

## STATISTICS IN PRACTICE: MAKING OF PROFESSIONAL STATISTICIANS IN A CLASSROOM

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*This paper discusses our classroom experience in teaching “Statistics in Practice” – a third year course conducted during a 15-week semester, where students learn actively by changing their role to be a reporter, a data integrator, a statistician, and a statistical consultant. As required for the course, the students prepared a newspaper article on the issue of graduate employability based on census data; they collated and prepared complicated data sets to be ready for analysis; they were consultants to a client solving their business problem related to lower revenues in retail sales; they helped conduct a large survey for the education sector. This novel learning approach created an elevated student-centered learning environment that paved the way for them to become professional statisticians.*

### BACKGROUND

Student Centered learning, as opposed to teacher centered learning, has been the focus in higher education for more than two decades where the student takes an active role in learning. Literature reveals that such an environment would focus on each student’s interest, learning ability and learning styles (Barr & Tagg, 1995). Moreover, over the past years, educators also have realized the need for a shift in assessment practices. In addition to focusing on content, the importance of assessing student performance too has been discussed (Gal and Ginsburg, 1994). The assessment in terms of observable outcomes that describe what a student is able to do after the learning experience is considered by educators to be of utmost importance (Huba & Freed, 2000). Literature reveals that such a learning environment will develop a student’s cognitive and motor skills as well.

Student Centered learning has been discussed for more than two decades in the context of Statistical teaching pedagogy as well. Garfield (1995), argues that educators need to understand how students learn statistics and complement their teaching by incorporating activities that are more geared towards statistical thinking and reasoning. Moore (1997) proposes a variety of such activities, including facilitating discussion among students, exposure to practical work, more importance to practice of essential techniques, and developing their problem-solving skills and, investigational work.

This Statistics in Practice course details how to create an elevated student learning environment allowing students to actively change their role to a professional statistician. The “elevated student learning environment” is created through different activities carried throughout in the Statistics in Practice course where students get an exposure, in a class room environment, in experiencing various skills a professional statistician must possess.

### COURSE STRUCTURE

The “Statistics in Practice” course (IS 3005) is a 15-week semester course offered at our institution that amounts to six hours of teacher student interaction time per week. This three-credit course is offered to third year students who have acquired a good background in Statistics during the first two years of their study programme. The course was co-taught by us and there were 34 students enrolled this semester. The major activities of this course were;

1. Preparing a Newspaper article based on a data analysis
2. A consultancy Project for Industry
3. Being an enumerator for a national survey
4. Group project on analyzing a dataset and presenting findings
5. Writing a review based on a seminar conducted by the two leading institutions responsible for national surveys and census in the country

6. Three in-class assignments
7. Participation in workshops on public speaking, facing interviews, CV/resume writing and presentation skills

Each of these activities mentioned above were reasonably paced during the semester and their timeline is given below. It is worth noting that the students worked on some activities concurrently. The assessment for the course was based completely on the deliverable on each of these activities. The students’ notional learning hours is estimated to be on average 15 hours per week.

| Activity                               | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 | Week 13 | Week 14 | Week 15 |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|
| 1. Newspaper article                   | █      |        |        |        |        |        |        |        |        |         |         |         |         |         |         |
| 2. Consultancy project                 |        |        |        |        |        |        |        |        |        |         |         |         |         |         |         |
| 3. Being an enumerator                 |        |        |        |        |        |        |        |        |        |         |         |         |         |         |         |
| 4. Data analysis                       |        |        |        |        |        |        |        |        |        |         |         |         |         |         |         |
| 5. Writing a review based on a seminar |        |        |        |        |        |        |        |        |        |         |         |         |         |         |         |
| 6. Three in-class assignments          |        |        |        |        |        |        |        |        |        |         |         |         |         |         |         |
| 7. Participation in workshops          |        |        |        |        |        |        |        |        |        |         |         |         |         |         |         |

Figure 1. Timeline of Activities

## LEARNING ACTIVITIES

### Activity 1: Preparing a Newspaper article

This activity was designed to enhance the student experience and knowledge in analyzing large messy datasets and improving their ability to communicate statistical findings to the general public. The dataset consisted of more than 45,000 records with over 70 variables of a census carried out on a variety of aspects on employability of Graduands in state universities in Sri Lanka. Information on areas such as, type of education, the family background, preferred employment, how soon they secured a job and the satisfaction of the current job they are in were the main focus in the dataset. The students were required to analyze the data to bring out a newsworthy story and write a newspaper article based on their findings.

The duration of this activity was three weeks and each student in the class had to prepare a write up individually. It was essential to clean the dataset prior to the analysis, and the students performed this task with our guidance. Then they were given one week to explore the data and come up with an interesting story on their own. Each of these stories were then discussed with the students to assess the plausibility of each story. They were given another week to submit the newspaper article along with the supporting statistical findings. This analysis and the newspaper article were assessed. This activity improved data management skills, analytical and writing skills of the students; skills that will be essential for them as professional statisticians. More importantly students developed the ability to transform their findings into a layman’s language through this activity.

### Activity 2: A consultancy Project for Industry

This activity was designed to familiarize the students to a statistical consulting environment. Through this activity, the entire process, of a typical client approaching a statistical consultancy firm until the delivery of the findings to the client was experienced by the students.

Here, the problem to be solved was explained at the first meeting by a leading private sector research-based organization (hereafter named as Clients) to the students (hereafter named as Consultants). Each team of consultants were formed with 4 to 5 students from the class. The project details were exchanged between the client and the consultants at the first meeting, where clarifications regarding the consultancy project were made. The first deliverable was a questionnaire that the client could use to collect data from users of a particular brand of shoes.

Next, a large complex dataset on the particular brand of shoes along with information of its competitor's coproducts were provided to the consultants by the client. During this time period, the consultants were encouraged to communicate with the client either in person or via email for further clarifications. A second meeting with each group separately was set up after three weeks for an interim Q&A session to discuss the process thus far, their approach and draft findings to the problem. Finally, each team of consultants presented their solutions to the client and also submitted a report of their findings. The assessment was based on the designed questionnaire, the preparedness at the interim Q&A session, presentation of the findings, and the final report.

#### *Activity 3: Being an enumerator for a national survey*

This activity was designed to provide the students an overall knowledge on how to conduct a national survey especially focusing on the aspect of data collection. Here the students took part in a large survey conducted by the University Grants commission in Sri Lanka. After receiving training on conducting telephone interviews, the students conducted phone interviews of past graduates from both the state sector and the private sector. The students were required to maintain a log of their activities and were given four weeks to complete the task. The purpose of introducing this activity was multi-fold. Here the students not only developed their communication skills but were also instilled with the value of proper data collection. The students also understood the importance of data integrity and confidentiality of data.

#### *Activity 4: Data Analysis and Report Writing*

This activity was designed to assimilate the knowledge acquired by the students in their previous statistics courses. The students were expected to incorporate statistical inferential methods such as regression, clustering, etc. into their analysis. Unlike in the other activities, formal report writing was emphasized in the task.

Here the students were given a large dataset with a large number of variables and were required to formulate objectives that could be solved via a suitable statistical analysis by themselves. The students worked in groups of three or four and the duration for this project was 5 weeks. The students submitted a report based on their findings and were required to defend their work at an oral examination. This activity developed their data management and data integration skills, enhanced their analytical skills, and improved their communications skills, team work and report writing skills.

### LEARNING OUTCOMES AND FEEDBACK

After the successful completion of this course, students were expected to be able to employ the complex process of problem-solving amassing various areas in the field of Statistics. Moreover, it was expected that the students will be able to formulate problems, improve on report writing and research skills, communication, personnel and business skills. These learning outcomes acquired by the students were described under each activity above separately.

The anonymously completed student feedback revealed many positives and a few negatives about the course. Most students valued the exposure to the industry and the real life statistical problems they had received through this course. They have stated that through the varied activities carried out, they have developed the skills they would require to be professional statisticians, once they graduate from the university. Receiving quick feedback on their assignments is said to have helped them to identify their weakness early in the course. On a more negative note, they revealed that this course consumed a lot of their time than they had anticipated. Even though the students had worked in groups on the consultancy project, they seemed have been overwhelmed with the tasks assigned and strict deadlines they had to meet as well.

The industry personnel who had the opportunity to evaluate the students were impressed with their maturity in particular with their problem solving and presentation skills. Possibly due the procrastination of assigned work and/or their lack of confidence, the students had failed to contact their client if and when they needed clarification. The industry personnel were of the view

that this late communication of the students could be the reason why the students felt overwhelmed in meeting deadlines of the project. The industry personnel also stated that they would be pleased to consider some these students for a six-month industry placement in their final semester of their degree programme and even provide employment opportunities in their company, after graduation.

## CONCLUSION

The majority of the students who follow this course would be graduating in a years' time. Since today's employers want graduates who can hit the ground running as soon as they are hired, giving the students an edge in this highly competitive current job market is very important. This course was brought about to help students meet these employer expectations by preparing them for the road ahead of them after graduating.

This Statistics in Practice course will create an elevated student learning environment in a class room. We have reasoned that the students will develop data management and data integration skills, enhance analytical thinking, improve team work, communication skills, article and report writing skills, gain real world statistical consultancy experience, become efficient in brain storming problems and improve their problems solving skills, through the activities carried out in this course.

Our desire is that this newly designed course will provide a new student-centered environment that will help students to gain the experience of being a professional statistician in a class room environment. The student feedback information and the industry feedback have justified the importance of incorporating such a module into the course curriculum.

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