BSc in Actuarial Mathematics[1]

Programme Description[2]

School of Mathematical Sciences

Dublin City University

2011/12

Contents

1 Overview of the Programme

- The BSc in Actuarial Mathematics programme provides students with a firm foundation in mathematics, computing and statistics for careers as actuaries in particular, or in finance in general. It is also suitable for students who may be interested in research, teaching, industry or business generally. Specifically, the course provides the opportunity to gain exemptions from some of the professional actuarial examinations. It is a challenging programme both in terms of breadth of application and intellectual depth. Enjoyment of mathematics, problem-solving and an interest in the applications of mathematics are important prerequisites.

- The programme is of four years' duration and may be divided into two parts. In the first four semesters (i.e. in the first and second years) students are introduced to a wide range of mathematical subjects to allow them to make informed choices about subjects in the fourth year. In the latter semesters, students may select subjects with varying degrees of emphasis on actuarial or financial mathematics. Details of the subjects are set out in Section 4.

- It is possible for students to be recommended for exemption from some of the professional actuarial examinations. Performance in particular modules may lead to recommendations for exemptions in these professional subjects. Details of the possible exemptions are set out in Section 6.

[1] As part of a re-structuring of the School's degree programmes, this is the new title for the BSc in Financial & Actuarial Mathematics programme and applies to all students entering the programme from September 2008 onwards.

[2] This version of the document was created on 21 March 2011.

- An important feature is INTRA, a programme under which the University attempts to place students in relevant commercial employment, normally in the second semester of year three. This is an opportunity for students to gain valuable employment experience in an appropriate commercial area.

- Modern business and industry need sophisticated mathematical and allied skills. While the programme is specifically designed for an actuarial career or careers in finance, it is also useful for graduates who may wish to progress to research, teaching or employment in business or industry generally.

2 Programme Aims & Objectives

- The educational philosophy underpinning this programme is that there is intrinsic value attached to acquiring a deep knowledge of mathematics; knowledge of the role of applied mathematics in science and society; knowledge and experience of the use of technology in mathematics; the ability to generate and contribute new knowledge to the areas of actuarial science and financial mathematics.

- The aims of the programme are the following:

  - To provide a strong grounding in basic mathematical principles, with a strong emphasis on the use of computers at every stage;
  - To ensure a knowledge of areas of application of mathematics in financial engineering, actuarial science and risk management;
  - To ensure competence in statistical methods and stochastic processes and their use to model demographic and actuarial concepts;
  - To develop problem-solving skills, analytical reasoning and critical thinking in relation to the assumptions underlying any mathematical models formulated within the course;
  - To give students an opportunity to gain experience of employment in the financial and actuarial services areas during the programme.

- The specific objectives for the programme are:

  - To introduce students to the concepts and applications of actuarial studies as an academic discipline, appropriate to the attainment level of an undergraduate degree in actuarial mathematics.
  - To offer students the opportunity to gain exemptions from a number of the professional examinations of the Institute of Actuaries and the Faculty of Actuaries;
  - To introduce students to subjects which do not form part of the professional actuarial syllabus currently but which are nevertheless of interest to actuaries.

The nature of a mathematics programme is such that the majority of the time is spent acquiring and honing analytical and problem-solving skills. Apart from problem-solving skills, the programme incorporates, to some extent, learning skills, management skills and information technology skills:

- Analytical & Problem Solving Skills:

  Virtually all modules will develop abstract thinking and problem-solving skills. Indeed this is the feature of mathematics programmes most valued by employers.

- Information Technology:

  The full-year, first-year Computing module is dedicated to C++ programming as is the second-year Numerical Mathematics module (in which 25% is allocated to C++ computing assignments), while the Statistics modules employ various computer packages. The Treasury Mathematics module will be entirely Excel-based, and will involve students using real market data and Excel to price vanilla treasury products (futures, swaps, FRA's etc) along with other interest rate products. The techniques include those covered in CT1 and other techniques not currently in the actuarial syllabus. Furthermore, information technology will be used in the delivery of many modules in the form of 'moodle' pages, and it is anticipated that the Industrial placement in third year will involve programming or the use of computer packages for most students.

- Communication Skills:

  The Industrial Placement in third year will have a large and practical communication element.

- Resource Management Skills:

  The modules Introduction to Economics and Mathematics of Finance are delivered during the first two years of the degree. These courses will increase economic awareness and will help the students to make more informed financial decisions in both business and personal settings.

- Learning Skills:

  University-level mathematics requires a different learning method than pre-university mathematics. Part of the difficulty encountered by students in mathematics programmes is making this transition. The first year module 'Maths Experience' will address the issue of independent learning to assist students in making this transition, while the modules Analysis I and Differential Equations in second year will address the change to abstract thinking, using the method of guided enquiry.

3 Intake & Entry Requirements

- The programme can be accessed exclusively through the Central Applications Office (CAO code DC126). The entry requirement (in addition to the general conditions set by the University) is a grade B3 or higher in honours Mathematics in the Irish Leaving Certificate examination. Where a school-leaving examination other than the Leaving Certificate is presented, an equivalent grade in Mathematics will be required.

- There is also an alternative entry mechanism via the common entry route, which has a designated CAO code (DC127) and is entitled the Common Entry into Actuarial, Financial and Mathematical Sciences (CAFM). The entry requirement (in addition to the general conditions set by the university) is also a grade B3 or higher in honours Mathematics in the Irish Leaving Certificate examination, in line with the standard required for direct entry into the BSc in Actuarial Mathematics programme.

- The entry requirement equates to a score of at least 75% on the average of two examination papers in Leaving Certificate Mathematics. Where a school-leaving examination other than the Leaving Certificate is presented, an equivalent grade in Mathematics will be required.

- At the end of the second year, students on the common entry degree will be ranked based on their second-year results. In order of merit, students will then choose places on the BSc

in Actuarial Mathematics or the BSc in Financial Mathematics or the BSc in Applicable Mathematics. At any particular stage, a maximum of 50 students per year on either degree will be permitted. Admission to the BSc in Actuarial Mathematics will also be subject to the approval of the Progression & Awards Board, in consultation with the External and Independent Examiners for that degree.

4 Programme Structure & Assessment

- The modules which make up the programme are core or option modules in semesters 1 and 2, or year-long linked modules, core or option. Each module carries the credit value given below. Successful completion of each year of the programme has an ECTS credit value of 60.
- Within the Bologna Declaration, it is proposed that European Higher Education should be based on courses which are compatible with the European Credit Transfer System (ECTS). ECTS is a tool for conversion between national education systems and is an important instrument in removing barriers to mobility. The two main elements of ECTS are a credit system and a grading scale. In the ECTS credit system, one year of full-time study corresponds to 60 credits. ECTS also offers a grading scale which can be used to convert grades awarded in one national system into the most closely-corresponding grade in another system. The two elements, when used together, enable a student's learning achievement in one institution to be recognised by another.
- The distribution of modules across the programme years is presented in Table 1. The following points should be noted:
  - Year 1: Modules 1 and 2 are core in Semester 1, modules 3 and 4 are core in Semester 2, and modules 5, 6 and 7 are year-long core modules.
  - Year 2: Modules 8 to 12 are core in Semester 1 and modules 13 to 18 are core in Semester 2.
  - Year 3: Modules 19 to 22 are core and module 23 is optional in Semester 1. Students undertake a 32-week industrial placement (INTRA) commencing at the beginning of Semester 2.
  - Year 4: Modules 25 to 28 are core in Semester 1. Modules 29 to 30 are core in Semester 2 and students must choose two of the Semester 2 option modules 31 to 34.
- The core idea underpinning the learning philosophy of this degree is that graduates in applied mathematics must accumulate a combination of knowledge, skills and modes of thinking in order to succeed in bringing their education to bear in their future careers. We see this accumulation as happening on a gradual basis, with students starting at a level where they must review and refine their school-mathematics knowledge and skills and begin the process of reflecting on the nature of mathematics and their engagement with it.
- In subsequent years, students will become more independent in their learning: modules dealing specifically with helping students to make this transition take place in years one and two. In particular, the flow of modules is designed with a view to helping student to make the transition to the stage where they can construct their own formal mathematical arguments.

ACM 2011/12

No.	Code	Module Title	Credits	Terminal Examination	Continuous Assessment
Year 1					
1	MS105	Calculus	7.5	75%	25%
2	MS108	The Mathematical Experience	5	50%	50%
3	MS109	Analysis I	7.5	60%	40%
4	MS117	Probability I	5	75%	25%
5	CA167	Computing for Mathematics	15	70%	30%
6	EF110	Introduction to Economics	10	80%	20%
7	MS106	Linear Mathematics	10	80%	20%
Year 2					
8	MS205	Calculus of Several Variables	5	75%	25%
9	MS213	Numerical Methods	7.5	75%	25%
10	MS217	Linear Algebra	5	75%	25%
11	MS229	Analysis II	5	75%	25%
12	MS255	Statistics I	5	80%	20%
13	AC316	Accounting I	7.5	80%	20%
14	MS206	Complex Analysis	5	75%	25%
15	MS208	Probability II	5	75%	25%
16	MS211	Differential Equations	5	75%	25%
17	MS216	Mathematics of Finance	5	80%	20%
18	MS258	Statistics II	5	80%	20%
Year 3					
19	AC334	Principles of Accounting & Taxation	10	80%	20%
20	MS308	Stochastic Modelling	7.5	75%	25%
21	MS318	Financial Mathematics	7.5	75%	25%
22	MS332	Actuarial Modelling	7.5	100%	
23	MS306	Treasury Mathematics	—		P/F
24	IN306	INTRA	30		100%
Year 4					
25	MS427	Financial Economics I	7.5	75%	25%
26	MS447	Time Series	7.5	75%	25%
27	MS449	Risk Theory	10	100%	
28	MS450	Simulation for Finance	7.5		100%
29	MS428	Financial Economics II	7.5	75%	25%
30	MS448	Life Contingencies	10	75%	25%
31	EF520	Financial Engineering	7.5	100%	
32	MS415	Optimization	7.5	75%	25%
33	MS505	Coding & Cryptography	7.5	75%	25%
34	MS551	Monte Carlo Methods in Finance	7.5	50%	50%

Table 1: 2011/12 Modules by ACM Programme Year

- The guiding philosophy behind the assessments is to develop and test the understanding and mastery of the various skills required of a graduate in applied mathematics. The assessment methods will aim towards the measurement of specific module learning outcomes and the encouragement of creativity, critical thinking and academic writing skills.

- The assessment of the modules will be by continuous assessment, project work and terminal examination or by a combination of these elements. The nature of the assessment and percentage marks allocated to the elements of continuous assessment will vary depending on the module. Table 1 indicates the relative breakdown of marks between continuous assessment (CA) and terminal examination (TE) for each module.

- Strict adherence to the University's Marks and Standards will be observed in all matters relating to progression regulations, compensation regulations, accumulation of credits, the attainment levels for award classifications and regulations regarding repeat attempts. All the taught modules in the programme are eligible for compensation as defined in the Marks and Standards.

- A brief summary of the main progression regulations and award classifications is given below:

  - The pass mark is 40%.
  - In order to progress from one year of study to the next, students must pass all modules, either unequivocally or by means of compensation (in accordance with such regulations as are in place prescribed for the programme of study).
  - Classification of the final degree award will be based on the final-year modules:

First-Class Honours	70%—100%
Second-Class Honours, Grade 1	60%—69%
Second-Class Honours, Grade 2	50%—59%
Third-Class Honours	40%—49%

  - A student who fails a module or who does not take a full set of examinations in the final year of the programme, is normally eligible for third-class honours only.

5 Programme Changes

- Year 4 of the ACM programme becomes available for the first time in 2011/12. While there is no change to the originally-accredited programme in terns of CT-associated modules, some new core and option modules have been added. The full set of module specifications for Year 4 will be circulated for approval to the Institute of Actuaries Accreditation Panel, the Independent Examiner and the External Examiner.

- From February 2011, the School of Mathematical Sciences has assumed responsibility for the teaching of CT3-associated modules CA255 and CA258. Without changes to the respective syllabi, the module codes have been amended to MS255 and MS258 respectively.

- On a phased basis (see Tables 2, 3, 4 and 5), the existing CT2-associated modules of EF107A and AC334 will be replaced by AC316 and EF316 (the latter two were the CT-associated modules in the old Financial & Actuarial Mathematics programme). While all the CT3 learning objectives remain in place, there will be some necessary re-organization of material across modules. ACM2 students will take AC316 for the first time in 2011/12. EF316 will be taken by ACM3 students for the first time in 2012/13.

6 CT Series Subjects & Independent Examiners

CT Series Subject	DCU Modules	Independent Examiner
CT1 Financial Mathematics	MS318	John Millett
CT2 Finance & Financial Reporting	EF107A, AC334	John Millett
	AC316 & EF316	
CT3 Probability & Mathematical Statistics	MS117, CA255, CA258	John Millett
	MS117, MS255, MS258	
CT4 Models	MS308, MS332	John Millett
CT5 Contingencies	MS448	John Millett
CT6 Statistical Methods	MS447, MS449	John Millett
CT7 Economics	EF110	John Millett
CT8 Financial Economics	MS427, MS428	John Millett

7 Contact Details

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ACM 2009/10

Year 1

No.	Code	Module Title	Credits	Terminal Examination	Continuous Assessment
1	MS105	Calculus	10	75%	25%
2	MS108	The Mathematical Experience	2.5	50%	50%
3	EF107A	Corporate Finance	7.5	75%	25%
4	MS117	Probability I	5	75%	25%
5	CA167	Computing for Mathematics	15	70%	30%
6	EF110	Introduction to Economics	10	80%	20%
7	MS106	Linear Mathematics	10	75%	25%

Year 2

8	CA255	Statistics I	5	100%	
9	MS205	Calculus of Several Variables	5	75%	25%
10	MS209	Analysis I	7.5	60%	40%
11	MS213	Numerical Methods	7.5	75%	25%
12	MS217	Linear Algebra	5	75%	25%
13	CA258	Statistics II	5	80%	20%
14	MS206	Complex Analysis	5	75%	25%
15	MS208	Probability II	5	75%	25%
16	MS211	Differential Equations	5	75%	25%
17	MS216	Mathematics of Finance	5	80%	20%
18	MS229	Analysis II	5	75%	25%

Year 3 (operational from 2010/11)

19	AC334	Principles of Accounting & Taxation	10	80%	20%
20	MS308	Stochastic Modelling	7.5	75%	25%
21	MS318	Financial Mathematics	7.5	75%	25%
22	MS332	Actuarial Modelling	7.5	100%	
23	MS306	Treasury Mathematics	—		P/F
24	IN306	INTRA	30		100%

Year 4 (operational from 2011/12)

25	MS427	Financial Economics I	7.5	75%	25%
26	MS447	Time Series	7.5	75%	25%
27	MS449	Risk Theory	10	100%	
28	MS450	Simulation for Finance	7.5		100%
29	MS428	Financial Economics II	7.5	75%	25%
30	MS448	Life Contingencies	10	75%	25%
31	EF520	Financial Engineering	7.5	100%	
32	MS415	Optimization	7.5	75%	25%
33	MS505	Coding & Cryptography	7.5	75%	25%
34	MS551	Monte Carlo Methods in Finance	7.5	50%	50%

Table 2: 2009/10 Modules by ACM Programme Year

ACM 2010/11

No.	Code	Module Title	Credits	Terminal Examination	Continuous Assessment
Year 1					
1	MS105	Calculus	7.5	75%	25%
2	MS108	The Mathematical Experience	5	50%	50%
3	MS109	Analysis I	7.5	60%	40%
4	MS117	Probability I	5	75%	25%
5	CA167	Computing for Mathematics	15	70%	30%
6	EF110	Introduction to Economics	10	80%	20%
7	MS106	Linear Mathematics	10	75%	25%
Year 2					
8	CA255	Statistics I	5	100%	
9	MS205	Calculus of Several Variables	5	75%	25%
10	MS209	Analysis I	7.5	60%	40%
11	MS213	Numerical Methods	7.5	75%	25%
12	MS217	Linear Algebra	5	75%	25%
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21	MS318	Financial Mathematics	7.5	75%	25%
22	MS332	Actuarial Modelling	7.5	100%	
23	MS306	Treasury Mathematics	—		P/F
24	IN306	INTRA	30		100%
Year 4 (operational from 2011/12)					
25	MS427	Financial Economics I	7.5	75%	25%
26	MS447	Time Series	7.5	75%	25%
27	MS449	Risk Theory	10	100%	
28	MS450	Simulation for Finance	7.5		100%
29	MS428	Financial Economics II	7.5	75%	25%
30	MS448	Life Contingencies	10	75%	25%
31	EF520	Financial Engineering	7.5	100%	
32	MS415	Optimization	7.5	75%	25%
33	MS505	Coding & Cryptography	7.5	75%	25%
34	MS551	Monte Carlo Methods in Finance	7.5	50%	50%

Table 3: 2010/11 Modules by ACM Programme Year

ACM 2011/12

No.	Code	Module Title	Credits	Terminal Examination	Continuous Assessment
Year 1					
1	MS105	Calculus	7.5	75%	25%
2	MS108	The Mathematical Experience	5	50%	50%
3	MS109	Analysis I	7.5	60%	40%
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31	EF520	Financial Engineering	7.5	100%	
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33	MS505	Coding & Cryptography	7.5	75%	25%
34	MS551	Monte Carlo Methods in Finance	7.5	50%	50%

Table 4: 2011/12 Modules by ACM Programme Year

No.	Code	Module Title	Credits	Terminal Examination	Continuous Assessment
Year 1					
1	MS105	Calculus	7.5	75%	25%
2	MS108	The Mathematical Experience	5	50%	50%
3	MS109	Analysis I	7.5	60%	40%
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12	MS255	Statistics I	5	100%	
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20	MS308	Stochastic Modelling	7.5	75%	25%
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22	MS332	Actuarial Modelling	7.5	100%	
23	MS306	Treasury Mathematics	—		P/F
24	IN306	INTRA	30		100%
Year 4					
25	MS427	Financial Economics I	7.5	75%	25%
26	MS447	Time Series	7.5	75%	25%
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28	MS450	Simulation for Finance	7.5		100%
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30	MS448	Life Contingencies	10	75%	25%
31	EF520	Financial Engineering	7.5	100%	
32	MS415	Optimization	7.5	75%	25%
33	MS505	Coding & Cryptography	7.5	75%	25%
34	MS551	Monte Carlo Methods in Finance	7.5	50%	50%

Table 5: 2012/13 Modules by ACM Programme Year