Math matters

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If math matters, why don't we see more of it?

I was prompted to write this column by previous articles in the **Math matters** series. While there is a love of mathematics expressed in these articles — something I share — my role as a mathematician and statistician working as a consultant gives me a rather different view of both the problems and the solutions.[1]

While many mathematicians comment upon the apparent decline in mathematics in Australia, I strongly disagree with the assertion by several that the problem is completely external — simply one of insufficient funding or support. We, mathematicians representing our discipline, have to look to how we can do things better. That is what I would like to address here.

Firstly, a few words on my background. After a typical start to an academic career of eight years in teaching and research positions, I left the University of Western Australia in 1983 to join a venture in statistical and mathematical consulting, Siromath. This was an idealistic attempt by statisticians in the CSIRO to get involved with industry and business in a thoroughly commercial manner. It was an exciting time. Low cost computing — only $250,000 for a MicroVAX computer to be shared across the company — and reasonable statistical software meant that for the first time statisticians could get their hands dirty with real data. Siromath grew to around 35 staff by the time I left it in 1987. In 1988, I set up my own company, Data Analysis Australia. Initially I worked at home wishing that I had a client, but now Data Analysis Australia has a staff of 21, of whom most are graduates in various mathematical sciences.

Opportunities and failings

The mathematical community has failed to capitalise on the enormous interest in mathematics displayed by young people. The competitions and enrichment activities organised by the Australian Mathematics Trust have incredibly wide participation and I continue to be amazed by the enthusiasm of secondary mathematics teachers. In one sense, mathematics is an ideal challenge for young people — its abstraction means that otherwise immature minds can excel.

What happens to these young people when they go to university? Often they choose non-mathematical courses such as medicine or law because that is where the money is. Many want to keep their mathematics, but think that the only practical way of doing that and having a job at the end is to do a course such as engineering. Relatively few graduate majoring in mathematics.

Hence over a period of a few years, many talented young people are lost to mathematics. It is appropriate to ask why this is so, especially since it might be corrected.

University mathematics and wider mathematics

The major challenge for the mathematical community in Australia is to broaden its base beyond universities.

[1] When I offered to write this article and I commented that it was about time that one was written by a mathematician not in academia, the editors' very sensible reply was that most of the readership of the *Gazette* was in academia.

Almost all universities in Australia are under financial pressure and this creates problems for all disciplines. Many of the problems of funding that have been mentioned in **Math matters** are generic to universities and affect a range of disciplines, from ancient history through to physics. Each of these disciplines sees itself as important but under threat from lack of funding and lack of students. Unless our arguments detail issues genuinely specific to mathematics, they will be largely ignored as no more than self-interest.

The academic disciplines that *have* flourished are largely those that have created an image of relevance. These include business studies, biomedical disciplines and information technology. They attract students, grants and publicity. The important question is: why have these disciplines created this perception and why has mathematics not done so? A major factor is that mathematics has not established itself as a profession outside of universities.

A good profession against which mathematics can be compared is engineering, a subject that could almost be described as "very applied mathematics". Engineers in society are called by that name — engineers. Job advertisements ask for engineers. There are faculties of engineering at universities, with degrees in engineering accredited by Engineers Australia. Not surprisingly, secondary school students making decisions about what to study can readily imagine themselves becoming engineers.

The engineering faculties, with the assistance of Engineers Australia, reinforce this. Courses include compulsory units that might have the name "the profession of engineering" and cover the wider aspects of working as an engineer, often taught with lecturers from industry. Work experience is a critical requirement in obtaining a degree. Perhaps most importantly, every engineering graduate can call himself or herself an engineer.

The message given by the mathematical community is unconvincing when compared with this. Only a small proportion of mathematicians in industry or government have the term mathematician or statistician in their job title. Even the Australian Bureau of Statistics does not call most of its statisticians by that title! Saying that mathematics training opens up opportunities even though the job descriptions and job title don't mention mathematics may be true but it requires some faith to accept it.

The Society's own material has reinforced this. I recall a careers brochure that gave case studies of young mathematicians beginning their careers to illustrate jobs in mathematics, with two thirds of the case studies being young people doing further studies in mathematics. Even the Society's guidelines for accreditation link the requirements to academic employment levels. The Society has sometimes seen the loss of academics to industry as a problem for mathematics. Surely this should be seen as a positive, reflecting the high value industry places on mathematics.

How separate are the mathematical sciences?

Mathematics has been often split between three sub-disciplines — pure, applied and statistics — and some commentators have suggested that the consolidation into single departments is a sign that the discipline is under pressure. I take a very different view. If you regard mathematics as a means of solving real world problems (as I must in my consulting role), you are not concerned with which traditional area of mathematics the solution comes from. In many cases several areas of mathematics are required for a solution. Single departments reflect this reality.

Most of my company's work is statistical, but the boundaries between areas of mathematics disappear when solving real problems. For example, in designing a data collection strategy, combinatorial concepts of

designs are used. Forecasting demand for services is often the first step in a planning process and the next step is some form of optimization. Analysing environmental stream flow data needs some level of thought about the dynamics. Providing a complete service must not be limited by artificial boundaries, especially when the boundaries are not meaningful to our clients.

One effect of these artificial divisions is that we fail to give a coherent message to the wider community and to potential students. This leads to:

- a multiplicity of professional groups that don't always work together;
- a very weak umbrella body, the Australian Mathematical Sciences Council, that very few people relate to;
- some statisticians saying that statistics is not part of mathematics; and
- (what marketers refer to as) a weak or non-existent brand image.

It is not surprising then that we have trouble defending ourselves from the encroachment of other professional groups. If we do not define ourselves we cannot defend ourselves. It is our mathematical background that distinguishes us from other professional groups such as psychologists who often claim some ability in statistics. Our mathematical training and experience results in a different way of thinking, a clear differentiation in the commercial marketplace.

The importance of marketing

I am an applier of mathematics, an employer of mathematicians and perhaps most importantly, a marketer of mathematics. Every month my company Data Analysis Australia needs to invoice between $150,000 and $250,000 of work to keep afloat. This can only be done by ongoing marketing. Marketing is an essential activity in doing business.

I see little difference between business and other areas of mathematical enterprise. In my business if I do not have enough customers, it is my responsibility to find more, adapting my services as appropriate. Similarly if mathematical departments in universities do not have enough students, it is their responsibility to find them. It takes effort but it is part of the job. It is hard to have much sympathy for those who argue that they should not be expected to be so involved.

I also need to market the type of career that Data Analysis Australia offers to potential employees and, indirectly, I need to market mathematics to students who will form a pool of potential employees several years later. In Western Australia, Data Analysis Australia has for many years sponsored the Young Statisticians' Workshop, targeting a range of students and young professionals but especially students in their second and third years when they are making critical educational decisions.

Summary

For this article, the starting point was comments in **Math matters** that mathematics was being treated unfairly. I claim that this is our responsibility. The government and the university systems might both be imperfect but they do try to direct resources to what they view as important. If mathematics is missing out, it is because mathematics is not seen as sufficiently important. That perception is, I would argue, largely the fault of the mathematical community. Mathematics is seen as not related to significant problems in the community and mathematicians are not valued as contributors to our society.

This is partially an issue of perception, but as always there is an element of truth in this perception. It is up to the mathematics community to change this perception. Perhaps the first step is to recognise and support all our graduates and all the work they do. This is a challenge for the Society that has had such a strong a focus on research

mathematics. It will be a particular challenge to do so with one voice, overcoming the divisions between the mathematical disciplines.

We need to actively market mathematics as a subject of value and as a viable career option. If we don't do this we have little right to complain.

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