NCMS News

Nalini Joshi*

How mathematical sciences add value to the national economy

The Australian Academy of Science is about to embark on an exercise to assess the economic impact of the physical sciences (chemistry, earth sciences, mathematics and physics) on the Australian economy. To whet your appetite for this extremely important study, I wanted to describe a recent study of the economic impact of the mathematical sciences on the Dutch economy and its major findings.

The Dutch mathematical community was inspired by an earlier study in the UK[1] and commissioned Deloitte to assess the economic impact of mathematical sciences on the Dutch economy. The Dutch report[2] focusses on mathematical sciences and skills, methods and tools that result from higher education in mathematics, statistics and operations research.

There were three major steps in the study (see the summary on p. 8 of the report):

1. Identifying jobs that use mathematical sciences and estimating its extent in each job category. This leads to a calculation of the *mathematical sciences intensity* for each industry representing a grouping of jobs.
2. Calculating the direct, indirect and induced impact of the mathematical sciences on the economy by each industry.
3. Combining the above results to calculate the total economic contribution of mathematical sciences to the Dutch economy.

Most readers of the *Gazette* would know about major applications of mathematics and statistics. The Deloitte report highlights particular areas of mathematical thinking and tools that affect daily life in the Netherlands, in particular, a study of optimal dike heights, personal navigation systems, train schedules, computer chip manufacturing, medical imaging, and smart phone data management (p. 10).

However, many readers of the *Gazette* may not know how jobs data are categorised and classified. The Deloitte report points out the almost obvious fact that more accuracy in the estimates requires more refined categories of employment (p. 11). The Centraal Bureau voor de Statistiek of the Netherlands (CBS) uses 1211 defining categories of jobs. In comparison, the Australian Bureau of Statistics (ABS)

*Chair, National Committee for Mathematical Sciences, School of Mathematics and Statistics F07, The University of Sydney, NSW 2006, Australia. Email: nalini.joshi@sydney.edu.au

[1] http://www.ima.org.uk/viewItem.cfm-cit_id=384406.html

[2] http://www.eu-maths-in.eu/download/generalReports/DeloitteMathematicalSciencesAndTheirValueForTheDutchEconomy2014.pdf. Page numbers refer to this report, downloaded on 01 August 2014.

has 1023 categories of occupation in its latest classification[3]. In order to increase accuracy, the Deloitte report relied on the mathematical intensity of more refined categories of occupations calculated in their earlier UK report.

These jobs are distributed across 39 industry groups in the Netherlands. By assessing the fraction of time relying on or spent on mathematical sciences, the Deloitte study calculated the mathematical sciences intensity per industry. It is interesting to note that this intensity ranges from 0% to 47% (p. 12). The top two industries ranked by intensity are information (e.g. software coding and maintenance) and IT services (e.g. data storage). Banks and other financial services were rated at around 23%, while the oil industry and car manufacturing came out at around 14%. (See Figure 2 on p. 12.)

The resulting calculations of economic impact are astonishing. (See p. 14.) The direct impact of mathematical sciences employment on the Dutch economy is estimated to be €71B in gross value added (GVA). The indirect effect, arising from procurement of goods and services by mathematically intensive parts of industries from other industries amounts to €37B in GVA. The induced effect, i.e., impact of household spending resulting from direct and indirect effects of mathematical sciences jobs, amounts to an additional €51B in GVA. The industry with highest direct impact is Banking, that with highest indirect impact is renting and trading in real estate, while that with highest induced impact is IT services.

So the total impact of mathematical sciences on the Dutch economy is almost €160B, which amounts to 30% of national GVA, and accompanying this figure is over 2.25M jobs, which is almost 26% of all jobs in the Netherlands (p. 15).

The report goes on to describe the relationship between mathematical ability of a nation's population and its economic competitiveness and explains how the absence of fostering mathematical talent weakens national competitiveness. Wouldn't it be great to have such a study for Australia that we can show to our government?

Nalini Joshi is an ARC Georgina Sweet Laureate Fellow and the Chair of Applied Mathematics at The University of Sydney. She was the President of the Australian Mathematical Society during 2008–2010, elected a Fellow of the Australian Academy of Science in 2008, became the Chair of the National Committee of Mathematical Sciences in 2011, and was elected to the Council of the Australian Academy of Science in 2012.

[3]See ANZSCO v.1.2 http://www.abs.gov.au/ausstats/abs@.nsf/mf/1220.0