

*Are Current Entry Pathways To
Engineering Programs The Right
Strategy To Meet The National
Demand For Engineers?*

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Background

- Current shortage of engineers across the nation.
- In SA, the economic development depends on industries which rely heavily on skilled engineers, like Mining and Defence.
- The shortage of engineers has its roots in the early stages of the education system.
- The curricula in primary and secondary school education has a very low profile on science, technology and maths subjects.
- In SA, student enrolments in these subjects are falling.



Demographic Issues

- In SA, the growth of students meeting the requirements and pursuing engineering careers is limited by demographic issues.
- The State has a small, ageing population in which the number of Year-12 students has remained static in the last few years.



In South Australia only	Number of Students			
	2005	2006	2007	2008
Completed 1 or more Stage 2 (Y12) Subjects	16,658	16,886	17,101	17,086
Completed All SACE requirements	11,504	12,167	12,056	12,237
Received a Tertiary Entrance Rank (TER)	9,885	10,177	9,921	9,960
Fulfilling Higher Education Selection Subjects (HESS)	11,431	12,723	9,464	9,599
Completed Mathematical Methods (intermediate)	645	796	893	1,100
Completed Mathematical Studies (intermediate)	3,291	3,156	3,076	3,280
Completed Specialist Mathematics (advanced)	1,122	1,121	1,146	1,322

* SACE: South Australian Certificate of Education

* HESS: requirement for all programs at The University of Adelaide, Flinders University, and the University of South Australia

Applications for Universities in SA

- SATAC is in charge of processing applications for the three universities in SA.

	Number of Students			
	Y12 - 2005	Y12 - 2006	Y12 - 2007	Y12 - 2008
Applied through SATAC for entry to a University program *	8,358	8,683	8,458	8,461
Offered a place in a University program *	7,280	7,418	7,115	7,249
Ended up enrolling at a SA tertiary institution **	4,738	4,918	4,636	4,912
Flinders	1,028	1,064	939	978
Adelaide	1,486	1,708	1,592	1,873
UniSA	2,224	2,146	2,105	2,061

* Includes SA and NT

** Does not include Intl. Bac. Students

Source: South Australian Tertiary Admissions Centre (SATAC)



Entry Requirements to Engineering

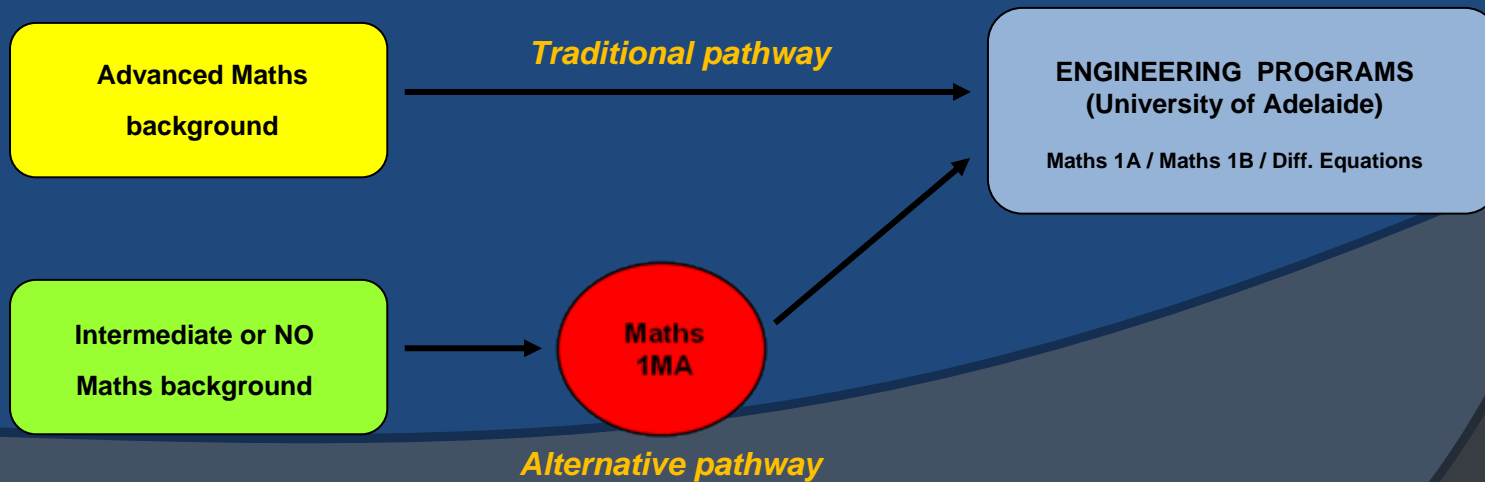
- At UoA, the *traditional* Y-12 entry pathway to engineering programs requires an advanced maths background – **Specialist Maths** (or the IB High Level equivalent).
- In SA, Y-12 advanced maths subjects are not offered in all schools, restricting the access to students from certain metropolitan and rural areas.
- A TER of 80 is also required for UoA's engineering programs.





An Alternative Entry Pathway

- Advanced maths subjects (*Specialist Maths* or IB HL) are critical in providing tools to succeed in engineering programs.
- Not all school leavers can meet this entry requirement.
- Some students only take Y-12 intermediate maths courses or no maths courses at all.
- Committed students with no advanced maths but who meet all other requirements can access an alternative entry pathway which includes an enabling course: *Mathematics 1MA*.

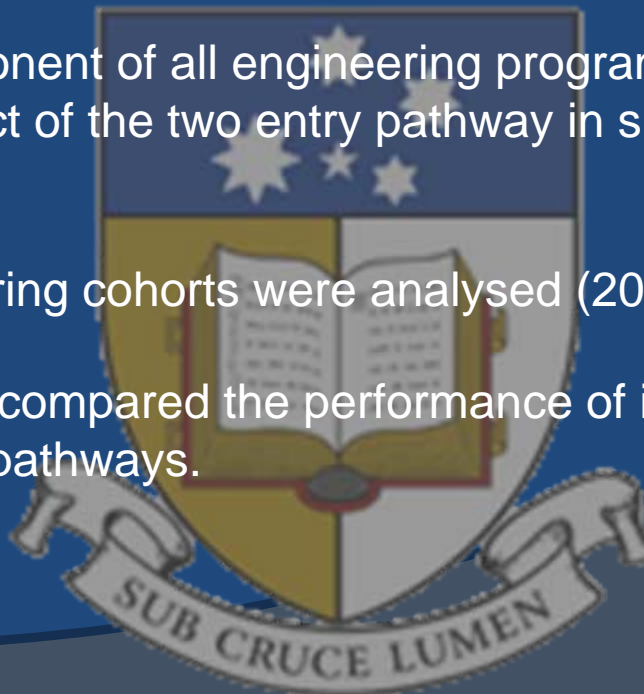


Specialist Maths vs Maths 1MA



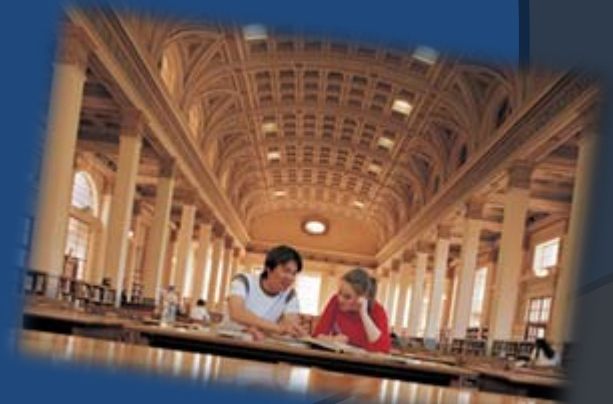
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- According to the Faculty (EC&MS), *Specialist Maths* is the most critical entry pre-requisite for engineering programs.
- *Mathematics 1MA* was designed to provide similar advanced tools to help students succeed in further maths courses through engineering.
- Engineering students at UoA are required to take Level 1 (Maths 1A and 1B) and Level 2 (Diff. Equations) maths courses.
- Maths is an important component of all engineering programs; it was important to assess the effect of the two entry pathway in subsequent academic performance.
- Three commencing engineering cohorts were analysed (2006-2008).
- The exercise examined and compared the performance of individual students from the two entry pathways.



Study Analysis

- There was a strong belief that students with advanced maths background tend to perform better in subsequent Level 1 and Level 2 maths courses.
- The study tried to prove the hypothesis that Y-12 advanced maths courses do not necessarily provide better tools to help students perform well through different engineering maths courses.
- In the end, if engineering students have a negative experience since their first year, regardless of their maths background, it will take them longer to complete or it will discourage them so that they do not complete at all.



Methodology

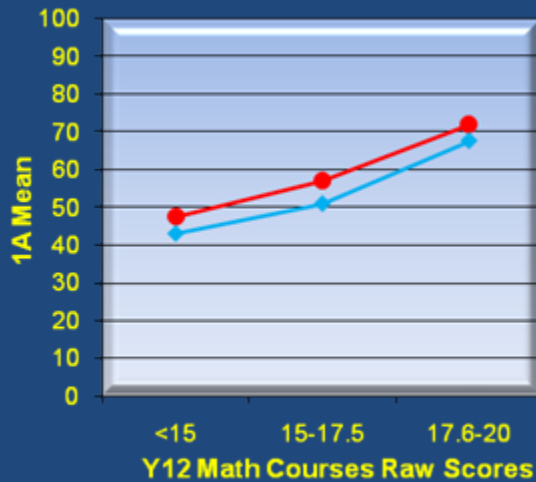
- The exercise examines the students' academic performance in Y-12 maths courses, followed by an individual tracking of their performance in engineering Level 1 and Level 2 maths courses.
- Students were divided into two groups: those with an advanced maths background and those taking the enabling Maths 1MA course.
- This approach provides a correlation between students' maths skills prior to enrolling in an engineering program, and their performance across engineering maths courses.
- Only first attempts were considered.



Results

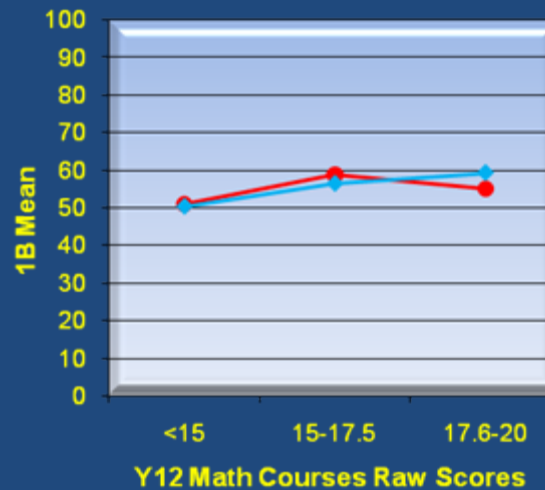
- For the 2006 commencing cohort, the data showed mixed results.
- On average, students who entered without Specialist Maths achieved a higher grade in Maths 1A.
- When those students moved into Maths 1B and Differential Equations, the trend reversed back.

2006 Cohort
Y12 Math Courses vs 1A



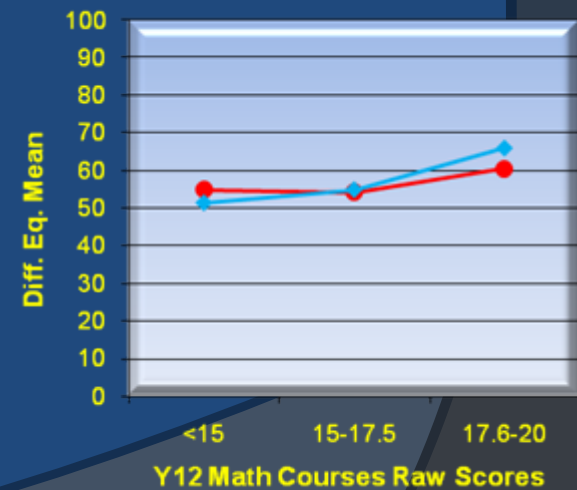
Intermediate / No Maths Advanced Maths

2006 Cohort
Y12 Math Courses vs 1B



Intermediate / No Maths Advanced Maths

2006 Cohort
Y12 Math Courses vs Diff. Eq.

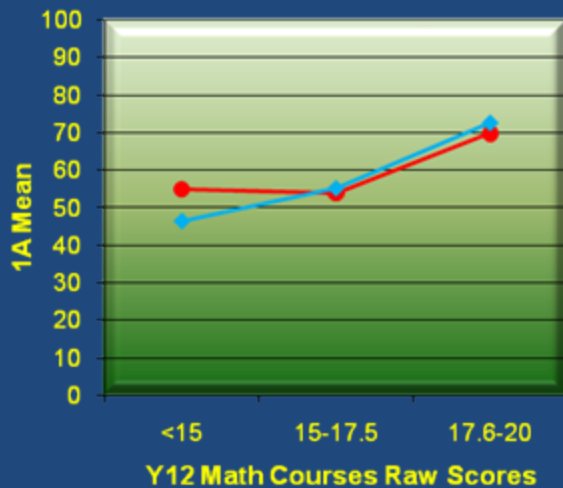


Intermediate/No Maths Advanced Maths

Results

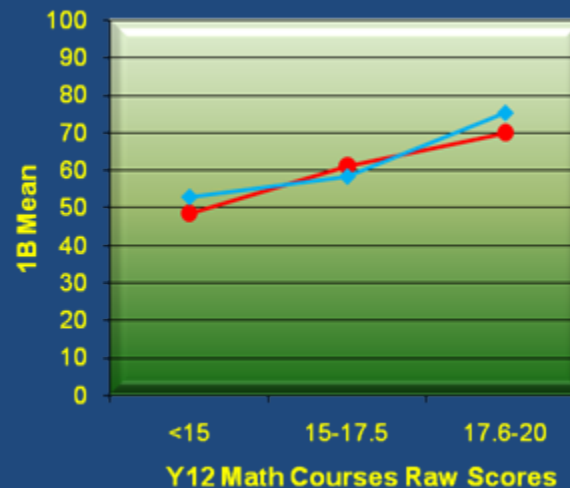
- For the 2007 commencing cohort, the data proved the hypothesis wrong.
- Students who took Y-12 advanced maths achieved a higher average grade in Maths 1A than those who took intermediate or no maths courses.
- The same happened when the same students moved into Maths 1B and Differential Equations.

2007 Cohort
Y12 Math Courses vs 1A



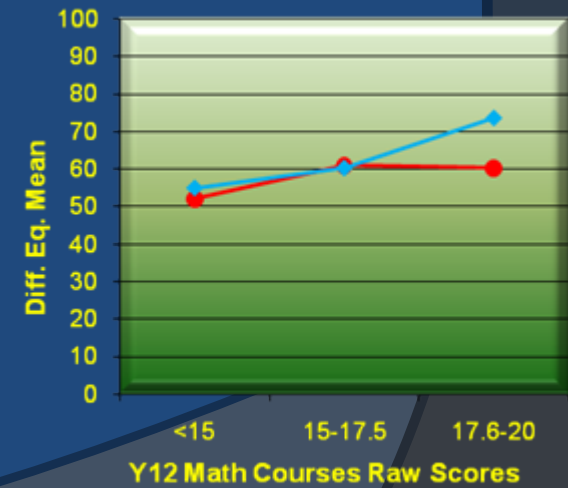
Intermediate or No Maths Advanced Maths

2007 Cohort
Y12 Math Courses vs 1B



Intermediate or No Maths Advanced Maths

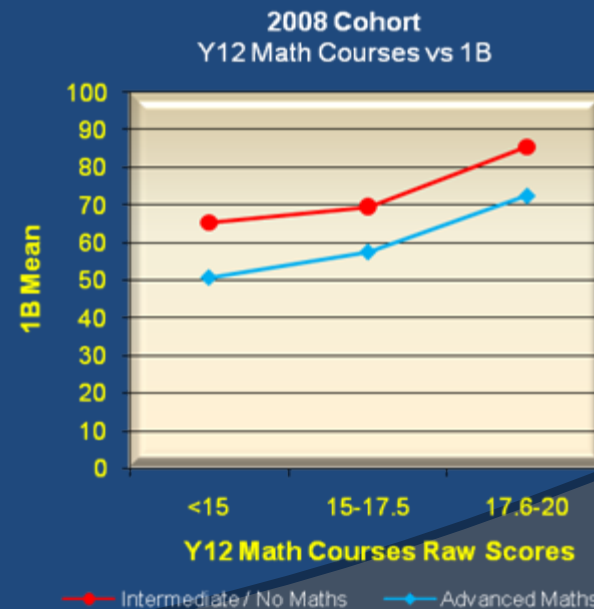
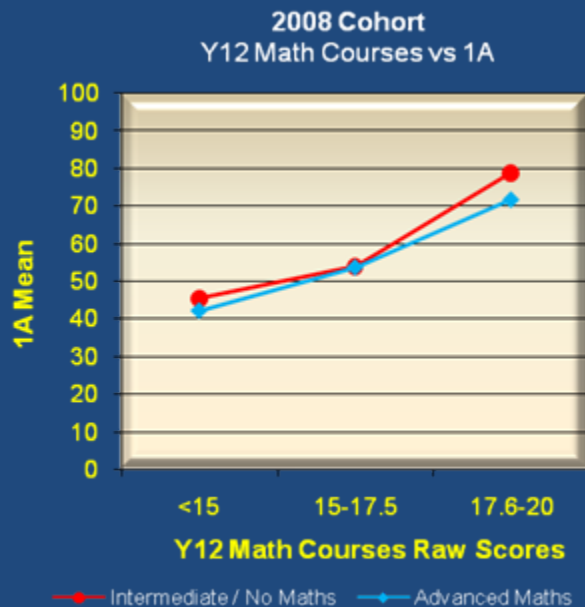
2007 Cohort
Y12 Math Courses vs Diff. Eq.



Intermediate or No Maths Advanced Maths

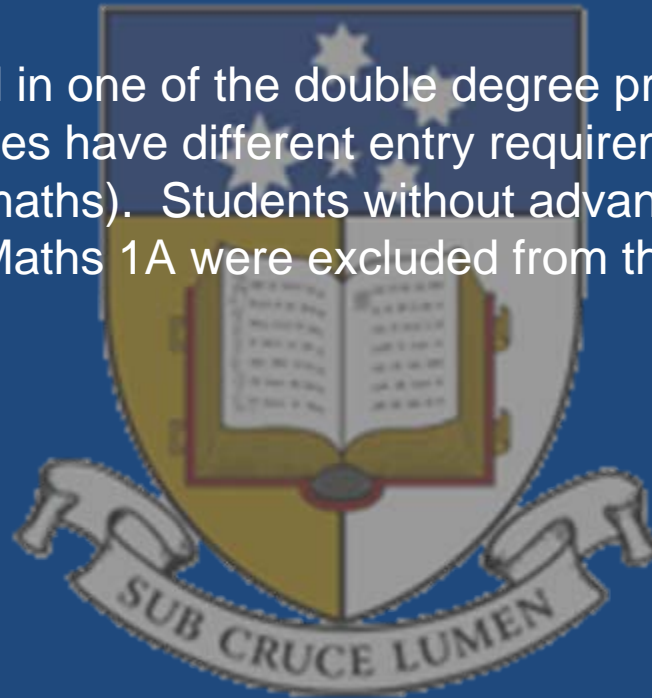
Results

- For the 2008 commencing cohort, the data proved the hypothesis right.
- On average, students who entered with an intermediate or no Y-12 maths background, achieved a higher grade in Maths 1A and Maths 1B.
- At the time of writing this paper, most 2008 commencing students had not been long enough in their programs to move into Differential Equations.



Caveats

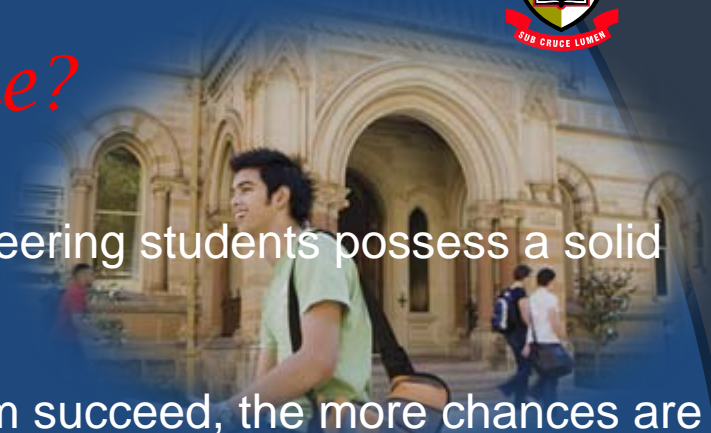
- Commencing students with Y-12 records are mainly domestic students.
- Most international students do not have Y-12 records and were not included in the comparison.
- Some students enrol in one of the double degree programs available at UoA, which sometimes have different entry requirements (i.e.- may not required advanced maths). Students without advanced maths and enrolling directly in Maths 1A were excluded from the comparison.





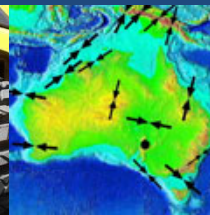
Shortage of Engineers: why is it such a big issue?

- Why is it so important to ensure that engineering students possess a solid grounding in maths skills?
- The better tools students have to help them succeed, the more chances are they will complete their degree and become skilled graduates.
- What is the relevance? There is an important shortage of skilled engineers across Australia.
- That shortage is already having a negative impact on the economic development of certain industries and the future economy of states like SA.



Shortage of Engineers: why is it such a big issue?

- The mining and defence sectors are projected to considerably increase the employment level and their economic contribution in SA.
- The defence industry is projected to double its contribution to the economy from \$1 billion to \$2 billion by 2013.
- The mining industry is expected to increase the value of minerals production and processing to around \$4 billion by 2014.
- Engineering graduates in all disciplines are essential to these two sectors.
- Other industries related to water and electricity supply, climate change, infrastructure renewal, etc also have a great demand for skilled engineers.





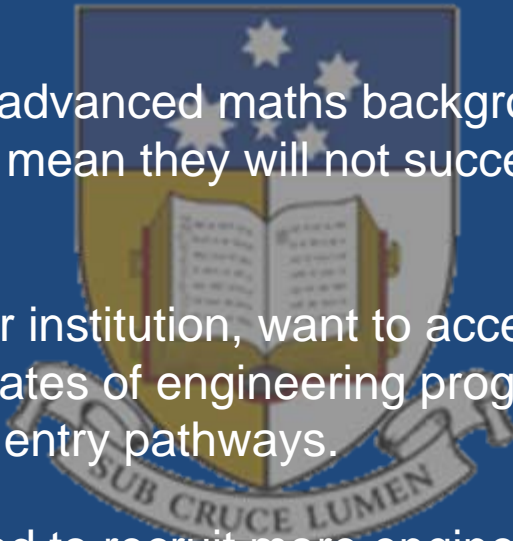
Shortage of Engineers: why is it such a big issue?

- The shortage of skilled engineers is currently impacting on the ability of organisations to undertake and complete projects.
- Engineers Australia estimates a shortfall of around 28,000 engineers. If things do not change soon, that shortfall could double in ten years.
- EA conducts an annual survey and the 2008 results include:
 - 73% of businesses reported skills shortages.
 - 80% of businesses could not recruit the required skill set.
 - 82% of businesses reported there were moderate to severe consequences of skills shortages, including monetary problems and project delays.



Conclusion

- The analysis of the academic performance of engineering students from three commencing cohorts indicated mixed results.
- The hypothesis was proved correct in some cases, but incorrect in some others.
- Students without an advanced maths background may lack some important skills, but it does not mean they will not succeed in engineering maths courses.
- If UoA, and any other institution, want to access bigger markets and increase enrolment rates of engineering programs, they need to keep providing alternative entry pathways.
- If the flexibility needed to recruit more engineering students is tied to the commitment from the government and related industries, the shortage of engineers can start to be reversed.



Thank you

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Strategy & Planning

The University of Adelaide