People Pipeline

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- It is well known that female students in Mathematics are less likely to progress from undergraduate programmes to PhD programmes than male students, as illustrated in the LMS report *Advancing women in mathematics: good practice in UK university departments* which was launched in 2013.
- A significant proportion of current EPSRC funding for Mathematics PhDs is through Centres for Doctoral Training (CDTs) and it is a concern that this might exacerbate the situation.
- Following a suggestion from Professor Michael Singer (UCL) as the lead for one of the Mathematics CDTs, the Good Practice Scheme steering group arranged a discussion session (held on 19 May 2014 in London) to bring together representatives of all of the mathematics CDTs to discuss how the CDTs might be involved in improving the recruitment of women to PhDs and mitigate the significant drop-off of women between undergraduate and PhD levels of study.
- The meeting was attended by representatives from 12 of the 15 current Mathematics CDTs present and discussions were enthusiastic and made a number of practical suggestions of joint initiatives that could be undertaken.

- One suggestion that was made was to hold events similar to the LMS's Women in Mathematics Day, but specifically targeted at undergraduate women, specifically second-year undergraduate students. One-day events would be held at various locations across the country to enable undergraduates to hear talks from the academics responsible for recruiting PhD students, current PhD students and prospective employers.
- The events are intended to complement the *Prospects in Mathematics* meetings. The proposed workshops come at the point at which undergraduates need to decide to aim for a PhD, whereas the Prospects meetings come at a point when they need to decide what and where they will study.
- Irrespective of the source of funding, the idea is to highlight the entire range of options for funding PhD study, and the way a PhD enhances career choices.
- These workshops would be open to female and male students, though Heads of Department would be encouraged to specifically invite female undergraduates.

CMS People Pipeline

Executive Summary (Draft)

Figure 1 gives a graphical representation of the **mathematical sciences pipeline**, from application, through first and possibly subsequent degrees, and into employment. It is based on data relating to the academic year 2012-13 across the UK. The movement across the diagram follows the three key phases covered by the data in the report:

- the **Application Phase**,
- the **Learning Phase**, and
- the **Graduate Phase**.

Working group:

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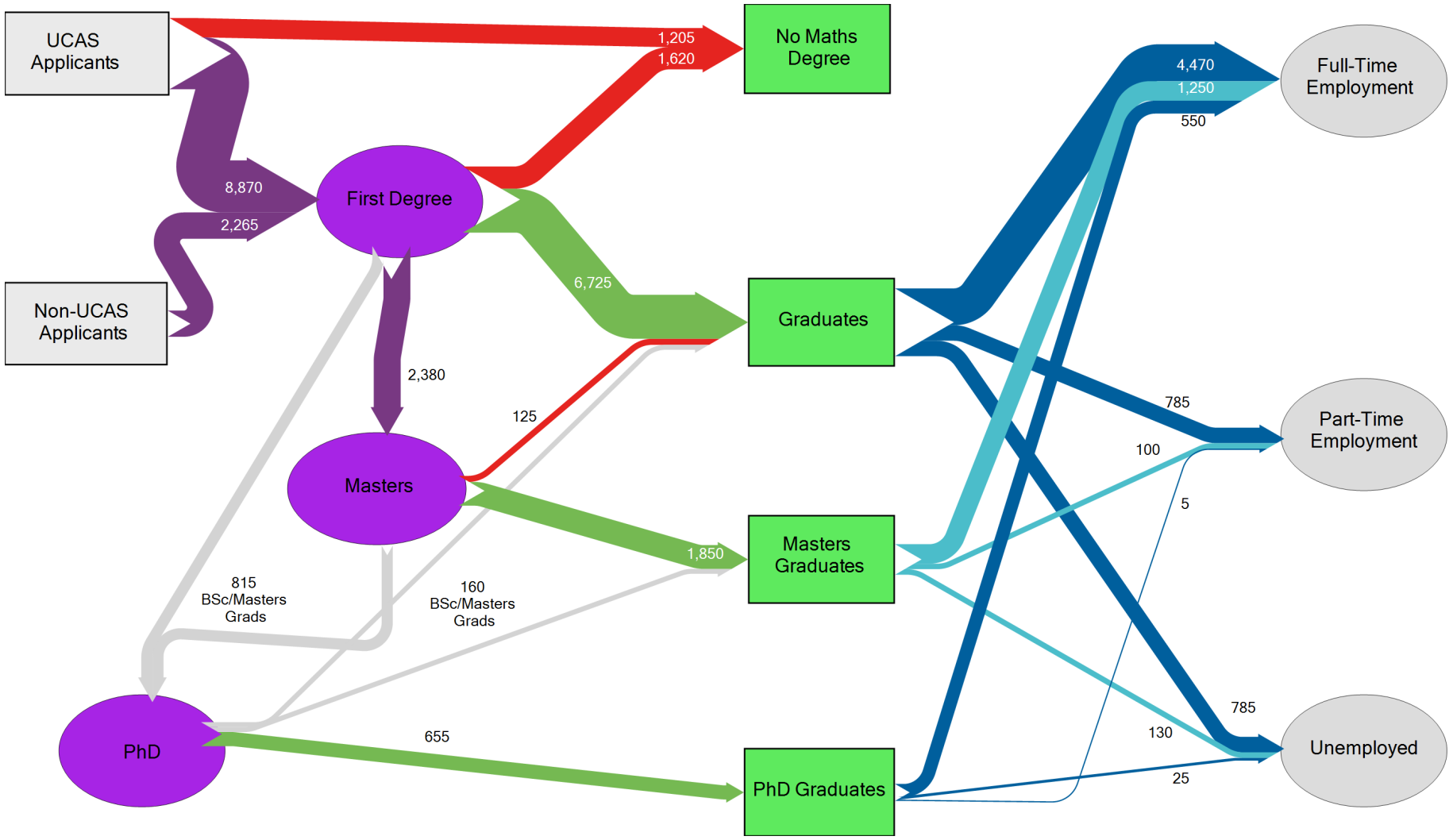
Any comments to John Greenlees (j.greenlees@sheffield.ac.uk)

Figure 1: The Mathematical Sciences Pipeline

Source: TBR



The Application Phase

- The **number of individuals applying** for a higher education course with mathematical sciences as main subject rose by 7% between 2009 and 2011, but has since fallen back to 2009 levels. There were an estimated 10,074 applicants for mathematical sciences courses in 2013.
- The **UCAS tariff points** for accepted offers of places on mathematical sciences degrees are in general much higher than the average across all degree subjects. The ratio of applications to acceptances is broadly similar (around 5:1) across tariff bands of 120 points and above.
- As regards the **entry routes to HE**, acceptances in mathematical sciences subjects are around half as likely to come from further education colleges as acceptances among the UCAS population as a whole. Those accepting places on mathematical sciences degrees are also less likely than average to come from state schools (including school sixth forms but excluding grammar schools) and sixth form colleges. But mathematical science acceptances are more likely than the average across all subjects to come from academies, grammar schools and independent schools.

The Learning Phase

- The **number of mathematical sciences undergraduate students** (including both those on first degrees and those on other undergraduate courses), grew steadily between 2009/10 and 2011/12 and showed an overall increase of 8%, compared with a fall in the total number of undergraduate students in all subjects of 6% over the same period... There were 35,450 students undertaking a first degree in the mathematical sciences in 2012/13.
- **Postgraduate numbers**: The number of mathematical sciences Doctoral students rose steadily between 2009/10 and 2012/13, at a compound annual growth rate of 6.9%. The number of Masters students studying mathematical sciences rose slightly between 2009/10 and 2010/11, and has remained fairly constant since. There were 2,515 students undertaking Doctoral courses in the mathematical sciences in 2012/13, 3,135 students undertaking Masters courses, and 115 undertaking other postgraduate courses.

- **Geographic distribution**: The highest concentrations of undergraduate mathematical sciences students come from London and the South East. For example, over 18% of mathematical sciences undergraduates originated from London throughout the review period, compared with the 13% of the total UK population who live in London. Among postgraduates, students from London are over-represented to an even greater extent.
- **Undergraduate gender distribution**: **40%** of undergraduate mathematical sciences students are female; this figure has remained constant across the review period. This is in sharp contrast to the general student population, with around **56%** of undergraduate students being female. A similar gender imbalance is seen among UCAS applicants for mathematical sciences subjects.
- **Postgraduate gender distribution**: The above imbalance is even starker at postgraduate level: the proportion of female students among postgraduate mathematical sciences students is lower than among undergraduates and is falling, from **36%** in 2009/10 to **33%** in 2012/13.

The Graduate Phase

- The reports analysis of the mathematical sciences workforce categorises the UK workforce in four tiers, reflecting the concept of a continuum of mathematical sciences skills and knowledge across different occupations. This categorisation builds on previous research undertaken by Deloitte and on analysis of graduate employment destinations. The four tiers are:
  - Tier 1: Occupations in which mathematical sciences qualifications (or qualifications with a mathematical sciences element) are essential.
  - Tier 2: Occupations in which mathematical sciences qualifications (or qualifications with a mathematical sciences element) are desirable.
  - Tier 3: Occupations in which mathematical sciences qualifications (or qualifications with a mathematical sciences element) are useful.
  - Tier 4: Occupations in which mathematical sciences qualifications (or qualifications with a mathematical sciences element) are irrelevant.

- Between 2011 and 2013, the number of people in the Tier 1 workforce rose by more than 20%. In comparison, the total UK workforce grew by 2.3% over this period. Tier 1 accounted for 7% of the total UK workforce in 2013, a slight increase from 2011 (6%). There were almost 2,000,000 people in the Tier 1 workforce in 2013. The number of people in the Tier 2 workforce fell by 1% over the same period, and accounted for 10% of the total UK workforce in 2013 (down from 11% in 2011). There were around 3,000,000 people in the Tier 2 workforce in 2013.
- The economic value of mathematical sciences qualifications is clear from **salary data**: thus about half of those in the Tier 1 workforce have salaries of £29,000 or above, compared with 19% of the total UK workforce. By contrast, 39% of the Tier 2 workforce, 28% of the Tier 3 workforce and 9% of the Tier 4 workforce earn above £29,000.
- Among mathematical science graduates, Doctoral graduates have the highest **employment rates after six months** (91% in 2013), followed by other postgraduates (80% in 2013). The employment rates at the same stage of first degree, other undergraduate and Masters students are broadly similar (at around 60% among 2012/13 graduates).

- Six months after graduation, the largest **employment sectors for mathematical sciences graduates** are: Financial Services (18% of 2012/13 graduates), Education (17%), Professional Scientific & Technical Activities (16%), Information and Communication (11%), and Wholesale, Retail & Motor Repair (10%). Combined, these five sectors account for over 70% of mathematical sciences graduate jobs after six months.
- The most common **occupations for mathematical sciences graduates** from first degrees and other undergraduate courses six months after graduation are Professional occupations (40% of mathematical sciences graduates), including Business & Public professionals (20%, most commonly Actuaries, Economists & Statisticians, Management Consultants and Business Analysts), Science & Technology professionals (12%, half of whom are Programmers & Software Development Professionals) and Teaching & Research professionals (9%, most commonly in secondary education). An additional 29% are in Associate Professional & Technical Occupations (most commonly Finance & Investment Analysts and Advisors). Most of the remainder are in Sales & Customer Service or Administrative & Secretarial occupations.

B.H. Casey, "The economic contribution of PhDs", *Journal of Higher Education Policy and Management*, **31** (2009) 219–227

Table 1. Earnings premia by type of level of degree, discipline and sex.

	Men			Women		
	BA/BSc	MA/MSc	PhD	BA/BSc	MA/MSc	PhD
Medicine and related	20	20	38	41	49	55
Sciences	12	12	20	22	30	36
Maths and computing	28	28	28	34	49	47
Engineering and technology	25	33	25	32	48	32
Architecture and related	16	30	16	36	36	*
Social sciences	14	22	22	28	46	42
Business and financial studies	24	38	44	35	54	46
Arts	−3	6	−3	19	27	28
Languages	7	7	7	19	19	19
Education	18	30	18	42	49	54
Combined	14	23	26	23	38	38

Source: own calculations from O'Leary and Sloane (2005), Tables 4, 5, 9 and 10. Only premia that are significant at a minimum of 90 per cent confidence level are taken into account.

Notes: The earnings premia show the per cent by which the holder of a qualification earns more than a person who had the basic qualifications to attend university (two A-levels) but who chose not to. The Table is to be read as follows: a woman obtaining a Bachelor's degree in maths and computing receives a premium of 34 per cent. If she also has Master's degree, she earns 49 per cent more, but if she has a PhD (irrespective of whether she has a Master's degree), she earns only 47 per cent more; *insufficient data available to calculate a premium.