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Dept. of Statistics,  
Uppsala University,

Thommy Johan Anders  
Perlinger

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**[FINAL REPORT  
EXCELLENCE IN TEACHING]**

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## **Introductory remark**

The stay at Nanyang Technological University (NTU) in Singapore 2014 was our second try. I was a STINT Fellow in Singapore already in 2013, but due to illness in the family we had to cancel the stay after one month. My family and I would hereby like to extend a very big thank you to STINT, Uppsala University, and NTU for that we just one year later were able to resume and finish the assignment.

## **Preparation and planning**

### **Planning trip April 2013**

The planning trip was essential for the upcoming stay. During this reconnaissance week we had the opportunity to get acquainted with the country, the city, the university and the host institution. We were also able to sort out all practical details like visas, housing, and schools for the children. Most importantly, I was able to bring order to and grasp my teaching assignment for the upcoming stay. Since I was a Stint Fellow in 2013, the planning trip took place in April 2013.

The first day was very well planned and filled with activities. It began with a meeting with Prof Er Meng Hwa, Vice President of International Affairs who gave a very detailed presentation of NTU, its history, and visions for the future. The second part of the morning was a meeting with representatives from my host institution, the Division of Mathematics (MAS) at the School of Physical and Mathematical Sciences (SPMS). At the meeting there was the Head of Department Prof Wang Huaxiong and my two contacts at MAS, Prof Andrew Kricker and Prof. Edith Elkind. When we discussed my upcoming assignment, it became apparent that it was not entirely clear which course I should be involved in, but it seemed as if it would either be a course in Game Theory or a course in Calculus. Nothing I had expected but I started preparing for it.

The afternoon was devoted to practical matters. We began by visiting the newly renovated apartment in which we were to live in during our stay. The housing situation was arranged by NTU. The University has Staff Housing with spacious apartments at subsidized rent. Private accommodation outside the campus is hardly possible to solve in Singapore without contacts. The day ended with a visit to a local preschool (Ichiban Montessori) just off campus. We had been recommended this preschool by Ulf Ellervik who was a STINT Fellow at NTU 2012.

The next day began with a tour of the campus and a presentation of the work done in terms of e-learning. The rest of the day was dedicated to the visa application process. This is a somewhat lengthy procedure but it was simplified (or made possible) thanks to Ms. Fern Yeo who is a manager at the Office of International Affairs at NTU. Ms Fern Yeo has been my administrative contact at NTU and she made my life there, from a practical matters point of view, a lot easier. I owe a lot of gratitude to her.

The third and the fourth day were all about the teaching assignment. To get a feel for how teaching is conducted at MAS, I participated in both a lecture and a tutorial session for one of

the potential courses. During the fourth day it turned out that the teacher of the introductory course in probability theory had just resigned which opened for me to be in charge of that course. The course is completely in line with what I usually teach so I stood very positive about the change of plans. Together with representatives from the department, we decided that it was this course I would be responsible for during my stay at NTU.

### **Summer 2013**

It turned out that the probability theory course was a bit of a problem child where it had basically been a new instructor every year. This lack of continuity meant that there was not any proper order on the course and the course material. I could not really use the material I was given access to so I had to do basically everything from scratch. I spent much of the summer of 2013 structuring the course and preparing PowerPoint presentations.

### **Singapore August 2013**

Our month-long stay in 2013 may in retrospect be seen as a second planning trip. I managed to get acquainted with the teaching and administration of the course, I got into practical matters at the department, and I got acquainted with the surroundings. I worked intensively during this time and managed to complete much of the material that was meant for the course.

### **Some practical issues**

The visa procedure is a rather expensive and time consuming process. If you are a family with two adults and two children you will need one Employment Pass and three Dependent Passes which costs S\$970 (or approximately 6 000 SEK) in total.

A visiting family with children would usually prefer an international school for their children, but we had to choose a local preschool (Ichiban Montessori) because international schools have extremely high fees which does not make this possible. Employees at NTU often have agreements with the University that allows them to put their children in international schools where about 70% of the fee is paid by the University.

When staying for a longer time in South East Asia you are recommended to be vaccinated against Japanese encephalitis, which costs 2 000 SEK per person, that is a total of 8 000 SEK for a family of four.

The apartment offered by NTU is spacious and furnished but the kitchen is sparsely equipped. This problem is however easily solved by a few visits to one of the two IKEA stores available in Singapore.

### **Tasks and responsibilities**

I have held a position as Visiting Professor at NTU. My responsibilities have been to be the course coordinator and instructor for the course MH2500 Probability and Introduction to Statistics. This is a course with a large student group of about 350 students which means that the administration of the course is substantial. As instructor, I have been responsible for all of the course lectures and also for the tutorial sessions for one of the fourteen tutorial groups. So

besides constructing the PowerPoint presentations for the lectures, I have constructed all supplementary material as, for example, exercises and solutions for the tutorial sessions and a collection of formulas. Furthermore, I have constructed and administered all examination in the form of Quizzes, Midterm Exam and Final Exam. As course director, I have also had overall responsibility for the course, which includes most of the course administration and contacts with students. It was also my responsibility to administer the course website in NTU Learn which is the Blackboard-based learning management system used at NTU.

## **Activities during the semester**

### **Teaching and administration of MH2500**

#### **General information about MH2500**

MH2500 is basically a first course in probability theory for second-year students of mathematics. It is designed to provide students with the necessary knowledge and tools to be able to tackle the course MH3500 which is the introductory statistics course given the semester after. MH2500 is a “big” course seen both to the number of students and to the course content. The pace is fast and the mathematical content is advanced considering the fact that it is an introductory course in probability theory.

#### **Teaching**

The teaching period of the semester is 13 weeks divided in two parts separated by a recess week after 7 weeks of teaching. Every week there are 3 hours of lectures and a 1 hour tutorial session. This means that during the course I had 39 hours of lectures and 12 tutorial sessions. These tutorials are given in small groups of about 25 students, and since there were 350 students registered for the course, it was no less than 14 such tutorial groups.

Due to the large number of students, all lectures took place in a big auditorium. Furthermore, as instructor you are assumed to use PowerPoint (or similar software). None of this, however, is new to me because back home in Uppsala I am used to large auditorium lectures and these lectures are usually PowerPoint-based. What I am not used to is the fact that all lectures are recorded. Just minutes after a lecture ends, students can download it in a neat and professional package on the course website in NTU Learn. There are clear benefits with recorded lectures but also some pitfalls that must be avoided. More about this later.

All tutorial sessions are one hour (or 50 minutes) long which means that they easily become a little too fast-paced as it usually is (too) much material to go through. These sessions are not recorded and the traditional blackboards are used. There are different teaching styles used in these tutorials and I employed the one where the instructor does all the writing on the blackboard but where it is the students, as a group, who have to come up with the solutions as the instructor pose questions at well-chosen times. One-hour tutorial sessions is not a concept I will introduce in my courses back home in Uppsala.

Furthermore, we were eight teachers responsible for the 14 tutorial groups and as the head instructor it was my responsibility to ensure that they did the job they were instructed to do.

As was mentioned above, I was as course coordinator also responsible for creating all the course material such as tutorial problems with solutions and a collection of formulas.

### **Administration**

A big course always means a lot of administration and as course coordinator this was my job. To administer a course homepage can be quite a chore when everything has to be done from scratch. The contact with students is rewarding but time consuming, and a lot of time was spent talking, chatting, or mailing with students.

The final exam is administered centrally, but all other parts of the examination are handled entirely by the course coordinator. Especially the midterm exam, which in format and administration is very similar to the final exam, demanded a lot of work.

When the preliminary grading is done there is a final assessment of the students. A part of this assessment is done automatically by computer software but it is up to the course coordinator to find the appropriate cut-off points. As the final step, the course coordinator must be able to motivate this assessment to the head of the department.

### **Other teaching/pedagogical activities**

I have visited a couple of lectures in courses where the instructor had received good student evaluations. As course coordinator of a big course you have contact with a lot of other teachers, from PhD students to more seasoned lecturers and professors. I have had a lot of interesting pedagogical discussions with many of these teachers.

### **Other academic activities**

Since I was just visiting staff, I have not participated in any other academic activities at the department. In retrospect, this is something that I should have shown more interest in.

### **Important lessons**

The most important lesson is the experience with recorded lectures whose advantages and shortcomings have given me ideas on how this can be used at home. I am convinced that this, combined with tests on the concept of “the flipped classroom”, will develop into something very positive and useful.

As a course coordinator, I have been given very useful insights into how the administration works on a foreign (Asian) university. Especially the experience to be involved in the entire examination process has been very rewarding.

I have now a better understanding of the culture and higher education in Southeast Asia which in my new role as director of studies at the master's programme at the Department of Statistics in Uppsala will help me because we are continuously recruiting master's students from this region (particularly China).

To teach in English is always useful. Although most courses we offer at the Department of Statistics in Uppsala are taught in English, the introductory courses are still taught in Swedish. As the new director of studies at the master's programme, I will most likely be

involved in teaching some of those courses so from that point of view this semester has been a perfect in practicing my English teaching skills.

## **Comparison between the foreign and the home institutions (in Sweden)**

This comparison is in the general sense between Nanyang Technological University (NTU) and Uppsala University but also between NTU and National University of Singapore (NUS), the other major university in Singapore. Also, more specifically, there is a comparison between the Division of Mathematics (MAS) within the School of Physical and Mathematical Sciences (SPMS) at NTU and the Department of Statistics at Uppsala University.

### **Student population**

NTU is, with its about 30 000 students, similar in size to both Uppsala University and NUS. It is also similar to Uppsala University when it comes to University Rankings and even though NUS is rated higher, NTU is one of the fastest rising universities in the world when it comes to University Rankings.

About two thirds of the undergraduate students are from Singapore and most of the remaining students are from other surrounding countries in South-East Asia, mainly China. There are also some exchange students from other countries, e.g. USA and Australia.

In the past NTU have not gotten many of the strongest students in Singapore because NUS is much more famous. But NTU has been improving rapidly and now gets a much larger share of the top 15% students – approximately the same as NUS. The international students are typically scholarship students from the region (China and South-East Asia) and are usually much stronger than most of the locals. They usually have 3 or 6 year bonds after graduating – they have to work for a Singaporean company for that time.

From a mathematics point of view, a direct comparison of the students at MAS and the students at my home institution would not be fair due to the fact that the Department of Statistics at Uppsala University is a part of the Faculty of Social Sciences. The students at MAS are students of mathematics whereas the mathematical background of the students registered in the introductory course in Uppsala in general is quite weak.

Most students in Uppsala are hard-working, but my impression is that the students at NTU are even more so. The students at MAS are highly motivated, mathematically well equipped, and study very hard. It was a pure pleasure to be the instructor for these students.

### **The relation between research and education**

Students have many opportunities to do research with faculty, at every stage of their education. This includes both the regular semester and vacation. The university encourages as much research as possible in the student experience. The flagship programme is called “URECA” (Undergraduate Research Experience on Campus). In this programme the top students are invited to browse a list of several hundreds of project proposals from many different schools (not necessarily their own) and look for a project that matches their interest.



Research is a high priority in recruiting faculty. At NTU they typically create higher level or graduate courses to give such faculty a chance to teach these “hot” topics as self-contained courses to students.

Several of the university’s flagship scholarship programmes have a strong emphasis on research. Two to mention are the “Renaissance Engineering” programme and the “C N Yang Scholars” programme.

### **The relation between teacher and student**

When meeting students one by one they are very polite, but at the same time it is almost impossible to make them calm down in the lecture hall. I found it very annoying, and a sign of lack of respect, but it might just be a cultural difference that you have to accept.

It is difficult to have meaningful discussions during the tutorial sessions. This can be due to cultural differences but is probably more due to the linguistic concerns because a large portion of the students come from China.

It is common with Office Hours but I often made appointments with students outside these scheduled times which apparently is not so common. My impression is that Singaporean, or more generally Asian, teachers tend to be very conservative in their contact with students and in some cases unwilling to answer students' questions outside the schedule.

### **The institution’s view of breadth versus specialization in education**

MAS is moving from a traditional culture of specialization towards a culture with a much stronger emphasis on breadth. For example “Interdisciplinarity” is currently a very important word in the university, and its importance will only increase. There is, for example, a graduate programme set up recently which is specifically for interdisciplinary graduate students.

There are two components of the undergraduate curriculum that permit and force breadth onto students: the GER component (General Education Requirement) and the UE component (Unrestricted Elective). Every student at NTU does a certain amount of GER courses. These courses are common courses taught to students from any school. The other broadening component is the UE. These are courses students can choose completely freely from any school in the university, if they have the prerequisites.

### **Competence development for teachers**

At NTU, the Centre for Excellence in Learning and Teaching (CELT) offers a lot of courses for teachers. The division occasionally hires outside experts to mentor poor teachers. This involves attending their lectures and tutorial sessions.

### **Teacher recruitment**

A few years ago NTU struggled with a poor reputation for its teachers. There were even some letters to the editor of the largest Singapore newspaper, The Straits Times, complaining about the teaching.



To improve this state of affairs the university started putting much more emphasis on teaching in recruitment, promotion, and tenure.

During recruitment, every potential hire must give a sample lecture to a class full of undergraduate students. After the lecture the students write feedback and give grades to the candidate. The response of the students is taken very seriously in the hiring process. Poor feedback can definitely kill a candidate's case.

Also, because teaching is taken so seriously now during the tenure process it becomes much more important during recruitment to find someone who the division thinks has good enough teaching skills to have a chance to make it to tenure.

### **Pedagogy and its importance**

The academic study of teaching and its impact on actual teaching is becoming increasingly important at NTU. The centre of this is the CELT. They arrange many courses and seminars to pass some of this theory onto faculty.

There is good financial support for pedagogical initiatives. There is something called an "EdEx grant" (Education excellence grant). These are grants of up to S\$30 000 to try support educational projects based on some interesting idea about teaching. There is some pressure when applying for these grants to show that the project is informed by the pedagogical literature.

### **The status of pedagogical merits compared to research merits**

At NTU research and teaching are granted equal weight when it comes to tenure cases. Teaching is definitely crucial. There are many cases where poor teaching has killed the career, even for very strong researchers.

Teaching is assessed in three different ways during the tenure process:

- The formal student feedback on the courses the faculty has taught.
- The teaching portfolio – faculty present their teaching materials and discuss their teaching methods and philosophy, and its relation to pedagogy.
- Peer review – a senior faculty member will actually attend some of their lectures and write reports.

### **Curriculum and courses offered**

MAS offers an extensive list of mathematics and statistics courses. For a list of courses please see <http://www.spms.ntu.edu.sg/mas/undergraduates/MASUndergradModules.html>.

### **Forms of examination**

The course MH2500, like most courses at NTU, assesses the students by using a weighted average of quizzes, a midterm exam, and a final exam. The weights can differ and the weights used in MH2500 were quizzes 15%, Midterm 25%, and Final 60%.

## **To what extent educational programs conform to labour market needs**

Labour market needs were and are a very important motivation for the structure of the programmes at MAS. This is why most programmes at MAS are not traditional theoretical mathematics programmes.

Some examples of very popular programmes at MAS include:

- Mathematics and Economics.
- Mathematics with a minor in finance.
- The business analytics track.

These programmes specifically target certain careers, such as in Singapore's Banking and Finance sector. For example the introduction of the Business Analytics track was specifically in response to a government decision to prioritize the Data and Analytics sector.

MAS also has a much stronger emphasis on topics like programming and computation than is normal in a mathematics department. This is in part to equip graduates with skills for the labour market.

It is worth mentioning that the university has introduced a number of GER courses such as Absolute Basic for Career and Career Power Up to assist in general preparation for the workforce. Also worth noting is that a number of these GER courses are targeted to labour force preparation, such as the courses on communication and entrepreneurship.

## **Use of technology**

Over the past decade there have been a few tentative steps in the direction of e-learning. For example, since 2006 every semester has had something called an "e-learning week" where every faculty was supposed to conduct the week's lectures entirely online. Another example is our first year GER course MH8300 It's a discreetly discrete world, which three years ago was turned into a flipped model for the class of 400 students. This is a model where the lectures are recorded online by a team of faculty, but where the tutorials are held live, in the usual way.

There have also been a few MOOCs created by the school. One which has been extremely popular was created by the Department of Chemistry on the topic of Forensic Chemistry.

But in the last few years this tentative exploration has turned into a massive priority for the university. In fact there is approximately \$100 million Singapore dollars which the university has budgeted for these initiatives. The new key phrase is "Technologically-enabled learning". The school has actually committed to having 25 technologically enabled courses running within the next year. Furthermore, the school is building a recording studio where faculty can record online lectures.

## **Distance education**

Distance education is not used at MAS to any large extent. However, NTU has a well functioning system for distance education. One reason for this is the outbreak of avian influenza in 2004. The instructors are supposed to prepare the material in such way that all lectures can be given as distance education, and since all lectures are recorded, there are good

opportunities to quickly get going with this. Also, as was mentioned above, each semester there is an e-learning week.

## **Action plan – topics to address and if possible introduce in Sweden**

### **Personally**

As was previously mentioned, the experience with recorded lectures has given me ideas on how to implement this back home in Uppsala. However, I have realized that recorded lectures have to be implemented with care because there is an apparent risk that students consider them as an alternative rather than a complement to the actual lecture. If it is to be done properly, it should not be recorded lectures in the traditional sense but rather recorded modules that are made especially for the purpose of web lectures. This in combination with “the flipped classroom” which is a concept we have just started to look at might develop into something very positive and useful.

### **For the department**

The work on recorded web lecture modules in the spirit of the flipped classroom is of course something that affects the entire department, especially if it turns out to be successful.

Also, I will have a seminar where I will talk about my experiences and really push the other teachers to apply to the Teaching Sabbatical program (and other similar programs) to go to a foreign university and develop and widen their pedagogical skills.

I was very impressed by the entire examination procedure used at NTU for the Final Exam. I will look into the possibilities to adapt some of these concepts back home.

### **In the Swedish research and education system**

If I will get the chance to discuss my experiences of the Excellence in Teaching program at conferences and seminars outside Uppsala I will definitely promote it. It is important that teachers, and not only researchers, get the opportunity to experience new academic environments.