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Research Notes

A quantitative exploration of the statistical and mathematical knowledge of university entrants into a UK Management School

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ABSTRACT

Mathematical and statistical skills are increasingly important for securing fruitful employment in the modern world. Regardless of the increasing demand for such skills by employers, witnessed at present is a drop in the mathematics and statistics knowledge of university entrants. This paper uses a British university as a case study and exploits the induction week to collect primary data on the mathematical and statistical knowledge of entrants into two degree programmes. The data is then analysed using statistical techniques to identify the current patterns relating to the mathematics and statistics knowledge of students with a view to developing appropriate methods for enhancing their mathematical and statistical knowledge. Our findings indicate statistically significant differences in the mathematical and statistical knowledge of students entering this British university based on the chosen degree programme, gender and educational qualifications.

1. Introduction

Science, Technology, Engineering and Mathematics (STEM) are widely recognised as crucial areas for the development of modern society (Brown, 2009; Dalby et al., 2013) via its contribution to innovation, economic growth and progression (Newman-Ford, Lloyd, & Thomas, 2007). However, as noted in Manning and Dix (2008), Tariq (2003) and Todd (2001), many studies have confirmed the weakening mathematical knowledge of undergraduates, even when some level of mathematical skills are required in all university courses (Galligan & Hobohm, 2015). As such, the main concern of this paper is on one component of STEM, namely mathematics (including statistics). As Truss (2013) eloquently asserted, through the directing of cars on the streets, planes in the skies and shopping to our doors, algorithms are entwined into the core of our lives.

Notwithstanding the importance of mathematics, it is well known that there is a gap in the mathematical and statistical knowledge of entrants into the UK Higher Education Institutes (HEI) and this problem has been in existence for some time

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now (Dalby et al., 2013). This is more evident where the courses include use of advanced mathematics and statistics for which a sound foundation is required. It is interesting to note that even physical geography students have identified the need for including statistics for data analysis in the school curriculum (Hill & Jones, 2010; Mathison & Woodward, 2013). The disjuncture in mathematical and statistical skills result from a variety of issues. Firstly, the transition from secondary to tertiary level in mathematics has been identified as problematic owing to lack of preparation and mathematical rigour, among other problems (Brandell, Hemmi, & Thunberg, 2008; Hillel, 2001; Hoyles, Newman, & Noss, 2001; Wood, 2001). Secondly, the under-preparedness of students taking up higher education courses has been cited as another reason for the existing disjuncture by many authors (Kajander & Lovric, 2005; Lowe & Cook, 2003; Luk, 2004; Hourigan and Ó Donoghue, 2007). Thirdly, this under-preparedness was worsened by the fact that for example, in comparison to 1989, by the year 2004 there was a drastic decline in the number of entries for Advanced Level (A-Level) mathematics (Grove & Lawson, 2006). However, according to ACME (2012), recently there has been an increase in the numbers taking up mathematics at A-Level and in fact it is able to challenge the many negative preconceptions in literature up until 2012. Finally, many students experience difficulties with connecting mathematics to real world applications (Chang, 2011) and this too adds further to the deterioration and declining interest in mathematics skills.

In a world where organizations seek those with sound mathematical and statistical skills (ACME, 2012) to ensure increased productivity and value for money, there are added implications on the employability of students lacking such skills. According to the Parliamentary Committee Publication (2012), in UK there is an inadequate level of numeracy knowledge in pupils studying mathematics post age of 16. These students then enter university and find it increasingly difficult to cope with the expected mathematical and statistical demands of their programmes. In response, a number of changes have been implemented over the years in order to improve the level of mathematical knowledge of British students. For example, in 2000 a major change was implemented to the curriculum and examination process via the 'Curriculum 2000', but this resulted in a drop in students studying mathematics at A-Level by 20% (Vorderman, Porkess, Budd, Dunne, & Rahman-Hart, 2011). Those interested in examining the 'Curriculum 2000' changes in detail are referred to Vorderman et al. (2011, pp. 71). A more successful and noteworthy attempt is the role played by the Sigma Mathematics and Statistics Support Network[1] in funding and supporting the establishment of mathematics support centres across the UK HEI.

Issues pertaining to poor mathematical foundations and its negative impact on university entrants has been a problem which has surfaced over the years. For example, see Ireson (1996), Sutherland and Pozzi (1995), Gonzalez-Leon (1980), and Baker, Crampin, and Nuttall (1973). Gill (1999a) considers students undertaking science and engineering courses at King's College London and identifies some key points which help explain the deteriorating mathematical and statistical skills in university entrants. Firstly, the mathematics syllabuses at schools are no longer tailored as feeders for university entrants following the introduction of GCSE and A-Levels. Secondly, students rarely identify a relationship between mathematics and their main subject studies. This leads to a lack of confidence in mathematics and worsens the already problematic situation (Parsons, Croft, & Harrison, 2009). Therefore, it is prudent for universities to assess and provide additional support to entrants who do not have either GCSE or A-Level mathematics in particular. Gill (1999) considers the problems that physical science and engineering students face with mathematics and these include difficulties in understanding graphs and adapting to the different learning styles at HEI. Difficulties with adapting to different learning styles was also noted in Nardi (1996). Whilst it is arguable that the above research is outdated, more recent research suggests that the problems still continue with the likes of Gill, Mac an Bhaird, and N Fhloinn (2010) and Lawson, Croft, and Waller (2012) noting that the Mathematics problem is still common in HEI across UK and Ireland. As such, it is evident that emphasis should be placed on delivering mathematical content in a manner which helps the students see and understand the relationship it has to their main course of study.

In this paper we aim to provide a definitive answer to the proposition (based on feedback from academics at this particular university) that there is a decline in the mathematical and statistical skills of entrants into Bachelor of Business Studies (BABS) and Bachelor of Accounting and Finance (BAAF) frameworks at their Faculty of Management, and that there is a need to provide additional mathematics and statistics support. More specifically, this paper aims at providing answers to the following research questions. a) Are there any differences between the basic statistical and mathematical knowledge of students entering the BABS and BAAF frameworks at this British university during the 2013/14 intake? b) Are we able to differentiate between the basic statistical and mathematical knowledge of these cohorts based on gender? (This is important as gender gaps in maths have been of interest in previous research, see for example, Niederle and Vesterlund (2010), Else-Quest, Hyde, and Linn (2010) and Lindberg, Hyde, Petersen, and Linn (2010)). c) What is the impact of educational qualifications on the basic statistical and mathematical knowledge of students entering this British university? In order to provide comprehensive answers, during the analysis stage we compare the scores between the two frameworks and between genders both within and between the two frameworks of BABS and BAAF.

The topic itself is timely and important for several reasons. Firstly, as Shulka, Hassani, and Casleton, (2014) states, two prominent researchers and practitioners in developmental education, i.e. Casazza (1999) and Maxwell (1979) believe that there will always be university entrants who are poorly prepared and academically weak. This claim is further strengthened by Abdulwahed, Jaworski, and Crawford (2012) who states that most STEM higher education students enter university with gaps in the mandatory prerequisite knowledge pertaining to mathematical topics. Secondly, issues arise due to students noticing that the mathematical elements of their degrees are more than what they had anticipated (Rafik, 2004). For this

[1] http://www.sigma-network.ac.uk/.