Original Paper

Making an Impact: Creating a University Student-Driven Statistical Consulting Group for Non-Profits

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Abstract

A common problem in mathematics and statistics departments at academic institutions is providing students with experience working with real data in place of the often sanitized "toy" datasets used in the classroom. A solution can be creating mutually beneficial collaborations with local organizations and businesses. This paper discusses the creation of the Bryant University Statistical Consulting Office (BUSCO), and explores both its successes and challenges, with the purpose of guiding and inspiring other colleges and universities in establishing similar organizations. In particular, we discuss the challenges involved with obtaining funding, identifying and partnering with non-profits, and guiding students through meaningful and purposeful consulting experiences. We also share some note-worthy project outcomes.

Keywords

consulting, statistics, education, non-profit, real-world applications

1. Introduction

Many graduates of college and university mathematics and statistics departments seek careers in applied fields, employing their analytical skills in business, finance, health, or numerous other industries. Oftentimes external internships are the only source of real-world experience for these students before embarking on their careers, and such opportunities can be difficult to come by (Ritter, Starbuck & Hogg). Faculty frequently apply their connections and resources to assist students in finding and obtaining these internships, but generally speaking, faculty often lack sufficient networking breadth and depth to provide help to more than the occasional student.

University business programs have seen the benefits of partnering with local businesses for hands-on projects in their courses (Allard & Straussman, n.d.; Heriot et al.; Grossman). Through these projects,

students gain direct business experience and knowledge applying their skills in real-world business applications, while faculty receive immediate feedback on the appropriateness of the skillsets of their students for their future careers.

Several mathematics and statistics programs have similarly created consulting offices (Hardin, Horton, & Jones). These are particularly prevalent at graduate programs, where students have gained additional valuable experience through managing the consulting program themselves (Jeske, Lesch, & Deng; Gunaratna, Johnson, & Stevens). Through these offices, more students are given the chance to work on real-world applications while receiving guidance from faculty. The benefits of these experiences for students and faculty alike have been well documented (Nolan et al.; Cohen). If funding is available, these can even be paid positions bearing similar weight as internships on resumes.

In the spring of 2019, the chair of the Mathematics Department at Bryant University, Rick Gorvett, received a small grant from the College of Arts and Sciences (CAS) to establish the Bryant University Statistical Consulting Office (BUSCO). The faculty involved had the following objectives in mind:

- Provide substantive pro-bono services for regional non-profit organizations

- Establish a consulting office to give credence to these services

- Build the office into a strong arm of our department, binding our statistical program and local businesses for years to come

The following paper outlines the ups and downs of implementing this idea, and reviews some of the benefits for the consulting "clients". We hope this paper also serves the purpose of guiding and inspiring other organizations to be established and to grow.

In particular, the challenges involved with obtaining funding, identifying and partnering with non-profits, and guiding students through a meaningful and purposeful consulting experience, will be discussed. We will also share some note-worthy project outcomes as inspiration for other collaborations.

2. Method

2.1 Obtaining Funding

While funding is certainly beneficial to the establishment of a consulting office, a department should not consider a lack of funding as a reason to post-pone. Everything that was accomplished in the first year of BUSCO's existence could have been accomplished without established financial resources, though funding certainly facilitated its creation.

In our case, the small amount of funding that we received was primarily used as a means to pay students an hourly wage for their work. The majority of our students that joined the organization expressed excitement to be involved with the work regardless of payment, but we felt that a paid position would lend more weight to the position on their future resumes, as well as encourage them to take their projects more seriously. The remaining funds were used to create materials for presenting the results of the projects at a local conference. The creation of a website is also currently underway.

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The initial funding of BUSCO came from a grant from the administration of the CAS at Bryant. In the spring of academic year 2019, the Mathematics Department was awarded $5000 to be used in an innovative way to help with the education of our students. This money had to be spent by June 30, 2019, end of the fiscal year. We formed BUSCO with the help of the controller. The students were able to submit their hours and be paid by the hourly rate that all students on campus were being paid for campus jobs. A nice benefit of this arrangement was that the headache of paying out the money was then handled by the controller's office, simplifying the process. Another unforeseen benefit came from the funding being available until the end of June that calendar year. We discovered that this allowed our students to continue working on their projects well after the rush of finals and prior to the start of their summer internships. They were very comfortable working from home, having zoom meetings with each other and the non-profits themselves, and were generally very productive during this time period.

Funding for the next academic calendar was complicated by the impact of the COVID-19 epidemic. To move away from a dependence on university grants, our future intention is to obtain exterior sponsorship through a collaboration with a for-profit organization. This could be an effective solution for any department looking for funds to support their students, particularly after demonstrating the effectiveness of a consulting office through some successful collaborations with non-profits.

2.2 Creating Collaborations

Critical to the establishment of a consulting office are a few immediate projects on which the students can begin working. We were able to leverage existing connections between faculty and non-profits in the area. However, this was not as straightforward of a process as we anticipated. Approximately fifteen organizations expressed initial interest after being contacted, and of those, four became collaborations.

Most organizations were intrigued by the offer of pro-bono statistical consulting. That said, many were unsure of what services we could possibly provide that would be of use to them. It became critical for us to provide diverse examples of projects and tasks that our students could perform:

- If they had data, we could help them organize, clean, and analyze it

- If they did not have much data, or if the data was not very robust, we could help them design databases that would be useful and show them how to develop good data collection techniques

- If they keep donor records, we could create profiles to help them be more targeted with future campaigns and advertising.

For many, our offer seemed too daunting; they viewed it as more work for themselves when they were already spread very thin. They knew that they needed this kind of help, but they simply did not know how to get started. This became a roadblock, especially if a collaboration meant taking people away from their jobs to work on these projects. If they did not have any collected data, they often did not want to go through the work of securing data.

Other organizations really thought the idea was worthwhile, but they simply could not sit down and get started with us. It was easy to continually put off our initial meeting, and we had a time constraint

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through the terms of our grant.

3. Results

3.1 Example Projects

Fortunately, several local non-profits were excited to work with our students. In this section we provide a few examples of projects on which our students collaborated in the spring of 2019. We believe that these can serve as inspiration for other organizations as they begin to establish their own relationships.

3.1.1 College Visions

College Visions is an organization located in Rhode Island that helps low income, first generation high school students prepare for college, apply to appropriate institutions, and find funding for tuition along with room and board. They also help these students find success at school by enrolling them in summer preparation classes or helping them with tutoring during the semester. One of our students already had familiarity with the organization, which allowed for our initial introduction.

Fortunately, College Visions had already been diligent in collecting and maintaining a large database with information about every student that participated in their program. Given an overwhelming amount of data about each student, they were interested in identifying what factors were most important in forecasting that student's ultimate success in a college setting. They wanted to build a predictive model that would extrapolate specific information and project whether a given student would be successful in completing an undergraduate degree. The intention was to then use this model as a method for signaling the need for earlier and targeted intervention.

A team of 3 students with supervision from their faculty adviser, Gao Niu, honed the large, but sparse database and down to a meaningful set of variables. From that meaningful set, they ran several types of predictive models. Using R and Python, they developed neural networks, decision trees, random forests, and regression equations. Analyzing all the models, they identified the most valuable predictive variables that should be used in any predictive model to project whether a student will be successful in completing an undergraduate degree.

In addition to the technical application, the consulting and professionalism experience are also critical to student's education. Classroom education mainly focuses on knowledge and skill comprehension. Any explanation or delivery of information are limited to classroom presentations, where the audience is their classmates. Throughout the consulting project, students treated College Vision as a client, provided explanations to those without same knowledge background. Their mindset changed from completing a homework assignment to defining and solving clients' problems. They learned that a real business problem is never as well-defined, as they typically experience with textbook problems. This was an invaluable experience, which a student-driven statistical consulting experience provides.

The complete presentation was a substantial piece of work. College Visions was very impressed with the developed models and is planning on implementing the results as they work with future cohorts.

3.1.2 Katie Brown Educational Program

A second non-profit was the Katie Brown Educational Program (KBEP). Created in the memory of Katie Brown, the victim of domestic violence, this organization was established to educate young men and women about healthy relationships. They have a series of workshops and programs that they host for local elementary, middle, and high schools. As part of their programs, they evaluate the impact on students' knowledge and understanding through surveys that are administered before and after each workshop, and consequently have a wealth of data for their use. However, members of KBEP primarily have training in education and relationship violence prevention—not data analytics. They had previously partnered with faculty at our university for assistance in analyzing the survey results. The analysis not only served as an evaluation of the effectiveness of their various workshops, but also provided means to quantify the organization's impact when approaching board members and donors.

The opportunity for help from BUSCO arose from KBEP's need to transition to a new statistical software for their analyses due to cost concerns. A pair of students were able to step in, with the help of their faculty adviser Son Nguyen, assess KBEP's analytics needs, and provide training on the use of R and Tableau. They put together R Markdown scripts that could easily be used to analyze survey results and provided instruction on how to do so. In addition to providing KBEP with training sessions to use open source statistical tools, the team also directly analyzed the data and gave them statistical reports for their uses. The KBEP was looking for some immediate help in understanding their yearly-updated data; these statistical reports filled that need. We are still in contact with KBEP as we work to develop more sophisticated analytics of their surveys providing greater and broader insight into their results.

3.1.3 Catholic Foundation of Rhode Island

The Rhode Island Catholic Foundation of the Diocese of Providence (CFRI) is an organization within the Catholic church of RI that regulates large grants to the diocese. They were approached through an affiliation with one of our faculty members, Kristin Kennedy. Initial conversations between faculty and members of CFRI revealed that they were not only very interested in a potential collaboration, but that they had some very complex ideas for potential projects. In particular, they were interested in a better understanding of donation trends in context of their organization, and in relation to other Catholic Foundations in the United States, in order to grow and improve their own assets and resources.

This project proved to be more of a valuable experience for our students than for the non-profit. Meetings with the director resulted in many initial probing questions about the data and about what the director was trying to accomplish. A team of four students worked to translate all this information into statistically-answerable questions, under the guidance of their faculty adviser, Alicia Lamere. Ultimately, attempts to answer these questions led to the realization by CFRI that there were inconsistencies in their database that needed to be addressed before more rigorous analysis of interest could be performed, which was beyond what they felt appropriate for our organization to take on, due to privacy concerns. For our students, it was eye-opening to the realities and associated challenges of working with real-world datasets that have not been collected or maintained with analysis in mind.

Furthermore, CFRI is currently in a transition mode at the organizational level. They do want to continue to work with us in the future, but they must establish the new organizational structure first.

3.2 Feedback from Non-Profits

Throughout our collaborations, our students were in regular contact with representatives from the organizations. As a result, we received regular feedback about our students' work and the organization's experience. When asked to reflect on their experience with BUSCO, we received very positive feedback:

"We are so grateful for this opportunity!"

"This is so interesting. I am excited to get a deeper understanding of the data set. I can already identify some flaws in how we are recording data."

"They [our students] are just fabulous. Thank you so much for this work."

In retrospect, the organizations easiest to approach were those that had previous experience employing interns or those that had collaborated with academics in the past, and therefore better understood the service that we could provide.

3.3 Student and Faculty Involvement

In total, we employed seven students as consultants in the first semester of BUSCO's existence, who were involved in varying numbers of projects. We allowed them to decide the amount of time they would dedicate each week, while advisers worked to outline clear expectations of progress. While this certainly led to some students being more involved than others, it allowed them each to participate as their demanding schedules would permit.

When asked to reflect on their experiences, our students had the following comments:

"It's a good experience to test your knowledge and apply what we've learned in class to real world applications"

"Working for a non-profit offers more incentive rather than just a class grade"

"Teaching someone else is very rewarding and helps to reinforce your own skills"

Most reiterated the fact that while they were very grateful for being paid for their work on these projects, they would have gladly participated simply for the experience. We believe part of this enthusiasm was the result of us allowing students to choose which projects they were involved with, thereby allowing them to be involved with a topic that had some interest in.

Justifiably, some may view the creation of a consulting office as a daunting task, but in our case, the burden on faculty in the creation of BUSCO was alleviated by the large number that chose to be involved at various stages. We were fortunate enough to be able to split the workload up, with some members taking on the task of applying for funding and reaching out to prospective non-profits, while others came on board as advisers once projects were established. One faculty member took the lead as the head of the office, and participated in both stages, but the involvement of other members of the department made BUSCO's creation a much more manageable task.

Beyond the chance to improve our students' potential career outcomes, there are other benefits for

faculty involved with consulting offices. Most colleges and universities should recognize such involvement as significant service. In many cases, there is also the possibility of potential publications if collaborators are comfortable with the use of their data for academic research. These datasets may also serve as case-studies in the classroom, again with proper permissions from the respective organization. Finally, when students interact with businesses and organizations in the local community, it establishes a bond that is healthy and an avenue to promote cooperation with the university and the community at large.

Table 1. Key Take-Aways from the Experiences of Non-Profits, Students, and Faculty from Their Involvement in BUSCO

	Key Take-Aways		
	Non-Profits	Students	Faculty
Immediate Benefits	Pro-bono services Evaluation of data collection Potential for actionable insights	Experience working with real data Gain insight into the operation of organizations Exposure to statistical applications in industry	Generate new avenues for research Viewed as important community outreach by the University Improved Faculty-Student relationship
Long Term Benefits	Talent Pipeline Publicity	Networking Opportunity Exposed to different NGO professionally, which helps with career selection	Gain industry and society insight Serve the public
Surprising Insights	Experience with interns/college students made collaboration more accessible	Paid positions weren't important Generally very excited for the opportunity	Inspiration for more meaningful in-class examples

4. Discussion

Overall BUSCO's first year was a productive experience for all involved. The University Relations Office appreciated the community outreach. The students were excited to work with the non-profits. Whether they finished their project with a completed analysis or not, they embraced the experience of working with real data sets and learning about how different organizations operate. The students

reflected that the money was not important, but the experience was enticing and motivating. For most, it also broadened their understanding of potential statistical applications in industry.

Critical to this success were semi-regular meetings in which students met, supervised by their adviser, with members of their non-profit to discuss questions and present results. This provided valuable experience translating ideas to and from the statistical concepts they learned in class and ensured that the work being done matched each organization's needs and expectations.

Please see Table 1 above for a breakdown of what we believe are the key take-aways of this experience for all parties involved.

College Visions plans to keep working with our students in the future, helping them design more useful databases and examining different ways to analyze them. Katie Brown wants to expand their survey work, and from the survey analysis data develop more meaningful educational programs. This is especially true due to the pandemic, with many young people spending more and more time at home, which is not necessarily a "safe" place for them. The CFRI has completed some work on its own, comparing its practices to practices at other foundations, and as mentioned above it is in the process of overhauling the organizational structure itself. Although our students hit roadblocks on the initial attempt to work with CFRI, the students' influence motivated the CFRI to move forward. They plan to work with us in the future on new projects as well. These initial successes should prove vital in demonstrating the value of our students' work as we approach new organizations for collaborations and funding.

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