Nick Ovenden
Faculteit Wiskunde en Informatica
Technische Universiteit Eindhoven
Postbus 513, 5600 MB Eindhoven
n.c.ovenden@tue.nl

Experiences at SWI 2002

How to grow a mathematical model

In de week van 18 februari vond in Amsterdam de Studiegroep Wiskunde met de Industrie plaats. Zestig wiskundigen kwamen bijeen om in groepsverband een aantal problemen op te lossen die door verschillende bedrijven werden aangedragen. De studiegroep is een initiatief van de Stichting Wiskunde Toegepast (STW) en is dit jaar georganiseerd door het Centrum voor Wiskunde en Informatica en de Universiteit van Amsterdam. In 2003, van 17 tot en met 21 februari, zal de Studiegroep Wiskunde met de Industrie in het Lorentz centrum in Leiden plaatsvinden. Nick Ovenden uit Londen was een van de deelnemers aan de studiegroep in Amsterdam. Hij behaalde zijn PhD aan het University College London op een onderwerp in de stromingsleer en werkt nu aan de Technische Universiteit van Eindhoven als post-doc aan een Europees project om de geluidsproductie van vliegtuigen te verminderen. Hij vertelt over zijn persoonlijke ervaringen in de Studiegroep.

Throughout my life I have often bought roses for various reasons. Usually, the reason is to express love to the current object of my affections. Occasionally, I have bought roses to apologise or sympathise. But never have I bought them to calculate the leaf area per unit height or to determine the age distributions of the leaves. Has the way I live my life really changed since my attendance at the 42nd European Study Group with Industry in Amsterdam in February?

The first ever study group with industry was set up in Oxford in 1968 and the concept is simple to explain. A small group of industrialists each present a "real-world" problem to a throng of mathematicians eager to extract the relevant parts and transform the real world into something that can be written on a side or two of A4 paper. Whilst the outcome of a study group can be and is, more often than not, unpredictable, the closeness of the encounter between real world and mathematical model clearly delivers benefits to both sides. From one viewpoint, the study group acts as an excellent advertisement for applied mathematics to the wider community; how else would any of us get on Dutch children's television! However, the close interaction with industry additionally reminds mathematicians that some assumptions and simplifications, so easily made from the safe haven of their mathematics departments, are not always representative of what is actually going on. As an added bonus, the study group can lead to future collaboration and even new avenues of research, both being excellent incentives for anyone.

Introductory talks

On the first day at the University of Amsterdam, the industrialists were invited to give introductory talks about their respective problems. During the sessions we learned about: overheated fish in Amsterdam Zoo, lossless 1-bit data compression on a CD, diffusion of Eurocoins across the EU, growing roses in a greenhouse, placing components on chips with holes and, finally, determining past sea temperatures from the fossilised remnants of long-dead plankton. Well, no one could complain about lack of variety but that did not make the choice easy. I was clearly no expert in compressing data or electronics, every plant I had ever looked after had died and I wasn't entirely sure how compassionate I felt for the tropical fish.

In my opinion, the choice of which problem you decide to attempt is a very difficult, but unfortunately, a very important one to be made carefully. Of course, no one is forcing you to stay in one group and it is perfectly possible to wander around all of them during the week. However, the wandering strategy seemed an unprofitable exercise to me because, being a young researcher without a huge wealth of experience, I knew that I would need some time to get into a problem. I also imagined that wandering in on a group asking questions, making some sharp criticisms and then leaving might appear somewhat annoying to the more committed participants if I was not careful. In the end, it took me until the following morning to finally decide which problem to tack-

le, and the rose growing problem seemed to be a perfect 'study-group' problem for a variety of reasons. What I liked most about the rose problem was that the industrialist, Dick van der Sar, was a biologist and non-mathematician who has models but finds them difficult to apply directly to his situation. I envisaged that, in three days, it would be feasible to extract the relevant information from him and, by applying some realistic assumptions, create a simple model of the greenhouse. Certainly, it worried me whether such a task would be achievable for other problems, where the industrialist has a strong grasp of mathematics and where the problem has been around for decades. For this reason, perhaps problems that seem initially well-posed and set in mathematical terminology will actually turn out to be the hardest to solve. Indeed, unless you are an expert already or have some flash of inspiration, it is unlikely that you will perform better in three days than the countless people who have been struggling with such problems for years!

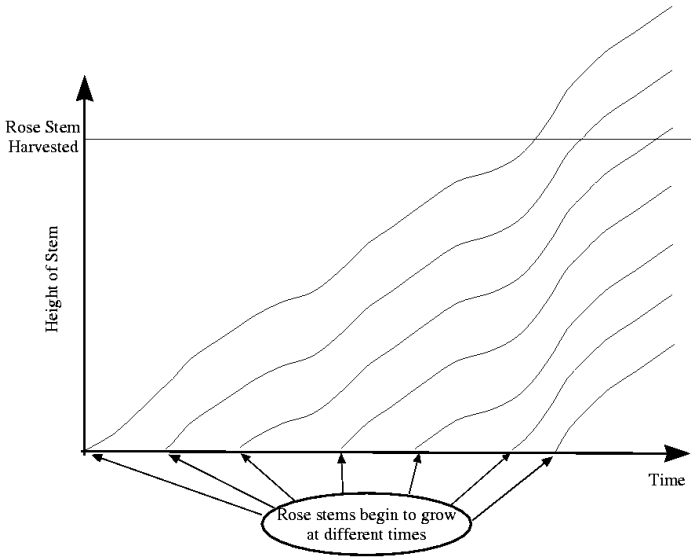
The rose model

Looking back, the three days I spent in a group developing the rose model were a fascinating time for me. The first two days defined the perfect love-hate relationship formed when a mathematician has too close an encounter with the real world. The conflict manifests itself as a tug-of-war, a push and pull, where assumptions are made and then broken by being unable to escape from the reality of the problem. For most biological systems, it is very difficult to find two variables that are truly independent. However, in every circumstance some dependencies are stronger than others and discovering these in a greenhouse full of roses proved to be challenging indeed.

Despite the initial difficulties, our group quickly settled into a very effective working strategy where no one assumed leadership and the work was planned democratically. This completely flat hierarchical structure of our group was a pleasant surprise for myself, and something I viewed as a typical Dutch trait, not always so easily adopted by other cultures. Major decisions were normally taken by the entire group prior to splitting into smaller units to investigate specific problems. These small groups would rarely last more than an hour or so before returning to a full group meeting. The frequent full-group discussions were required to make steady progress, especially as we had begun the project lacking any clearly defined goals. This situation I can only describe as similar to driving through thick fog, necessitating repeated corrections to our course to prevent the group from straying down the wrong path.

foto: Dick van der Sar

The roses study group: seated from left to right: Georg Prokert, Derk Pik, Bas van 't Hof, Onno Bokhove, standing from left to right: Philipp Getto, Nick Ovenden, Vivi Rottschäfer, Johan Dubbeldam.



Rose stems grow by roughly the same amount in the same climatic conditions. However, roses are in fact unselfish and the increase in biomass is shared equally throughout the entire rose bush.

On Wednesday afternoon, during a coffee break, the group reached something of a low point. With time rapidly running out, many of us were fearful whether we would have anything to present on Friday. In hindsight, our situation was not so depressing as a significant observation had just been made that would simplify the model greatly. One issue that had been nagging some of us was a graph of the heights of different rose stems over time (see sketch). What appeared strange was that all the stems grew by roughly the same amount in the same climatic conditions. But surely, taller roses with more leaves would photosynthesise more and grow faster? However, as we discovered from Dick, roses are in fact unselfish and the increase in biomass is shared equally throughout the entire rose bush. This observation formed a major basis for our model.

After the coffee break, a complete change of gear took place and a very intense two hours passed. Some of us thrashed out components of the model on the board, whilst others began to analyse real data and write the software for the model as details were finalised. All of us continued working into the evening and by the next day a skeletal outline of our model was produced, and even documented using LaTeX. We now knew where the flaws were and a small group of us went back to a heated debate on the blackboard. Two details remained, how to determine the age distribution of the leaves and how the part of the rose bush that is not harvested affects the photosynthetic production. These last points were finally hammered out just as the clock reached 3pm. With only three hours to go, the model was finished.

Presentation

A last fond memory of mine was writing the presentation, which was also done collectively. We would sketch each slide on the board, argue, people would grab a chalk and start changing things, and within a couple of hours the entire talk was complete! On Friday, the presentation went smoothly and I felt very proud of our accomplishments.

To conclude, the Dutch have taken the concept of study groups and made it into their own successful venture. I would like to thank particularly the organisers and the members of my group for making the week such an enjoyable and valuable experience. So, can anyone tell me how to register for next year's in Leiden?