Annex to subject benchmark statement

Mathematics, statistics and operational research

2009

Foreword

This document is an annex to the subject benchmark statement for *Mathematics, statistics and operational research* (MSOR), published by the Quality Assurance Agency for Higher Education (QAA) in June 2007[1]. The subject benchmark statement covers bachelor's degrees with honours in MSOR. This annex provides further information for those interested in integrated master's programmes in this subject area.

The annex is designed for use alongside the subject benchmark statement rather than as a free-standing document, and readers should refer to both documents.

[1] Available at: www.qaa.ac.uk/academicinfrastructure/benchmark/statements/Maths07.pdf

Annex: Programmes of MMath type

A1	Paragraph 2.17 of the MSOR subject benchmark statement refers to programmes of MMath type, which are subsequently covered in this annex. The annex must be read in conjunction with the benchmark statement; it is not intended as a free-standing document.

A2	The phrase 'MMath programme(s)' is used throughout this annex to avoid repetition of the phrase 'programme(s) of MMath type' which is used in the benchmark statement. However, although MMath is widely used as a degree title, many others are also in use and it is important to appreciate that 'MMath programme(s)' in this annex refers to **all** integrated master's programmes in MSOR.

A3	Within the academic tradition in England, Wales and Northern Ireland, these programmes are normally four academic years in length (or the equivalent by part-time study), each programme being coupled with a corresponding three-year programme leading to a bachelor's degree with honours. As is referred to in the benchmark statement (see paragraphs 1.10 and 2.16), the academic tradition in Scotland is different: four-year honours programmes are the norm, and a corresponding MMath programme would be five years long. Throughout this annex, references to programme length or the year within a programme should be increased by one year if referring to Scotland.

A4	It is worth repeating from paragraph 2.17 of the benchmark statement that MMath programmes were the result of deliberations by a committee of mathematicians in 1992. Changes in mathematics in schools had made it difficult to design honours programmes that were an adequate preparation for postgraduate studies or for employment requiring a similarly high level of mathematical knowledge and skills without, at the same time, being too demanding for the majority of learners.

A5	Thus, the essential aim of an MMath programme is to provide an opportunity for learners to proceed to a higher level of study in MSOR, within the context of an integrated programme based on a conventional three-year bachelor's degree with honours. The additional higher-level material gives the opportunity for a forward step in progression within MSOR.

A6	Such an opportunity is in accord with many of the characteristics of MSOR that are brought out in the benchmark statement. For example, paragraph 1.7 refers to 'the cumulative nature of [MSOR] and the ongoing development of greater maturity in its understanding and use'; and paragraph 2.1 refers to 'logical progression, with prerequisite knowledge always taken into account'.

A7	An MMath programme is always based on a three-year bachelor's programme from which it is a logical progression. The additional higher-level material will be in a limited and coherently chosen number of areas, always dependent on appropriate prerequisite learning; the particular modules chosen by learners may well be subject to approval on a case-by-case basis. The highly integrated nature of the overall four-year programme will mean that learners are able to achieve MSOR master's level within four academic years.

A8	Many learners who wish to advance in MSOR to master's level may be better served taking a separate MSc-type programme after graduating from a bachelor's

programme. This is particularly the case where they also wish to broaden their range of MSOR skills by covering a significant area that was not included in their previous studies. Progression to master's level in this way offers a very important career route into some MSOR areas.

A9   Typically, the first two years of an MMath programme will be identical to the corresponding bachelor's programme.

A10   Institutions are likely to wish to admit directly to an MMath programme as part of normal recruitment. An alternative is to recruit only to the corresponding bachelor's programme and permit learners to transfer at appropriate times during their studies. Such transfers should of course be permitted, even if there is direct recruitment to the MMath programme. Because of the demanding nature of the additional master's level work that will be encountered later, institutions are likely to think it suitable to impose fairly strict conditions on transfers in terms of the quality of work so far exhibited. Similarly, institutions are likely to impose regulations that require learners registered on an MMath programme to transfer to the bachelor's programme if they do not exhibit sufficient quality in their work to suggest that they would benefit from attempting to proceed to master's level.

A11   Institutions may wish to consider whether to permit transfer to an MMath programme from a bachelor's programme other than the one which corresponds to it. This might be reasonable if an institution offers several closely related bachelor's programmes; otherwise, it might be quite rare. This may also extend to the possibility of learners transferring from bachelor's programmes at other institutions, perhaps where MMath programmes are not available. Institutions must exercise great care with any such transfer and assure themselves about a learner's potential to succeed in the programme. See also the general remarks in paragraph 2.3 of the benchmark statement.

A12   The third year of an MMath programme will have much in common with the corresponding bachelor's programme. There may be some restriction on choice of modules and direction towards particular modules that are suitable foundations, or necessary prerequisites, for the master's level work that will follow in the fourth year. It may also be possible for learners to begin to work at the master's level in the third year. However, it should normally be possible for a learner registered on the MMath programme to choose to graduate instead with an appropriate bachelor's degree at the end of the third year, or subsequently.

A13   The entire MSOR subject benchmark statement is directly applicable to the bachelor's element of MMath programmes and the general tenor of the statement also covers many aspects of the master's level material.

A14   An MMath programme will contain modules designated by the institution to be at master's level amounting to at least the workload of a full academic year, normally including a master's-level project involving advanced scholarship by the learner.

A15   In assessing the degree of intellectual challenge represented by master's level work in MSOR, cognisance must be taken of the nature of MSOR, as elaborated in the main text of the benchmark statement. MSOR is a very advanced and highly developed subject and is being continually expanded by further advances in research. Many master's level programmes will nonetheless be informed by current research activity.

Graduates from MMath programmes will have demonstrated knowledge (including some awareness of current research problems) and understanding that is founded upon, extends and enhances that typically associated with the bachelor's level. That knowledge and understanding, and the general techniques for mathematical research that will have been acquired, will provide a basis for originality in developing and applying ideas.

A16   The general remarks on teaching, learning and assessment in section 4 of the benchmark statement apply directly to the master's level work within an MMath programme. Assessment for the award of the MMath degree must include assessment of performance in the master's-level material, taking into account some of the characteristics of assessment in MSOR that are set out in section 5 of the benchmark statement.

Benchmark standard for programmes of MMath type

A17   A benchmark standard[2] for programmes of MMath type is defined at the typical level as set out below. The points made in paragraphs 5.1 to 5.11 of the MSOR benchmark statement must be kept in mind when interpreting this typical MMath benchmark standard. It is intended that learners should meet this standard in an overall sense, not necessarily in respect of each and every of the statements listed.

A18   A graduate who has reached the typical level for MMath should have reached the typical level for a bachelor's degree (see sections 5.14 and 5.15 of the benchmark statement) and further should be able to:

● demonstrate understanding of the main body of knowledge of the programme of study, which should provide a basis for originality in developing and/or applying ideas, often within a research context, and should extend and enhance the understanding associated with achievement at the bachelor's level

● apply knowledge and problem-solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to the programme of study

● integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, where appropriate reflecting on social or ethical responsibilities linked to the application of that knowledge or those judgements

● communicate conclusions and the knowledge and rationale underpinning these, to specialist and non-specialist audiences, clearly and unambiguously

● demonstrate the ability to work professionally with a considerable degree of independence

● continue to study in a manner that may be largely self-directed or autonomous.

---

[2] This benchmark standard is adapted from the qualification descriptor for a second cycle award in *A Framework for Qualifications of The European Higher Education Area*. Available at www.bologna-bergen2005.no/Docs/00-Main_doc/050218_QF_EHEA.pdf

Membership of the benchmarking group for the annex to the subject benchmark statement for mathematics, statistics and operational research

Professor Adrian Bowman	Royal Statistical Society
Professor Peter Giblin	Heads of Departments of Mathematical Sciences in the UK
Mr Gerald Goodall	Royal Statistical Society
Mr Michael Grove	Higher Education Academy Subject Centre for MSOR
Dr Stuart Johns	Operational Research Society
Professor Duncan Lawson (Chair)	Higher Education Academy Subject Centre for MSOR
Dr Niall MacKay	London Mathematical Society
Dr David Salinger	Heads of Departments of Mathematical Sciences in the UK
Professor Nigel Steele	Institute of Mathematics and its Applications
Dr Brian Stewart	London Mathematical Society
Dr David Stirling	Institute of Mathematics and its Applications