with the campus initiative of creating a High Performance Computing Facility for training students. This collaboration has resulted in a NSF award for a Research Experience for Undergraduates (REU) site on High Performance Computing for 2010 and 2011.

Key Words: statistical consulting, graduate students, interdisciplinary research

1. Introduction

In a worldwide environment of interdisciplinary scientific collaboration, graduate students must prepare not only to become experts in their fields but also to build and support connections with other disciplines. Traditionally students have been expected to pick up the necessary “soft skills” along the way to achieving their primary research goals, but it is becoming increasingly important to help students adapt to the current academic climate. CIRC, the Center for Interdisciplinary Research and Consulting, has this goal as its mission: providing students of Mathematics and Statistics with vital consulting experience needed for jobs in academics or industry.

The University of Maryland, Baltimore County was founded in 1996 as the third research university in the University System of Maryland and currently has about 13,000 enrolled students, 3000 of which are graduate students. The University has 33 departments and employs 480 research faculty with a strong focus on science and technology, particularly in the field of Biology and medical research. On campus, there is a significant emphasis on interdisciplinary research, with several well-funded research centers (such as the Center for Urban Environmental Research and Education, CUERE; the Center for Advanced Studies in Photonics Research, CASPR; and the Joint Center for Earth Systems Technology, JCET). This emphasis on interdisciplinary collaboration is a perfect setting for CIRC.

The Department of Mathematics and Statistics at (UMBC) offers Master’s and Doctorate degrees in Applied Mathematics and Statistics, as well as several applied tracks at the Master’s level. The Department of Mathematics and Statistics has 380 undergraduate majors and produces about 50 Bachelor’s degrees a year. There are 30 faculty members and 60 graduate students in the department. This pool of graduate students is poised to benefit the most from innovated strategies

that incorporate consulting. Consulting opportunities are offered to its graduate students through the CIRC. Our consulting center has several unique and innovative aspects: one is the involvement of the graduate program in Applied Mathematics together with the program in Statistics. Another is the tight collaboration with other initiatives on campus, including the UMBC High Performance Computing Facility (HPCF) and the NSF-funded REU Site: Interdisciplinary Program in High Performance Computing.

CIRC was established in 2003 by the co-directors Dr. Gobbert, Professor of Mathematics, and Dr. Neerchal, Professor of Statistics, for the two-fold goals of making the departmental expertise available to support interdisciplinary research in the community on and off campus, and to give graduate students from both programs experience with real-life application projects. CIRC provides a full range of consulting services in Mathematics and Statistics ranging from free initial consulting to long-term support for research programs. While the services that CIRC provides for the community are invaluable, the most important contribution that CIRC makes is to the academic advancement of the graduate students: Graduate students are provided with opportunities to experience hands-on interdisciplinary research and consulting experience, which can be essential for careers in industry or academia.

2. Graduate Student Involvement

There are several ways through which students can get involved with CIRC: as supported graduate research assistants, as students (through an independent study class), or as CIRC affiliates. CIRC students participate in all levels of daily consulting activities: responding to web-based service requests, meeting with new clients, working on projects, and presenting project results to clients. All CIRC students also assist with developing and presenting software workshops, one of CIRC's outreach activities to the general community: this is an opportunity to gain experience in developing training material and facilitating hands-on workshops. CIRC also takes on larger consulting projects on specialized projects, for which the client typically funds a dedicated RA for one semester. The CIRC students work closely with the CIRC directors and the Executive Director, Dr. Elizabeth Stanwyck. Adding an executive director is the latest development in CIRC, necessary to provide sufficient support to all graduate students involved. To coordinate all activities, all CIRC students and staff attend a weekly meeting to keep CIRC students and center directors abreast of new project developments and CIRC activities.

Consulting projects run the gamut from short-term advice on analysis techniques to long-term project development and structuring. Some examples of projects from industry clients are incubator reliability testing for GE Healthcare; modeling the spread of epidemic cholera for the Department of Epidemiology and Preventative Medicine, University of Maryland School of Medicine; analysis of failure time data in cancer patients for Dr. Didolkar of the Sinai Hospital of Baltimore; and validation of drug-testing software for Constellation Energy. Examples of on-campus clients include statistical analysis of Baltimore storm water monitoring data for Dr. Ghosh in the Department of Civil and Environmental Engineering; support to develop parallel code for Dr. Frey in the Department of Chemical Engineering; and retention rate and academic performance of UMBC students for the Learning Resources Center. These are examples of CIRC consulting for a paying client, consulting in collaboration with and paid for by UMBC High Performance Computing Facility, and consulting provided free of charge to the university administration, respectively. Similar to the collaboration with HPCF, the REU Site receives CIRC support by its graduate students and profits from their experience and continuity, but provides its own funding stream.

3. Benefits of CIRC

The benefits of CIRC for graduate students are manifold. Students are provided with research opportunities unlike anything they encounter in a classroom environment – an incomparable experience as they develop their own research interests. Exposure to industry clients in a professional situation can create job opportunities down the line, or just help students decide what their interests are. Through the software workshops, students gain experience with a variety of computer programs, software tutorials, and training guides – as well as learning how to create such guides themselves. Students make connections with graduate students and faculty from other departments, creating a network of interdisciplinary collaborators they may keep in touch with long after graduation. In addition to experience, students may get awards, give presentations, and get published. Each year a CIRC Consultant of the Year award is granted to the student who does the most outstanding consulting work; this award comes with a cash prize as well as presentation of a certificate. Students present consulting projects (either spoken presentations or posters) at various conferences (for example, students regularly present CIRC projects at the annual Probability and Statistics Day Conference at UMBC). Perhaps most importantly, some projects grow into publications – giving the student an additional experience as they learn to work through the publication process. There have been more than 5 student publications in peer-reviewed journals over the last 6 years as a direct result of CIRC projects.

CIRC provides an invaluable service not only to the graduate students, but also to the research faculty and industry specialists who have been helped. “... [CIRC] has done an exemplary job on a project currently being conducted at Sinai Hospital involving Cyberknife Radiosurgery (CK) and pancreatic cancer. Their insight and help in doing this statistical work was invaluable. This is one of our first collaborative efforts involving Surgical Oncology and UMBC. It is my hope that this mutually fruitful relationship will materialize into a larger national protocol, which will certainly bring UMBC’s name into the forefront of national group protocols ...” noted Dr. Mukund S. Didolkar, MD, Director, Surgical Oncology, Sinai Hospital of Baltimore. Dr. Uri Tasch, Professor of Mechanical Engineering, UMBC, said, “I had several opportunities to interact and get services from statisticians who were part of CIRC. I was very pleased with the professionalism and high quality scientific support. I recommend the services of the center to scientists, researchers, and businesses.”

CIRC provides an important service to the entire campus community by collaborating with the Division of Information Technology to provide free introductory software workshops for various mathematical and statistical packages including MATLAB, COMSOL Multiphysics, Microsoft Access, SAS, R, SPSS, and more. These workshops target first-time users as well as advanced workshops on more specialized features of software packages. Workshops are taught interactively in an instructional computer lab at UMBC, accompanied by tutorial handouts. New workshops are being created all the time to keep up with new versions of software and to offer a wider range of tutorials. Workshops being developed now include WINBugs, R, and Maple.

CIRC also provides a department service in the form of CIRC Social Hour. Every Friday morning, before Statistics and Mathematics colloquia, CIRC provides refreshments (coffee, tea, and doughnuts) and an opportunity for the graduate student and faculty members of the Mathematics and Statistics department to interact socially. This is an ideal time for graduate students to network with each other, and to meet the colloquium speakers (abstracts are sent out ahead of time, so students know who they could meet). Members of the University administration also take the time visit CIRC social hour, and it is a convenient time to arrange visits from other campuses.

4. Concluding Remarks

It is needless to reiterate the “interdisciplinary research” has become the way of life, especially for Applied Mathematicians and Statisticians. Traditionally, applied mathematics and statistics

students seeking employment in industry were naturally expected to be participating in interdisciplinary projects involving scientists from a variety of areas and are therefore encouraged to pick up the necessary “soft” skills. On the other hand, students pursuing employment in academia were expected to pursue individual research programs with a limited number of collaborators. Tenure and promotion criteria in the applied mathematics and some statistics departments emphasized single author publications and research programs by individuals surrounded by a group of graduate students. Clearly, there has been a sea change in the academic environment. Most applied math and statistics programs now are championing interdisciplinary research. A majority of today’s academicians are trained in the traditional mould and have had to adapt to this shift. They have had to learn to step down from their proverbial ivory towers and build connections to other disciplines. While we have done very well, it is our responsibility to prepare the current group of graduates to this changed world. CIRC has embraced this responsibility as its mission.