MACQUARIE UNIVERSITY

Faculty of Science
Rodney I. Yager
Department of Mathematics
MACQUARIE UNIVERSITY NSW 2109 AUSTRALIA
Phone +61 (0) 2 9850 8934
Fax +61 (0) 2 9850 8114
Email rod.yager@mq.edu.au

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Review of the Faculty of Science
Office of the DVC (Provost)
Attn: Ms Barb McLean

Dear Ms McLean,

Following wide consultation within the department of Mathematics, I have been asked to prepare the following submission on behalf of the Mathematics Department which addresses a number of the terms of reference for the review of the Faculty of Science. For your convenience, the comments have been organised using the relevant terms of reference as headings.

I would be happy to make myself available to meet with members of the review to discuss any aspect of this submission.

1c. What is the proper role of service teaching in Departments?

Study in many disciplines requires students to develop a substantial degree of competence in a range of other enabling subjects which are beyond the level typically achieved in their secondary education. Since its inception, Macquarie University has recognised that its commitment to excellence in cross-disciplinary education is underpinned by its adherence to a policy which ensures that students at all levels are taught by staff who are experts in the area being taught. This is achieved either through the use of cross-disciplinary units in which the teaching of various components of the unit is shared between the appropriate disciplines, or through the development of units in the enabling disciplines which are structured to address the needs of these students.

Mathematics is fundamental to any deep understanding of the world. Consequently the study of mathematics plays a vital role as an enabling subject underpinning a wide range of disciplines. In recognition of this key role, the 100-level Mathematics curriculum has been carefully designed to address the service needs of students from many areas outside mathematics, with a particular focus on the needs of Education, Business and Economics generally (as well as particular units tailored for the needs of Actuarial Studies), and general Science (with additional units focussed on the needs of engineering, physics, chemistry and computing students). In addition, mathematics offers a 200-level unit (DMTH237) specifically for computing students in the Software Technology major, and the department is also responsible for teaching ACST604, a unit designed to meet the mathematics background requirements of students in the Master of Actuarial Practice.

The Mathematics Department at Macquarie is committed to excellence in service teaching. It views such teaching as a central part of its core business, and ensures that these units are regularly taught by our most experienced and most capable staff. It has been our consistent practice to regularly review the content and delivery of our units to ensure that the content and presentation, and particularly the choices of examples and contexts for applications, are appropriate to the needs of the full range of students taking these units. Both formal and informal methods are used

to consult with relevant faculty members from across the University regarding the effectiveness and appropriateness of these units, in addition to the usual processes for obtaining feedback and engaging in reflection and review of unit offerings.

Having emphasised the extent to which we, as a department offering service teaching, make every effort to consult the areas within the University that we support, it is worth mentioning that communication from other areas is often less than satisfactory. Substantial changes in the statement of mathematical prerequisites and assumed knowledge, with significant impacts on the viability of Mathematics units especially tailored for a particular cohort, are almost never communicated to the Mathematics Department. On three recent occasions, we have discovered changes in late December/early January which have had dramatic impacts on enrolments for the semester about to begin. At this stage, it is impossible to organise the additional rooms, slots in the timetable and staff required to respond to large increases — and the last minute responses which are possible to adjust to these changes are often far less than satisfactory for everyone involved. While it is true that these communication problems were exacerbated by the sheer volume of the changes in curriculum over the past few years, it is of serious concern that there is still no process requiring timely notification of such changes to departments offering service units which are likely to be impacted.

It should also be noted that, in addition to sound academic reasons for teaching substantial required components for other disciplines in service units, rather than, say, embedding them as incidental components in the units for which this knowledge is required, there are also significant pragmatic arguments in favour of this arrangement. Firstly, an organised and coherent presentation of the 'service' material avoids duplication of delivery of this material. The material provided in the Mathematics service units is essential background for a wide range of units within each of the disciplines we serve. Attempts to embed this material within those disciplines would require this material to be covered multiple times to ensure that all students within each of these units had the required knowledge. It would also negate the value obtained by the substantial number of students who have studied mathematics at a higher level in their secondary education, as this mode of delivery provides no mechanism to cater for cohorts with different mathematical backgrounds.

Moreover, in the case of mathematical service units provided for students in Education and the Faculty of Business and Economics, there are financial advantages for the University in the current arrangements. The income per student received by the University for teaching a mathematics service unit is much greater than the income generated by a corresponding education or accounting, commerce or economics unit. Commonwealth supported students also benefit financially from this arrangement, as the National Priority status of these Mathematics units means that the student contribution required for Mathematics subjects is significantly lower than the contribution required for units offered by the Faculty of Business and Economics.

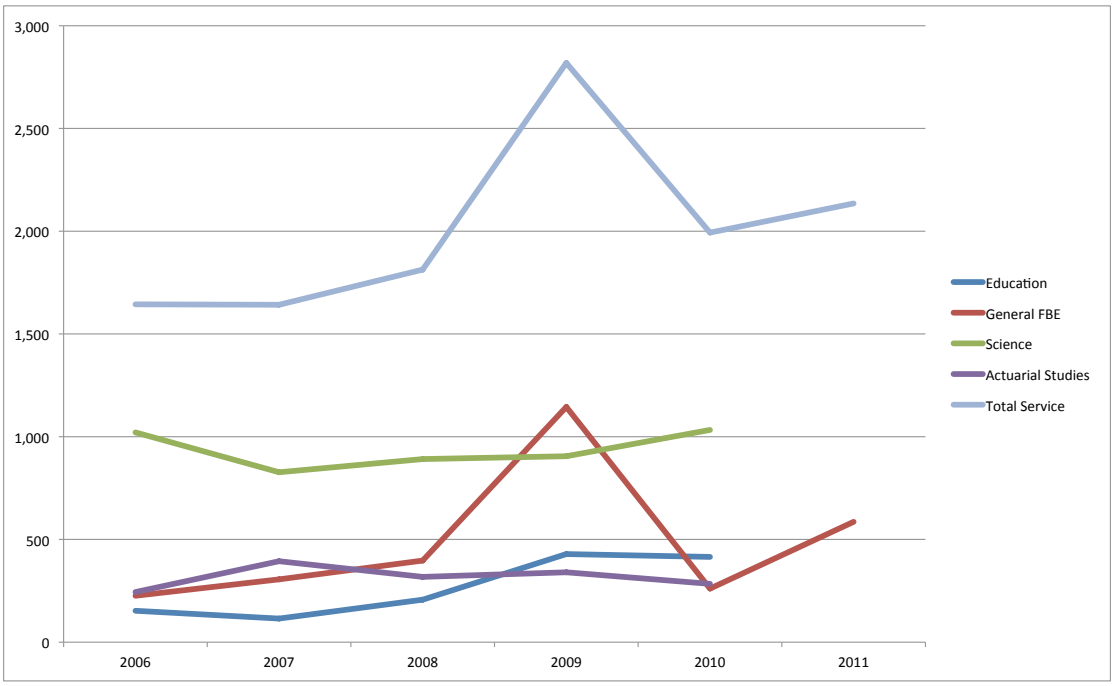
1d. What are the factors contributing to the loss of service teaching in Statistics, Mathematics and Computing and what are the risks of losing more?

The first half of the question in this term of reference entirely misstates the position of service teaching in Mathematics. It is true that there was a steady loss of mathematics service teaching numbers during the period 2000-2005, largely due to a decline in the University intake into computing. However, since the low point reached in 2006, student numbers in mathematics service units have been growing steadily, with the number of students enrolled in such units in 2010 being 21% higher than the corresponding figure in 2006.

While there has been overall growth across this period, the pattern of enrolments has changed. The number of education students taking the MATH106 service unit, for example, has almost trebled from 153 in 2006 to 415 in 2010; numbers in the Actuarial Studies service units MATH132/MATH133 have risen by 16% in that period, while numbers in the service units designed to support engineering and science have remained largely static over that period with an increase of just 1%.

It is worth drawing attention to the volatility in one particular area of service teaching by the Mathematics Department. This illustrates the unintended risks to service teaching posed by changes

made in areas outside the teaching department. Enrolments in MATH123, the unit provided to support the general mathematical needs of students in the Faculty of Business and Economics, have grown from a base of 226 students in 2006 to an enrolment of 586 in the current 2011 first semester offering (a growth of 159% over 5 years). This growth was spread evenly across the period 2006-2008, with growth of approximately 80 student enrolments each year. However, in 2009 the Faculty of Business and Economics changed its prerequisite structure, removing the Mathematics prerequisites for 100-level units and placing Mathematics prerequisites on some of the 200-level Accounting units. This had an extraordinary and unexpected effect, causing a one-off spike of approximately 700 students[1] in enrolments in MATH123 and MATH130, the science oriented equivalent of MATH123 which took much of the overflow in demand for a unit to meet this prerequisite. In 2010, the Faculty of Business and Economics chose to re-express its statement of the required mathematical background for these 200-level Accounting units by describing the same standard in the language of "assumed knowledge". This resulted in a return of numbers in MATH123 to 2007 levels, with current indications being that 2011 enrolments have returned to be in line with the growth rate predicted by the 2006-2008 trend line.



Numbers of students in the various categories of service units taught by mathematics

Note that the 2011 figure in the above chart for General FBE is the current enrolment in MATH123, a first semester unit. The other categories have substantial second semester components and the volatility in enrolments between semester 1 and semester 2 mean that the figures currently available have a high level of uncertainty. The total service unit enrolment for 2011 is our best current conservative estimate based on historic patterns of changes to enrolments between the start of semester 1 and the semester 2 census date. It is worth noting that semester 1 enrolments in Mathematics units are currently at levels which, with the exception of 2009, have not been seen since 2002.

[1]The magnitude of this spike is surprising, and requires some explanation. Our investigation of this matter revealed two contributing factors. Firstly, we found that a substantial cohort of students had been using an alternative route to 200-level Accounting which effectively by-passed the mathematical gateway provided by the previous prerequisites on the 100-level Economic units. The change required many of these students to take a service mathematics unit in 2009. In addition, large numbers of 200-level students responded to the placement of a mathematics prerequisite on the 200-level Accounting units by enrolling in MATH123 or MATH130 without seeking any academic advice. A significant number of these students would have been assessed as having met the stated prerequisite if such advice had been sought.

3a. How appropriate is the current Faculty Funding Model for Science?

In his review of his first 100 days at Macquarie, the Vice-Chancellor indicated that it was important for the University to understand the real costs of teaching, research, etc., in each area of the University.[2] However, it is not apparent that any such investigation has been carried out, beyond the self-evident observation that the University continues to manage somehow. The current faculty funding model allocates funding based on a convenient proxy for the cost of teaching delivery in various areas arrived at by calculating weightings based on the total income (combining the Commonwealth funding and the student contribution) provided to the university for Commonwealth Supported Students in each of the funding categories under the model current in 2008. This results in funding for a student enrolled in a Mathematics, Computing or Statistics unit which is essentially 60% greater than that for a typical student in a unit outside the Faculty of Science, while students in Physics and many other sciences enjoy an even higher weighting.

However, this simplistic model fails to properly interpret the basis of the Commonwealth's computation of the real costs of delivering various types of courses and its intention for its expenditure. As recently as the 2007 Federal budget,[3] additional funding of approximately $3 000 per EFTSU was provided to support teaching in the National Priority areas of Mathematics and Statistics. At Macquarie University, the effect of the Faculty Funding model has been that the vast majority of this additional funding for such teaching has been allocated to the provision of centrally administered services and facilities.

To understand how this happens, it is important to understand that in 2011 the Commonwealth Government and the student together contribute $10 883 for an effective full-time student studying accounting, commerce or economics, while the total contribution for an effective full-time student studying mathematics is $16 534, which is approximately 52% higher. Currently, the University's faculty funding model provides funding of $3 427 to the faculty for the teaching of an effective full-time accounting, commerce or economics student, while the amount provided to the faculty for an effective full-time mathematics student is $5 483.[4] The consequence of this model is that the University is effectively asserting that an accounting, commerce or economics student's contribution to the overall central running of the university is appropriately measured at $7 456, while the contribution assessed from a mathematics student is $11 051, even though it is difficult to point to any area in which a mathematics student at Macquarie receives any greater provision of centrally provided services or facilities than the corresponding accounting, commerce and economics student. In particular, it means that the university has appropriated for central services and facilities 68% of the additional funding for teaching in National Priority areas.

The fact is that the higher costs of teaching Mathematics which have always been recognised in the funding model established by the Commonwealth Government, and increased in the National Priority initiative, occur almost entirely in the areas of expenditure for which the Faculty is responsible. Indeed, they are almost entirely due to the fact that the amount of face-to-face contact time between students and faculty members for Mathematics units (5-6 hours per week) is more than double that required for units in the Faculties of Arts or Business and Economics (1-3 hours per week).[5]

Full recognition of the cost centre to which this additional funding should be allocated would require the distribution of income from a Commonwealth supported student to be made by allocating $7 456 to the funding of central activities and $9 078 to the teaching activities. This would imply a weighting factor of 2.6 for Mathematics in the funding model, rather than the current 1.6. Consideration of a compromise between this and the current system would considerably relieve the chronic

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[2] Steven Schwartz: Macquarie@50 p.8

[3] DEST: Budget Information – Realising our potential 2007 p.8

[4] Commonwealth Government: Information for Commonwealth Supported Students 2011 p.16 and http://www.mq.edu.au/unifees/stucont_bach_11.htm

[5] http://timetable.ofm.mq.edu.au/scientia/web/2011TT-all.pdf

underfunding of mathematics. This severely constrains our research activity and contributes to overcrowded classes in many units due to staff shortages which prevent the offering of multiple lecture streams in these units.

Similar considerations apply to most other science disciplines, although in some instances it is legitimate to argue that the costs of the services provided centrally by the University for these students are somewhat higher as the University does fund the provision of some specialised facilities.

It should, of course, be noted that non-Commonwealth supported students bring considerably more income to the University than their Commonwealth supported counterparts. In the current model, none of this extra income is returned to the faculties in the taught-load component of their funding.

It is important to point out that the flaws in the current University Faculty Funding model create economic distortions within the University. It encourages decisions which are not in the University's interests by sending incorrect price signals. At a macro level, the University's perception that the Faculty of Science is not paying its way derives from its methodology of retaining a much higher amount per student for Science students, disproportionate to the actual costs incurred. The inaccurate perception risks the University deciding that it is more profitable to teach students in other faculties. However, if it were to do so, it would not make the expected "savings" in central services predicted by this model, and the proportion of income earned required to fund central activities would grow considerably beyond the current level of 68%. This would create even greater pressure on teaching budgets across the University. Thus, changes prompted by a flawed modelling of the distribution of real costs within the University would produce outcomes which run counter to the expectations.

3b. Is the funding distribution to the Departments appropriate?

This item is difficult to respond to as it is unclear as to which funding distribution to the Departments it refers. The current process by which the University funds Faculties enables Faculties and Departments to readily compute the value of the funding provided to the Faculty attributable to the activity of each Department. However, from there the process becomes quite muddied. The practice within the Faculty of Science has been to attempt to fund departments in proportion to the income generated by the department (effectively again distributing the central costs within the Faculty of Science without any regard to the relevance of that expenditure to the particular department). However, the underfunding of Science due to the deficiencies of the University Faculty Funding model outlined in my response to 3a. results in a small number of departments where the cost of maintaining the department vastly exceeds the income attributed to that department within the Faculty.

The consequence of this is that any improvements in the apparent financial position of other departments is effectively diverted to cover the 'deficits' in these departments. Indeed, the departments which on the face of it generate the largest surpluses are the ones which are the most constrained in their ability to gain approval for initiatives to improve the standard of their teaching and research. The unfortunate consequence of the application of these constraints over the course of many years has been that the most financially secure departments within the faculty are also those which are marked by relatively poor performances in measures such as the recent ERA round.

For instance, in 2010, the Mathematics department's prima-facie income exceeded its approved budget by approximately $700 000 due to the flow on through the budget of the spike in enrolments in 2009 detailed in my response to 1d. Regardless of any view of the sustainability of this income, the financial position of the Faculty meant that the Mathematics department had been unable to acquire additional resources in 2009 to deal with the greatly increased workload caused by the spike in enrolments (as the funding for this was not provided to the Faculty until the following year), nor was it able to to spend any of this 'surplus' in 2010 on any of the numerous initiatives which we would like to be able to take to improve research and teaching within the department.

All of this surplus was required by the Faculty to 'subsidise' the growing apparent losses in other departments.

3c. Is the Science budgeting process optimal and the allocation of resources appropriate?

To a large extent, the response to 3b. above addresses this point. The inadequacy of overall funding for Science means that most, if not all, areas of Science have exhausted every opportunity to cut costs. They are struggling to maintain research and teaching at levels which are appropriate for an institution of Macquarie University's standing. At the moment this is only possible through reliance on the good-will of staff to undertake workloads which are significantly higher than those envisaged by the workload model. In implementing this requirement for Departments to cut their expenditures to the barest minimum, the perception within Mathematics is that the Science Faculty works well. There is a widespread understanding that the individual departments within the faculty are highly dependent on each other, and that it is essential to approach the cost-cutting process in a transparent manner, working co-operatively in the best interests of the faculty.

However, the lack of substantial discretion within its budget means the faculty must concentrate the few discretionary resources it has in pursuit of a small number of strategic initiatives. Such initiatives must be chosen more for the ease with which they can be sold in the University's budgeting process than for the expected payback on investment, as they can only be pursued using funds obtained outside of the faculty funding model process. Currently, these discretionary resources are being utilised entirely to fund the CORES initiative and to support the push to expand the Engineering program. There are considerable risks associated with this. Without changes to the funding available to Science, the future of the faculty depends entirely on their success.

Yours sincerely

Rodney I Yager
Senior Lecturer in Mathematics