Department of Economics, Mathematics and Statistics

Mathematics and Statistics
Undergraduate Programmes

Handbook for Students

2016/2017
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Introduction
Welcome to Birkbeck. We hope you will enjoy your time here. This handbook aims to provide the information you need to get started here and will be a useful reference throughout your programme. It can also be downloaded from http://www.ems.bbk.ac.uk/for_students/bsc_maths.

We have included information about the modules you will study on your programme, as well as guidance on dealing with coursework and examinations and the ways in which Birkbeck can help with this, such as library and computing facilities and provision for students with a disability. Contact details for all staff are given at the end of the handbook.

Obviously it isn’t possible to anticipate every question that you might have. If you have any questions or difficulties during your time at Birkbeck, there are several people who can help. The Department Undergraduate Administrator is Cassie Fernandes; she looks after all our undergraduate programmes. Jo Kwok is the administrator for our Graduate Certificate and Graduate Diploma programmes. Both are available in the Department office between 10am and 6pm weekdays. You can also speak to your personal tutor (you will be told who this is) about your programme or any issues affecting your studies. Lecturers are happy to answer questions about their modules.

About Birkbeck
Birkbeck College was founded in 1823 and is one of the multi-faculty colleges of the University of London. The principal aim of the College is to provide for part-time students engaged in earning their livelihood during the daytime. Birkbeck has consistently been highly rated both for the quality of its teaching and its research – in fact we have the highest proportion of research-active academic staff of all London Universities. This means our curricula and teaching programmes are kept up-to-date and relevant. We are regularly rated very highly in the annual National Student Survey for the quality of our teaching.

Mathematics and Statistics
The Mathematics and Statistics section is part of the Department of Economics, Mathematics and Statistics in the School of Business, Economics and Informatics. The Department has an excellent teaching record. It has been praised by both internal and external quality assurance reviews for the level of support and guidance available to students, and the constructive undergraduate admissions procedure, which enables students from a wide variety of backgrounds to gain access to higher education.

Members of Staff
All mathematics and statistics academic staff are involved in teaching, and we strive to provide a friendly and sympathetic environment for our students. In addition to their teaching commitments academic members of staff are engaged in research in mathematics and statistics. Some modules for our joint honours programmes are taught by other members of the School, in particular Economics and Finance lecturers in our Department, as well as members of the Department of Management and Organizational Psychology. There are also sessional lecturers who teach individual modules.

On the next page is a list of Academic and Administrative Staff involved on the programmes covered here. Contact details for staff can be found in the section at the end of this handbook.
Mathematics and Statistics Academic Staff

- Brad Baxter, MA (Cantab), MMath (Cantab), PhD (Cantab), Reader in Mathematics
- Andrew Bowler, BSc (Warwick), MSc (Nottingham), PhD (London) Lecturer in Mathematics, BSc Programme Director
- Anthony Brooms, BSc (Manchester), MSc (Sheffield), PhD (Bristol), Lecturer in Statistics, MSc Applied Statistics Programme Director and Examinations Officer
- Ben Fairbairn, MMath MA (Cantab), PhD (Birmingham), Lecturer in Mathematics Full-time BSc admissions tutor
- Isabella Gollini, B.Sc. (Genoa/Nice Sophia Antipolis), M.Sc. (Bologna), Ph.D. (U.C.Dublin), Lecturer in Statistics, Graduate Cert/Dip Statistics Programme Director
- Sarah Hart, MA (Oxon), MSc (Manchester), PhD (UMIST), Professor of Mathematics, Graduate Cert/Dip and MSc Mathematics Programme Director
- Simon Hubbert, BSc (London), PhD (London), Senior Lecturer in Financial Mathematics
- Steven Noble, BA (Oxon), DPhil (Oxon), Reader in mathematics
- Georgios Papageorgiou, BSc (Athens UEB), MS (Florida), PhD (Florida), Lecturer in Statistics
- Maura Paterson, BSc (Adelaide), PhD (London), Senior Lecturer in Mathematics, Undergraduate Mathematics and Statistics Examinations Officer
- Rosalba Radice, MSc (Lond), PhD (Bath), Lecturer in Statistics
- Amarpreet Rattan, BSc (Queen's), M.Math, PhD (Waterloo), Lecturer in Mathematics, MSc Mathematics Examinations Officer

Departmental Administrative Staff for programmes in this handbook

- Cassie Fernandes, BSc and Cert/Dip HE Maths/Stats Administrator
- Charles Graham-Dixon, Grad Cert/Dip Maths/Stats Administrator

Communication between Students and the Department
Apart from face-to-face communication, there are three main ways in which we will give you information.

Email
Email will be the main way that we update you about your programme. When you register you will be asked to provide an email address. If you wish, you can be given a Birkbeck email address. You are expected to check your email regularly as this will be the main way that we update you about your programme.

Online
There are many resources for students both on the Department website http://www.ems.bbk.ac.uk/for_students
and the MyBirkbeck webpage (http://www.bbk.ac.uk/mybirkbeck). The MyBirkbeck page has links to the Library, Finance pages, Students’ Union, Disability Office and Careers Service. On the mathematics and statistics pages you will also find timetables, items of news, minutes of Student-Staff exchange meetings, and detailed information about modules. The online resources for individual modules will vary depending on the lecturer and how long the module has been running. However you will always find a syllabus, learning outcomes and a list of recommended books. Additionally all assignments will be available to download, as well as being distributed in lectures. Some lecturers will post course materials on the virtual learning environment Moodle (moodle.bbk.ac.uk) – you will be given a Birkbeck username and password which you can use to access this.

**Noticeboards**

There are noticeboards in the department where programme information is posted. It is worth checking them regularly. Opposite the lifts on the 7th floor, there is a noticeboard with lecture timetables and information about coursework, such as which assignments are ready for collection and confirmation of whose work has been received. Job advertisements are posted on the noticeboards opposite room 719 (by the Department Office).

**Student Feedback**

It is essential for the success of the degree programme that we are able to find out what you think of it. It is our policy to seek students’ feedback about all the courses and lecturers, and to act upon this information. There are several ways in which you can give us feedback.

**Class Representatives:** These are elected to represent the class in the Students’ Union and the Staff/Student Exchange Committee meetings, and can also approach the Programme Director on behalf of the class.

**Student-Staff Exchange Meetings:** These are timetabled each term for the Class Reps who will receive notice of the meetings and will ask the class if there are any issues that should be discussed.

**Course Evaluations:** These are handed out at the end of each term and each module for your comments. In these, you are asked to comment on the quality of the teaching for that module. Responses are reviewed at the Department’s Teaching Sub-Committee, and any important responses will be provided to students at the Staff/Student Exchange Committee meetings.

**Personal Tutors**

Every student is assigned a Personal Tutor. Your personal tutor is there to discuss any problems and advise you on your academic progress. If you have any health or other personal issues, or academic problems that are worrying you or that might affect your ability to keep up with your work, you should come and discuss them with your personal tutor at the earliest opportunity. Even if you are not experiencing any difficulties, you should make sure you see your personal tutor at least once a term to let him or her know how you are doing. Most academic staff have weekly ‘office hours’ which are posted on their websites and office doors. At these times you can just drop in without an appointment. Staff are often able to see students at other times too, but it is best to make an appointment by phone or email to ensure that they are available. Your personal tutor is viewable on your My Birkbeck profile by viewing the tab ‘My studies, enrolments and timetable’, and then clicking on ‘My personal tutors’.

**Fees and Financial Support**

Part-time students enrolled at Birkbeck have to pay fees. These cover the cost of tuition, registration and examinations. Annual fees for 2016-17 are as follows:

<table>
<thead>
<tr>
<th>Programme</th>
<th>Home/EU</th>
<th>Overseas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cert HE Mathematics and Year 1 of Dip HE Mathematics</td>
<td>£4,500 pa</td>
<td>£4,500 pa</td>
</tr>
</tbody>
</table>
Fees can be paid in a variety of ways, including by monthly direct debit, and you will receive more information about this when you take up your place here. Until you have arranged payment of your fees, you will not be given a student card. This means you will not have access to the library or computing facilities. Students on some programmes have access to a student loan, see below. Detailed information about fees and financial support are available online at http://www.bbk.ac.uk/mybirkbeck/finance/studentfinance

<table>
<thead>
<tr>
<th>Programme</th>
<th>£6,750 pa</th>
<th>£9,750 pa</th>
</tr>
</thead>
<tbody>
<tr>
<td>All BSc programmes and Years 2 and 3 of Dip HE Mathematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduate Certificate and Graduate Diploma Programmes</td>
<td>£2,650 pa</td>
<td>£4,825 pa</td>
</tr>
</tbody>
</table>

If you can answer yes to these three questions you can get a loan:

1. Are you wanting to study for an undergraduate degree or certificate of higher education at Birkbeck? [Not Graduate Certificate or Graduate Diploma]
2. Is this your first time studying at this level?
3. Are you classified as a Home/EU student?

With a loan, you will pay nothing upfront. The government will pay your fees, and you will normally start to repay after you’ve graduated and you’re earning more than £21,000. The loan is available regardless of age or income.

You can apply and enrol on a course at Birkbeck with confidence because:

- You are eligible for a loan and can start your studies without paying anything upfront.
- You can get face-to-face support to help you apply for your course and your loan.
- Birkbeck will provide additional financial support including fee reductions and cash bursaries for students in financial need.

Orientation and induction events

To help our new students settle into Birkbeck, we offer orientation and induction events at the beginning of each academic year. If you are starting a course in October, we recommend you come along to September Student Orientation event for all new students. By attending the event, you will have the opportunity to attend a number of talks on areas such as the library resources, study skills, organising your time and much more. To register for the Birkbeck Orientation event you will need to be enrolled on your programme or have received an unconditional offer in order to be able to attend. More information, including dates for the events, is available at:

http://www.bbk.ac.uk/mybirkbeck/services/orientation/orientation-new

You can also contact the MyBirkbeck helpdesk if you need any help booking your place.

We also have an induction event for Mathematics and Statistics students in September – we will email you with an invitation nearer the time.

Withdrawal from Programme

If for any reason you are considering withdrawing from the programme, please come and discuss this with your personal tutor as soon as possible. It may be possible to take a break in studies rather than withdrawing completely. If you wish to take a break in studies, you need to do this via your My Birkbeck profile, by clicking on the ‘Change’ button. Full details are available at: http://www.bbk.ac.uk/mybirkbeck/services/administration/break-in-studies

A student who withdraws fifteen or more days after the start of the first term of study is liable for payment of tuition fees for the first term of their intended study, and all subsequent terms up to and including the term in which they withdraw. So the fees charged would be as follows.
Students leaving in the first 14 days of the Autumn Term – administration fee only;
Students leaving during Autumn term or before the end of the first fortnight of Spring Term – Autumn Term fees only are payable;
Students leaving during Spring Term or before the end of the first fortnight of Summer Term – Autumn and Spring Terms fees only are payable;
Students leaving after the first fortnight of the Summer Term will be liable for the full year’s fees.

Facilities for Students

My Birkbeck
The My Birkbeck helpdesk is your first point of reference for support during your studies with us - with a team of friendly and helpful staff on hand to provide the information and advice you need. If you need more specialist advice, our team will be able to refer you to the right person for more in-depth professional support, as well as book you an appointment with an advisor. We can help you with:

- all your application and enrolment queries
- general information about any aspect of your studies at Birkbeck
- getting referred to specialist staff for more in-depth professional support
- making an appointment for one-to-one advice
- general information about all our courses at Birkbeck

The My Birkbeck helpdesk is based at reception in the main building. Our staff are on hand to provide the information and advice from Monday to Friday between 12 and 6:45pm, and on Saturdays between 12 and 5pm.

If you can't come in, you can phone us on: 0845 601 0174. Phone lines are open between 9am and 6pm Monday to Friday. If calling from outside the UK: +44 (0)20 7631 6249 / 6435 / 6692. You can also use the self-service terminal to access information. The My Birkbeck Helpdesk is located in the main building at Torrington Square (WC1).

There is an extensive My Birkbeck website (http://www.bbk.ac.uk/mybirkbeck) which contains a range of information, including

- **Student guides**: these guides are designed for different groups of students so whether, for example, you’re a certificate-level student, a PhD student or studying in Stratford, you can use these guides to find the information most relevant to you.
- **Course administration**: all the procedural information you need, from application, enrolment and registration, to exams and assessment.
- **Student support**: we offer you a range of student support services, including learning support and skills training, careers advice, computing and IT support and library services.
- **About you**: get information on your student records, student card(s), getting proof that you’re a student and other personal information.
- **Forms and cover sheets**
- **Rules and regulation**

Disability Support
At Birkbeck there are students with a wide range of disabilities including dyslexia, visual or hearing impairments, mobility difficulties, mental health needs, medical conditions, respiratory conditions. Many of them have benefited from the advice and support provided by the College's Disability Office.
The Disability Office
Disability Statement

At Birkbeck there are students with a wide range of disabilities, specific learning difficulties, medical conditions and mental health conditions. Many of them have benefited from the advice and support provided by the College’s Disability Office.

The Disability Office
The Disability Office is located in room G12, on the ground floor of the Malet Street building. All enquiries should come to the Disability Office, who will determine the appropriate referral to specialist staff. They can provide advice and support on travel and parking, physical access, the Disabled Students Allowance, special equipment, personal support, examination arrangements, etc. If you have a disability or dyslexia, we recommend you call us on 0207 631 6316 to book an appointment. The Disability Office can also complete a Support Plan with you, confirming your support requirements with your School and relevant Departments at the College so they are informed of your needs.

Access at Birkbeck
Birkbeck’s main buildings have wheelchair access, accessible lifts and toilets, our reception desks and teaching venues have induction loops for people with hearing impairments, and we have large print and tactile signage. Disabled parking, lockers, specialist seating in lectures and seminars and portable induction loops can all be arranged by the Disability Office.

The Disabled Students Allowance
UK and most EU students with disabilities on undergraduate and postgraduate courses are eligible to apply for the Disabled Students’ Allowance (DSA). The DSA usually provides thousands of pounds worth of support and all the evidence shows that students who receive it are more likely to complete their courses successfully. The Disability Office can provide further information on the DSA and can assist you in applying to Student Finance England for this support.

The Personal Assistance Scheme
Some students need a personal assistant to provide support on their course, for example a note-taker, sign language interpreter, reader, personal assistant, disability mentor or dyslexia support tutor. Birkbeck uses specialist agencies to recruit Personal Assistants and they may be able to assist you with recruiting, training and paying your personal assistant. Please contact the Disability Office for information on this scheme.

Support in your Department
Your Department will receive a copy of your Support Plan from the Disability Office. This will make specific recommendations about the support you should receive from the Department. Whilst we anticipate that this support will be provided by the Programme Director, tutors and Programme Administrator in the Department, they will also have a Disability Lead. If you experience any difficulties or require additional support from the Department then they may also be able to assist you. They may be contacted through the Programme Administrator.

Support in IT Services and Library Services
There is a comprehensive range of specialist equipment for students with disabilities in IT Services. This includes an Assistive Technology Room, which may be booked by disabled students. We have software packages for dyslexic students (e.g. Claroread and Inspiration), screen reading and character enhancing software for students with visual impairments available in our computer laboratories, specialist scanning software, large monitors, ergonomic mice and keyboards, specialist
orthopaedic chairs, etc. We have an Assistive Technology Officer, who can be contacted via IT Services.
The Library has an Assistive Technology Centre, where there is also a range of specialist equipment, including a CCTV reading machine for visually impaired students, as well as specialist orthopaedic chairs and writing slopes. The Disability Office refers all students with disabilities to the Library Access Support service, who provide a comprehensive range of services for students with disabilities.

Examinations and Assessments
Many disabled students can receive support in examination, including additional time, use of a computer, etc. They are often also eligible for extensions of up to two weeks on coursework.

Specific Learning Difficulties (Dyslexia)
Mature students who experienced problems at school are often unaware that these problems may result from their being dyslexic. Whilst dyslexia cannot be cured, you can learn strategies to make studying significantly easier. If you think you may be dyslexic you can take an online screening test in the computer laboratories, the instructions for the screening test are available on the Disability Office website. If appropriate, you will be referred to an Educational Psychologist for a dyslexia assessment. Some students can receive assistance in meeting this cost, either from their employer or from Birkbeck.

Further information
For further information or to make an appointment to see the Disability Office, please call the Student Centre on 020 7631 6316 or email disability@bbk.ac.uk.

Examinations
Students with disabilities and dyslexia may be eligible for special arrangements for examinations e.g. extra time, use of a word processor, amanuensis, enlarged examination papers etc. In order to receive special arrangements a student must provide medical evidence of their disability (or an Educational Psychologists report if you are dyslexic) to the Disability Office. For School examinations you should contact your Programme Director to request special arrangements at least 2 weeks before the examination. For main College summer examinations you are given the opportunity to declare that you require special provision on your assessment entry form. Students who require provision should then attend an appointment with the Disability Office to discuss and formalise the appropriate arrangements. The closing date for making special examination arrangements in College examinations is the 15th March and beyond this date consideration will only be given to emergency cases.

Further information
Full information on disability support can be found at:
http://www.bbk.ac.uk/mybirkbeck/services/facilities/disability

For further information or to make an appointment to see the Disability office, please call the Student Centre on 020 7631 6316 or email disability@bbk.ac.uk. Alternatively you can go to the Disability Office in room G12 between 4pm and 6pm Monday – Thursday for during their drop-in hours.

Computing
All students are given an account on the College network which is activated on payment of fees. This gives access to College and Department resources, the web and an (optional) email account. Usernames and passwords can be obtained from the Department Help Desk (see below) on production of a College Membership Card. Student email addresses are of the form username@students.bbk.ac.uk. College staff email addresses are initial.surname@bbk.ac.uk.
The Department provides computing support for all Department students. IT Services (ITS) ([http://www.bbk.ac.uk/its](http://www.bbk.ac.uk/its)) is a College service that supports students throughout the College. The seventh floor notice boards have information on courses, software and hardware offers and other computer services.

**Department Student Help Desk**
The Help Desk is run by the Department computing staff:
Nigel Foster (room 759), tel 020 7631 6402, and
Awuku Danso (room 758), tel 020 7631 6433.
Email: helpdesk@ems.bbk.ac.uk at the following times:

Term: Mon – Fri 16.00 – 18.00  
Vacations: Mon – Thurs 16.00 – 18.00

**ITS Reception Help Desk**
Ground floor, Main Building, Tel.: 020 7631 6543.
Term: Mon – Fri 09.00 – 20.00  
Vacations: Mon – Fri 10.00 – 18.00

**Workstation Rooms**
The Department has its own Workstation Room, Room 742, for specialized software.
For more general software, ITS run the following Workstation Rooms:

- Rooms 10 and 11, 43 Gordon Square;
- Rooms 109, 412, 413, 422, 423 and 536

**Library**
Although lectures are an essential element of your programme, success in learning also depends on the additional study and reading that you undertake. Most items on module reading lists can be found in Birkbeck Library and it is important that you familiarise yourself with the Library as soon as you can. Birkbeck Library is accessible from the ground floor of the main Malet Street building (entrance on Torrington Square). Your College ID card gives you automatic access to the Library. There is no need to register. The opening times of the Library are designed to meet the needs of part-time students in full-time work. During term-time the Library is open:

- 7 days a week 8.30am – 11.45pm.

The Library is fully staffed for most of the above hours but self-service machines allow you to take out and return books when the Library is not staffed:

- Before 10.00am every day.
- After 10.30pm week days.
- After 6.00pm on Saturdays and Sundays.

You can borrow up to 10 items and they can be renewed as long as no-one else requests them. Most books can be borrowed for 3 weeks. Some books, videos and DVDs can be borrowed for 1 week. A few items can only be issued for 1 day. There is also a Reading Room Collection with reference access to key course readings.

Please be a responsible Library user. The smooth running of the Library depends on your cooperation. Please renew or return items promptly, especially if someone else has requested them. If you fail to return items on time you will incur fines and your borrowing rights will be suspended.
Birkbeck eLibrary
You can access a whole host of electronic journals and databases from any PC in College. These resources can also be accessed from outside College with your IT Services (ITS) username and password.

The Library website is at http://www.bbk.ac.uk/lib. As well as giving comprehensive information about the Library’s services and collections, you can also:

- Search the Library catalogue, renew your books and place reservations on items that are out on loan.
- Read articles in over 25,000 full-text electronic journal titles and newspapers.
- Search databases to help you find out what has been written about the subject you are researching, including the Current Index to Statistics, MathSciNet, Science Citation Index and Social Science Citation Index.
- Access past exam papers.
- Work through LIFE – an online tutorial to help you make the most of the Library.

Other libraries
Birkbeck students can also use other libraries. Students have reference access to most University of London college libraries, see http://www.london.ac.uk/libraries. Part-time students can also join the SCONUL Access Scheme, see http://www.access.sconul.ac.uk, allowing access to most other higher education libraries with limited borrowing rights. See the Library web site for more information.

Further information and help
If a book you need is not available in the Library or you require any help using the resources or finding information, please ask at the help desk (020 7631 6063). Alternatively, contact your Subject Librarian, Aidan Smith, directly. Telephone: 020 7631 6062. Email am.smith@bbk.ac.uk.

Learning Support
The School has two dedicated learning support officers – Richard Carabine specialises in study skills and academic English, while Eva Szatmari has expertise in mathematics and statistics. They run numerous workshops and can also offer one-to-one support. For more information, visit the BEI Study Skills area on Moodle (moodle.bbk.ac.uk).

Careers
Most students are interested in developing their careers, either within their current field of work or in a completely new direction. The Specialist Institutions’ Careers Service [SICS], part of The Careers Group, University of London, offers great expertise and experience in working with students and graduates of all ages and at all stages of career development. SICS is located on the 1st Floor of Stewart House, 32 Russell Square, London, WC1B 5DN.

- An Early Evening Advisory Service specifically for evening students on Wednesdays in term-time from 5pm to 7pm. You must pre-book by 12 noon on Wednesdays by calling 020 7866 3600 or emailing sics@careers.lon.ac.uk
- Drop-In Advice Service - Monday-Thursday, 14.00-16.30.
- Longer Advisory Interviews can be arranged - for career beginners, for people wanting a practice job interview, and for every stage and situation in between.
- They also offer Psychometric Testing and Personality Assessment Workshops, Employer Presentations, Computer-based Career Guidance Programs, Insight Career Courses as well as invaluable information on Course Funding.
Enrolled students of Birkbeck who are following degree programmes may use the services of SICS free of charge up to the end of July of the year they finish.

For more information visit The SICS website: http://www.careers.lon.ac.uk/sics.

**Employability - Careers and Employability Service**

We provide comprehensive careers, recruitment and employability advice, events and information services for our students, both online and face-to-face at our dedicated support space on the Birkbeck campus in Bloomsbury. These include: speaking to a careers advisor; panel discussions with employers, Birkbeck alumni and careers consultants; workshops and events on finding work, CV and application writing, and preparing for interviews; and online social media support.

We also work closely with Birkbeck Talent, our in-house recruitment service, to provide bespoke support for student pursuing employment and internship opportunities.

To find out more, visit [bbk.ac.uk/careers](http://www.bbk.ac.uk/careers)

**Birkbeck Talent: a dedicated in-house recruitment service for students**

Birkbeck Talent is a professional recruitment service aimed exclusively at assisting Birkbeck students to find work whilst studying and after graduation. We work with London’s top employers to offer innovative internships, prestigious job vacancies and exciting graduate opportunities.

To find out more, visit [bbk.ac.uk/talent](http://www.bbk.ac.uk/talent)

**Business Engagement team**

The School of Business, Economics and Informatics has a dedicated Business Engagement team where you can take advantage of extra support - in addition to what is offered by Birkbeck Talent and Birkbeck Careers.

The Business Engagement team deliver a range of activities to support you in your career aspirations including:

**Mentoring Pathways**
Mentoring Pathways pairs successful applicants with industry professionals for individual advice and guidance. There are approximately 100 places available for final year undergraduates and postgraduate students. We have partnerships with a number of key organisations and work alongside Birkbeck alumni who provide mentors. Please email mentoring@bbk.ac.uk

**Enterprise Pathways**
Whether you are setting out in your journey as an entrepreneur or have already established a thriving business, we offer various pathways to support you. These include a non-credit bearing module with workshops once a month throughout the academic year, access to digital resources, and enterprise boot camps to help you to develop your ideas and network with other students. Please email enterprise@bbk.ac.uk or visit [www.bbk.ac.uk/enterprise](http://www.bbk.ac.uk/enterprise)

**School Events**
From time to time we run events, competitions or offer the opportunity to attend conferences, with the aim to help you to find out more about industry sectors, entrepreneurs and professional bodies.
Insiders’ Guides
We take a small number of students to visit workplaces and ask questions about the culture, the roles and career progression. If you would like to participate please email developus@bbk.ac.uk

Employer Sponsorship
Talk to a member of the team about how your current employer might sponsor you through your studies. Please email: developus@bbk.ac.uk

You can also follow BEI on social media for information and conversations:

• Twitter: @BirkbeckBEI
• Facebook, Google+ and LinkedIn: Search ‘BirkbeckBEI’

Please visit our website www.bbk.ac.uk/business/business-services for resources and information about all of these initiatives.

We send a regular email newsletter with details of all upcoming events and activities to students in the School of Business, Economics and Informatics who allow marketing communications through their MyBirkbeck Profile.

BUSINESS ENGAGEMENT EVENT SCHEDULE 2016/17

<table>
<thead>
<tr>
<th>Month</th>
<th>Enterprise Pathways</th>
<th>Mentoring Pathways</th>
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</thead>
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<tr>
<td>October</td>
<td></td>
<td>Briefing sessions</td>
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<tr>
<td></td>
<td></td>
<td>Week commencing 31/10/16</td>
</tr>
<tr>
<td>November</td>
<td>Community Launch &amp; Brunch</td>
<td>Training sessions</td>
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<tr>
<td></td>
<td>05/11/16</td>
<td>Weeks commencing 12/11/16 and 19/11/16</td>
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<tr>
<td></td>
<td>Global Entrepreneurship Week Event</td>
<td>Launch event</td>
</tr>
<tr>
<td></td>
<td>16/11/16</td>
<td>21/11/16</td>
</tr>
<tr>
<td>December</td>
<td>Who are you? What type of entrepreneur can you be?</td>
<td>1-1 Mentoring</td>
</tr>
<tr>
<td></td>
<td>03/12/16</td>
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</tr>
<tr>
<td>January</td>
<td>Get LEAN</td>
<td>1-1 Mentoring</td>
</tr>
<tr>
<td></td>
<td>07/01/16</td>
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</tr>
<tr>
<td>February</td>
<td>Dynamic Business Plans</td>
<td>1-1 Mentoring</td>
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<tr>
<td></td>
<td>04/02/16</td>
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<tr>
<td>March</td>
<td>Pitch Perfect and Santander Competition Launch</td>
<td>1-1 Mentoring</td>
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<tr>
<td></td>
<td>04/03/16</td>
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</tr>
<tr>
<td>April</td>
<td>Sources of Finance</td>
<td>1-1 Mentoring</td>
</tr>
<tr>
<td></td>
<td>01/04/16</td>
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<tr>
<td>May</td>
<td>Take-off</td>
<td>1-1 Mentoring</td>
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</table>
The Students’ Union

Birkbeck Students’ Union provides a wide range of services for students. As well as organising various social events and running many student societies, it provides a free counselling service for any student seeking counselling and a drop-in advice centre where you can go to discuss any problems, academic or otherwise, that you may be having. The union runs popular study skills sessions which many people find very useful, particularly those who may have been away from formal education for a while. For further information email the organisers at administrator@bcsu.bbk.ac.uk or phone on 0207 631 6335. The students’ union website at http://www.bbk.ac.uk/su/ provides information about all these services and more.

Refreshments and other facilities

Malet Street Fifth Floor Eatery  (Room E505, 5th Floor Ext., Malet Street)
Located in the extension building in Malet Street, the Fifth Floor Eatery offers a wide selection of freshly prepared sandwiches, freshly prepared soup, pasties, cakes, confectionery, hot and cold beverages for a quick and easy grab and go service. They also offer a wide range of classic & modern meals, daily vegetarian choices, jacket potatoes, salads & made to order deli-bar & light bites.
Opening hours are as follows:
Term-time - Monday to Friday: 10.00 - 20.00.
Out of term - Monday to Friday only: 10.00 - 16.00.

Lunch time service is 12.00 to 2.30
Dinner time service is 5.00 to 7.00

Café on the Square (Costa Coffee)
Located on the ground floor of the Malet Street building facing Torrington Square you will find a ‘Fair Traded’ Costa Coffee outlet with freshly baked pastries and muffins, a premium range of Panini, sandwiches & snacks. Opening Hours:

Term-time - Monday to Friday: 08:30 – 20:00.
Saturday 08:30 – 19.00; Sunday 09:30 – 19:00
Out of term - Monday to Friday only: 08:30 – 17:00.
Saturday 9.00 – 17.00; Sunday 10.00 - 17.00

Gordon Square Snack Bar (42-47 Gordon Square)
The snack bar on the Ground Floor of the Gordon Square site offers a choice of cakes, sweets, sandwiches and savouries, as well as hot and cold drinks. Term-time opening hours are 9am – 8pm, Monday to Friday and 10am-7pm Saturday.

The Union Shop
The Union Shop (in the basement of the Malet Street building) stocks drinks, snacks, stationary, some medicines and Birkbeck memorabilia such as scarves, ties, and fleeces. The Union Shop also issues
NUS cards and is run by Union Assistants who are able to provide information about the Union and its services.

**Birkbeck College Bar**
The bar is on the 4th floor of the Malet Street building. It is open Monday to Friday, 12-2pm and 5-11pm. There is a pool table and plasma screen TV.

**University of London Union Facilities**
The College pays an annual subscription to the University of London Union, so all Birkbeck Degree students are automatically full members. This means that you have access to all the Clubs & Societies, bars and sports facilities that ULU has to offer. You can get a ULU membership card from the Union Office if you show your college ID card and provide a passport photograph.

ULU is the central Students’ Union for the University of London. It represents the interests of students throughout the University, complimenting the activities of Birkbeck Students’ Union and the Unions of the other Colleges.

At its main building in Malet Street (next door to Birkbeck) ULU provides a range of facilities and services. There is a shop, opticians, photocopying facilities, coffee shop, bars, a café and a gym and swimming pool with reduced membership fees for students. The ULU Website has full details: http://www.ulu.lon.ac.uk

**Childcare**
Birkbeck runs an evening nursery for the children of students (and staff) and accepts children aged 2 years - 10 years. In exceptional circumstances, children up to 12 will be accepted. The Nursery is open from 5.30pm - 9.00pm (Monday to Friday) during Term Time at a cost (for 2012/2013) of £15 per evening, per child. Payment is on a nightly basis (cheques payable to Birkbeck College).

The Nursery gets subscribed very quickly. To enrol your child you should complete, as soon as possible, the Application Pack documents that are available for download at http://www.bbk.ac.uk/mybirkbeck/services/forms/nursery_application.doc/view (alternatively contact the Nursery Manager: details below).

**Either:** return your application to Human Resources (out of term time). Confirmation of your booking will be sent to you by the end of September. **Or:** hand to the Nursery Manager (during term time)

**Contact details**
During Term, please contact Deirdre Lazarus, the Nursery Manager 020 7679 4634 (24-hour answer phone) or d.lazarus@bbk.ac.uk. Out of Term time please contact:
Human Resources, Birkbeck College,020 7631 6519, or email humanresources@bbk.ac.uk

**Your Programme of Study**
The academic year is split into three terms. The bulk of teaching takes place in the Autumn and Spring terms, where you will have three evenings of lectures each week. In the Summer term, there are revision lectures, followed by the examination period. Most mathematics and statistics modules will consist of eight evenings of lectures in each of the Autumn and Spring Terms, with two four-week blocks per term. The Autumn and Spring Terms are eleven weeks long. Most mathematics and statistics modules have lectures in weeks 2 – 5 and 7 – 10. Usually there are no lectures in the middle week of term – this is to allow you a week’s break to consolidate your work so far. Management, Accounting, and Economic modules may have some teaching in the Summer term. Check your My Birkbeck timetable for details of this teaching.
Terminology
Each programme of study consists of a certain number of credits (for example a BSc degree programme is 360 credits). A module lasting one year has a value of 30 credits. Your programme of study is your degree programme. Modules are also assigned a numerical level of difficulty. On an undergraduate programme modules are either Level 4, 5 or 6. (Level 3 would be ‘A’-level equivalent, and Level 7 is Postgraduate standard.) Core modules must be taken and passed to gain the degree; compulsory modules must be taken (but not necessarily passed). So for example, the module ‘Algebra 1’ is a 30 credit Level 4 core module on the ‘BSc Mathematics’ programme.

Your time commitment
Depending on your programme of study, you will have between two and three evenings of lectures a week in the Autumn and Spring Terms, one evening per module. Lectures take place from 6-9pm, usually with a break in the middle of the evening. You are expected to spend time studying outside of lectures, consolidating what you have learnt, isolating any areas of difficulty, trying examples and practice questions from lectures and books, and so on. A rough guideline would be that for each hour of lectures, you should spend at least an hour of private study.

You will receive assignments on a regular basis, up to four for each 30 credit module you study. You will have at least three weeks to complete each one.

The Summer Term is devoted primarily to revision and the exam period. Examinations will mostly be 3 hours long, and you will have one for each module. Exams take place during the day, so if you are in employment you will need to arrange time away from work for the exams.

Programme Structure
In this section the structure of each programme is described – that is, which modules you will be studying in which years. More detail about individual modules is found in the Modules section of this handbook. The only exception to this is that option modules in Economics, Accounting and Management are not described in detail. This is because these modules tend to change more frequently and the descriptions may not therefore remain accurate. This is not usually an issue with mathematics and statistics modules; after all prime numbers will still be prime numbers for the foreseeable future!

For most of the programmes discussed in this handbook, your first year of study (or two years for BSc programmes) will consist of compulsory modules, with the chance to choose options coming later when you have built a firm foundation of knowledge. However for the Graduate Certificate and Diploma in Mathematics, you will be able to choose options in your first year. So in the sections about these programmes there will be some advice about how to choose the best options for you.
Transferring Programmes

It may be possible for you to transfer from your current BSc programme to one of our other BSc programmes. You can transfer to the part-time programme, by requesting a mode of study change via your My Birkbeck profile, under ‘My Studies’ and then clicking on ‘Request a change to study status’. An electronic request will then be received by the undergraduate administrator and passed on to the programme director for consideration.

Full-time/Part-time students can take a maximum of 120/90 credits per year respectively. This means that if a part-time student transfers to the full-time programme, the duration of study will still be a minimum of 4 years overall.

Certificate of Higher Education students who would like to transfer to the full-time BSc programme are advised to wait until the successful completion of Year 2 to transfer. Transfer requests at the end of Year 1 will not be accepted.

BSc Mathematics (Full-time)

This programme offers a rigorous approach to mathematics and its applications opening up opportunities for careers requiring analytical and quantitative skills.

The first year

In the first year students take the core modules Algebra 1: Techniques and Applications; Calculus 1: Single Variable, Proof and Structure in Mathematics, and the compulsory module Probability & Statistics.

The second year

In the second year students take the compulsory modules Discrete Mathematics and Calculus 2: Multivariable and Differential equations, one of the compulsory modules Algebra 2: Theory & Structure or Real & Complex Variable, and one optional level 6 module from the list below.

The third year

In the third year students take the compulsory module Problems in Mathematics, one of the compulsory modules from Algebra 2: Theory & Structure or Real & Complex Variable, that was not taken in Year 2, and two optional level 6 modules from the list below.

Our level 6 mathematics modules currently run in alternating years (except for Problems in Mathematics, which runs every year).

<table>
<thead>
<tr>
<th>Running in 2016/17, 2018/19, 2020/21 etc</th>
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<tr>
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</tr>
<tr>
<td>Real and Complex Variable</td>
<td>Problems in Mathematics</td>
</tr>
</tbody>
</table>

BSc Mathematics (Part-time)

This programme offers a rigorous approach to mathematics and its applications opening up opportunities for careers requiring analytical and quantitative skills.

The first year

In the first year students take the core modules Algebra 1: Techniques and Applications; Calculus 1: Single Variable and Proof and Structure in Mathematics.
The second year
In the second year students take the compulsory modules *Probability and Statistics; Discrete Mathematics* and *Calculus 2: Multivariable and Differential equations*.

The third and fourth years
Over years three and four students take six level 6 modules, comprising the compulsory modules *Algebra 2: Theory and Structure; Real and Complex Variable* and *Problems in Mathematics*, in addition to three option modules in mathematics. Our level 6 mathematics modules currently run in alternating years (except for *Problems in Mathematics*, which runs every year).

### Running in 2016/17, 2018/19, 2020/21 etc
- Computational Mathematics
- Number Theory and Geometry
- Problems in Mathematics
- Real and Complex Variable
- Statistics: Theory and Practice

### Running in 2017/18, 2019/20, 2021/22 etc
- Algebra 2: Theory and Structure
- Calculus 3: Transforms and Models
- Games, Choice and Optimization
- Problems in Mathematics
- Statistics: Theory and Practice

Note: The BSc Mathematics and BSc Mathematics and Statistics programmes share the same first two years. It is possible to switch between them during this period if you change your mind about which programme you wish to complete, and potentially even later, depending on which options you have studied.

**BSc Mathematics and Statistics (Full-time)**
This programme is designed for students who are interested in the theory and application of mathematics and statistics methods to commercial and scientific problems. You will cover areas of pure and applicable mathematics, statistical theory and data analysis.

The first year
In the first year students take the core modules *Algebra 1: Techniques and Applications; Calculus 1: Single Variable, Proof and Structure in Mathematics*, and the compulsory module *Probability & Statistics*.

The second year
In the second year students take the compulsory modules *Discrete Mathematics* and *Calculus 2: Multivariable and Differential equations, Statistics: Theory & Practice*, and one optional level 6 module from the list below.

The third year
In the third year students take the compulsory modules *Probability Models & Time Series, Statistical Modelling*, and two optional level 6 modules from the list below.

Our level 6 mathematics modules currently run in alternating years (except for *Problems in Mathematics*, which runs every year).

### Running in 2016/17, 2018/19, 2020/21 etc
- Computational Mathematics
- Number Theory and Geometry
- Problems in Mathematics
- Real and Complex Variable

### Running in 2017/18, 2019/20, 2021/22 etc
- Algebra 2: Theory and Structure
- Calculus 3: Transforms and Models
- Games, Choice and Optimization
- Problems in Mathematics
### BSc Mathematics and Statistics (Part-time)
This programme is designed for students who are interested in the theory and application of mathematics and statistics methods to commercial and scientific problems. You will cover areas of pure and applicable mathematics, statistical theory and data analysis.

#### The first year
In the first year students take the core modules *Algebra 1: Techniques and Applications; Calculus 1: Single Variable and Proof and Structure in Mathematics.*

#### The second year
In the second year students take the compulsory modules *Probability and Statistics; Discrete Mathematics and Calculus 2: Multivariable and Differential equations.*

#### The third year
In the third year students take the compulsory module *Statistics: Theory and Practice,* and choose two option modules in mathematics (see below).

#### The fourth year
In the fourth year, students take the compulsory modules *Statistical Modelling and Probability Models and Time Series,* together with one option module in mathematics or statistics (see over).

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<td><em>Problems in Mathematics</em></td>
</tr>
<tr>
<td><em>Statistics: Theory and Practice</em></td>
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</table>

**Note:** The BSc Mathematics and BSc Mathematics and Statistics programmes share the same first two years. It is possible to switch between them during this period if you change your mind about which programme you wish to complete, and potentially even later, depending on which options you have studied. If you decide to take only one of the fourth year modules *Statistical Modelling and Probability Models and Time Series,* this would result in you gaining a BSc Mathematics with Statistics, to reflect the fact that you have done a lower proportion of statistics overall.

### BSc Mathematics and Accounting
This BSc programme aims to provide a broad education in mathematics and accounting. The programme concentrates on the methods and modelling techniques of mathematics, but also provides the theoretical background for these ideas. Students develop an knowledge of a range of mathematical skills together with an understanding of managerial and financial accounting.

#### The first year
In the first year students take the core modules *Algebra 1: Techniques and Applications; Calculus 1: Single Variable, Financial Accounting and Management Accounting.*

#### The second year
In the second year students take the compulsory modules *Discrete Mathematics; Calculus 2: Multivariable and Differential equations;* and *Proof and Structure in Mathematics.*
The third year
In the third year students take the compulsory modules Financial Reporting, Microeconomics for Business, Macroeconomics for Business, plus one level 6, 30 credit mathematics option module from the list below.

The fourth year
In the fourth year students take two level 6, 30 credit mathematics option modules from the list over the page plus 30 credits of accounting option modules at level 5 or 6. The available Level 6 mathematics modules in each year are given in the table below.

<table>
<thead>
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The following is an indicative list of options in accounting. These will run every year.
- Financial Management (level 6)
- Taxation (level 6)
- Advanced Management Accounting (level 6)

BSc Mathematics and Economics

The BSc Mathematics and Economics covers quantitative methods and modelling techniques in mathematics along with the main concepts of Microeconomics and Intermediate Macroeconomics. You will develop a knowledge of a range of mathematical skills, along with an understanding of their theoretical basis, together with an appreciation of the principles of economics.

The first year
In the first year students take the core modules Algebra 1: Techniques and Applications; Calculus 1: Single Variable and Introduction to Economics.

The second year
In the second year students take the compulsory modules Discrete Mathematics; Calculus 2: Multivariable and Differential equations; and Proof and Structure in Mathematics.

The third year
In the third year students take the compulsory modules Intermediate Macroeconomics and Intermediate Microeconomics, plus one level 6, 30 credit mathematics option module from the list below.

The fourth year
In the fourth year students take 90 credits of options modules in mathematics and economics. At least 30 credits of Mathematics and 30 credits of Economics must be taken. Mathematics option module(s) must be at level 6. At most 30 credits of the economics module(s) can be at level 5 if desired.

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</table>
Economics modules run every year. An indicative list of the 30 credit modules is as follows:

- **UK Financial Institutions and Markets (level 5)**
- **Time-Series Econometrics (level 6)**
- **Corporate Finance (level 6)**

**BSc Mathematics and Management**

This degree programme provides its graduates with a highly marketable toolkit of the methods and techniques of mathematics, together with knowledge and awareness of management and business practices. In your first three years you will study a broad base of mathematics and management modules. In your final year you will have the chance to specialise in your preferred area.

**The first year**
In the first year students take the core modules *Algebra 1: Techniques and Applications; Calculus 1: Single Variable, Management Studies I and Management Studies II.*

**The second year**
In the second year students take the compulsory modules *Discrete Mathematics; Calculus 2: Multivariable and Differential equations; and Proof and Structure in Mathematics.*

**The third year**
In the third year students take the compulsory modules *Financial Accounting, Management Accounting, Microeconomics for Business and Macroeconomics for Business*, plus one level 6, 30 credit mathematics option module from the list below.

**The fourth year**
In the fourth year students take 90 credits of Level 6 option modules in mathematics and management. Students have to take at least 30 credits of Mathematics and 30 credits of Management in year 4 to be awarded the BSc Mathematics and Management. Available mathematics modules are as follows.

<table>
<thead>
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</tr>
</tbody>
</table>

The following level 6, 30 credit Management modules currently run every year. This is an indicative list and may change over time.

- **Strategic Management (15 credits)**
- **Advanced Management Accounting**
- **Financial Reporting**
BSc Statistics and Accounting

This BSc programme covers topics in statistics and accounting. As with Mathematics and Accounting, the programme focuses not only on the methods and techniques of mathematics, statistics and accounting, but also provides the theoretical background. Students develop an knowledge of a range of statistical and quantitative skills together with an understanding of managerial and financial accounting.

The first year
In the first year students take the core modules Algebra 1: Techniques and Applications; Calculus 1: Single Variable, Financial Accounting and Management Accounting.

The second year
In the second year students take the compulsory module Calculus 2: Multivariable and Differential equations and the core module Probability and Statistics, plus one level 5 mathematics option from the list below.

The third year
In the third year students take the compulsory modules Financial Reporting, Microeconomics for Business, Macroeconomics for Business and Statistics: Theory and Practice.

The fourth year
In the fourth year students take the modules Statistical Modelling and Probability Models and Time Series, plus one option module at level 5 or 6. The following is an indicative list of the options that will be available.

- Discrete Mathematics (level 5)
- Proof and Structure in Mathematics (level 5)
- Financial Management (level 6)
- Taxation (level 6)
- Advanced Management Accounting (level 6)

BSc Statistics and Economics

This interdisciplinary degree integrates the disciplines of statistics and operational research with applications in economics and finance. It encourages a systematic approach to problem-solving and focuses on the collection, presentation and interpretation of data. The degree is suited to those working in the financial sector and develops the skills needed for statistical careers in commerce, industry, medicine, transport, government and education.

The first year
In the first year students take the core modules Calculus 1: Single Variable; Algebra 1: Techniques and Applications; and Introduction to Economics.

The second year
In the second year students take the compulsory modules Probability and Statistics; Calculus 2: Multivariable and Differential Equations and either Discrete Mathematics or UK Financial Institutions and Markets.

The third year
In the third year students take the compulsory modules *Intermediate Macroeconomics, Intermediate Microeconomics* and *Statistics: Theory and Practice*.

**The fourth year**
In year 4 you will choose three options from the following list. This is an indicative list based on currently available modules; it may vary slightly each year depending on the research specialisms of current staff. Note that at least one from *Probability Models and Time Series* and *Statistical Modelling* must be taken.

- Discrete Mathematics (level 5)
- UK Financial Institutions and Markets (level 5)
- Probability Models and Time Series (level 6)
- Statistical Modelling (level 6)
- Games, Choice and Optimization (level 6)
- Elective Option – Time-Series Econometrics (level 6)
- Corporate Finance (level 6)
- International Finance (level 6)

**BSc Statistics and Management**

Methods of modern management and the application of mathematics and statistics to the problems of business and management are the focus of this interdisciplinary degree. The degree encourages you to adopt a systematic approach to problem-solving and concentrates on the collection, presentation and interpretation of data. It is suited to those working in management and covers the skills required for statistical careers in commerce, industry, medicine, transport, government and education.

**The first year**
You will take the core modules *Calculus 1: Single Variable; Algebra 1: Techniques and Applications; Management Studies I* and *Management Studies II*.

**The second year**
In the second year students take the compulsory modules *Probability and Statistics; Calculus 2: Multivariable and Differential Equations, Financial Accounting* and *Management Accounting*.

**The third year**
In year 3 you will study *Microeconomics for Business, Macroeconomics for Business* and *Statistics: Theory and Practice* in addition to optional module(s) to the value of 30 credits from the list below.

**The fourth year**
In year 4 you will select options to the value of 90 credits. This is an indicative list only, and may change from year to year depending on staff specialisms. At least one from *Probability Models and Time Series* and *Statistical Modelling* must be taken and at least 30 credits must be management options. From the 120 credits gained from optional modules in years 3 and 4, at least 90 must be at Level 6.

<table>
<thead>
<tr>
<th>Level</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Discrete Mathematics</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>Marketing Principles and Practices</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Operations Management</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Organizational Behaviour</td>
<td>15</td>
</tr>
</tbody>
</table>
Certificate/Diploma of Higher Education in Mathematics

These programmes are designed for students with an A-level or equivalent in mathematics and are an ideal way of expanding your knowledge of mathematics and finding out more about the areas that interest you.

The first year of each programme is devoted to Algebra and Calculus. In the final year of each programme you will be able to choose options according to your particular areas of interest. The tables below summarise the structure of each programme. Note that it is possible to progress more slowly through these programmes, for example by doing one module each year, if that will suit you better.

Certificate of Higher Education in Mathematics (Cert HE Mathematics)

Students successfully completing the Certificate (Cert HE Maths) will be able to proceed straight onto Year 2 of the BSc Mathematics, or BSc Mathematics and Statistics programmes.

The first year
You will take the core modules Algebra 1: Techniques and Applications and Calculus 1: Single Variable.

The second year
In the second year students choose any two modules from Calculus 2: Multivariable and Differential Equations; Discrete Mathematics; Probability and Statistics; and Proof and Structure in Mathematics

Diploma of Higher Education in Mathematics (Dip HE Mathematics)

Students successfully completing the Diploma will be able to proceed straight onto Year 3 of the BSc Mathematics, or BSc Mathematics and Statistics programmes.

The first year
You will take the core modules Algebra 1: Techniques and Applications and Calculus 1: Single Variable.

The second year
You will take the compulsory modules Calculus 2: Multivariable and Differential Equations; Probability and Statistics; Proof and Structure in Mathematics

The third year
You will take the compulsory module Discrete Mathematics, plus two options from the lists below.

<table>
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Graduate Certificate/Diploma in Mathematics

These programmes are designed to be as flexible as possible; you will have a choice of modules taken from the BSc Mathematics programme. In conjunction with the programme director, you will decide on a suitable programme of study based on your interests and experience.

To obtain the Graduate Certificate in Mathematics, you will complete two year-long (30 credit) modules, usually over one year. To obtain the Graduate Diploma in Mathematics, you will complete four year-long (30 credit) modules, usually over two years.

Modules on the BSc Mathematics are at level 4, 5 or 6. Levels 4 and 5 roughly correspond to level of the first half of an undergraduate degree; level 6 to the second half. For the Graduate Certificate, you must take two modules at level 6. For the Graduate Diploma, one of your modules may be at level 5 or 6, with the remaining three modules at level 6. For this reason, depending on your level of mathematical experience, you may decide to take the two-year Graduate Diploma to give you the chance to cover some of the level 5 material.

The available level 6 modules are as follows. Advanced Mathematical Methods runs every year and can be taken by any student in the program. The module Number Theory and Algebra is only available to Graduate Certificate and Diploma students who are intending to progress to the MSc Mathematics – it consists of the Number Theory part of Number Theory and Geometry and the second half of Algebra 2.

Exclusions: No student may take both Calculus 2 and Advanced Mathematical Methods. Similarly, any student taking Number Theory and Algebra cannot take Number Theory and Geometry or Algebra 2.

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All level 5 modules run every year. They are:
• Proof and Structure in Mathematics
• Discrete Mathematics
• Calculus 2: Multivariable and Differential equations

Some level 5 modules run on the same day of the week as some level 6 modules, so those choosing a level 5 module as one of the options on the Graduate Diploma may have to consider timetable restrictions.

Choosing your options
In the Modules section, there is a description of each module offered as part of our BSc Mathematics degree – it is from these modules that you will choose the level 5/6 modules on your programme. When you are deciding which modules to take, you will want to consider your prior level of knowledge and what your aims are for any further study after your Certificate/Diploma, and of course what subject areas interest you most. You will have discussed the options at interview. If you are still unsure, please make an appointment with the programme director as soon as possible. In the
description of each module in the Modules section, the prerequisites are stated. These are in terms of earlier Birkbeck modules: you can refer to the syllabus for each prerequisite to check whether you have studied the topics therein.

It is not essential to finalise your module choices before the start of term; but it will help both you and us to make this decision sooner rather than later.

**Qualifying for MSc Mathematics**

Birkbeck runs an MSc in Mathematics, focusing on Algebra and Combinatorics. Gaining a merit (60% average mark) or better in the Graduate Certificate/Diploma could qualify you to proceed directly onto this MSc programme, depending on your choice of modules. Unless your first degree contained a large component of pure mathematics, you are likely to need to gain a Graduate Diploma, and to take the module *Proof & Structure in Mathematics* in year 1, either *Algebra 2* or *Number Theory and Algebra* in year 2, plus two other level 6 modules. If you are likely to want to enrol on the MSc Mathematics at Birkbeck, please let the programme director know so that we can work together to ensure that you are taking suitable modules. If your aim is to pursue your studies in a different subject, or at an institution other than Birkbeck, please contact the admissions tutor of the relevant programme directly to discuss whether the Graduate Certificate/Diploma will qualify you for that programme. We are happy to provide academic references describing the modules you are covering.

**Graduate Certificate in Statistics**

The Graduate Certificate in Statistics is intended mainly, but not exclusively, as a qualifying course for the MSc in Applied Statistics and related courses for students who already have a bachelor's degree in a different discipline. The course will usually be taken over one year part-time, but may be taken over two years. Students wishing to take a more extensive programme of statistics modules at BSc level may wish instead to consider the Graduate Diploma in Statistics.

The course consists of two year-long (30 credit) BSc level modules, designed to give students a thorough grounding in the mathematical and statistical methods required for more advanced study of statistics. More detail about these modules is given in the Modules section of this handbook.

1. *Advanced Mathematical Methods*
2. *Statistics: Theory and Practice*

**Qualifying for the MSc in Applied Statistics**

To qualify for the MSc, students will be expected to pass the course with at least a merit classification, which means passing both modules, with an average mark of at least 60%.

**Graduate Diploma in Statistics**

The Graduate Diploma in Statistics is a two-year programme designed for students with mathematical ability who wish to learn more about Statistics and its applications. By focusing exclusively on Statistics, this course allows you to cover all of the higher level Statistics offered as part of our BSc Mathematics and Statistics programme.

To obtain the Graduate Diploma in Statistics, you will take four year-long (30 credit) modules, usually over two years. In Year 1 you will take the following modules (see the Modules section of this handbook for further details):

- *Advanced Mathematical Methods*
Statistics: Theory and Practice

In Year 2 you will take the following modules:

- Probability Models and Time Series
- Statistical Modelling

Study skills

At Birkbeck, every student is a part-time student, and we recognise the particular difficulties that this can bring. Many of you are juggling jobs and family with your studies. In addition it may be quite a few years since you last received any formal education, did “homework” or sat in lectures and tried to take notes. It can all seem rather daunting at first. We find that the students who succeed are the ones who are well organised, keep their notes up-to-date and work consistently throughout the year. The most important thing to remember is that, just as you can’t learn to drive a car by watching someone else, mathematics is best learned by doing. So try examples, work through exercises and don’t be too quick to look at any solutions you’ve been given.

Tackling Problems Early

If you find there is something you haven’t understood from lectures, it is best to sort it out as soon as possible. Because mathematics tends to build on earlier foundations, you may find that if you ignore a topic you haven’t understood in week 2, it will become increasingly harder to understand what’s going on. This means you fall further behind. So tackle problems early. To do this, you should test your understanding by reading through your notes after lectures and making sure you understand all the steps in the arguments given by the lecturer. Try some examples or exercises from the notes, or a book, and see if you can work through them on your own. If you are still having difficulty, do ask the lecturer. We don’t bite and will do our best to help. If there’s something during a lecture that you don’t follow, it’s perfectly fine for you to ask there and then. No-one will be offended. Usually the lecturer will be able to answer the question quickly and then you can understand the rest of the lecture.

Organising your work

It is useful to organise your notes in some way, rather than just shoving everything into a big folder. One good method is to have a folder or ring-binder for each module, containing lecture notes (both typed from the lecturer and your own handwritten ones), any question sheets and solution sets, your own attempts at exercises, assignments and so on. These could be arranged in chronological order. Then whenever you sit down to work on that particular topic, you will have all the materials at hand. If you have the space at home, a dedicated (quiet!) study area is a good idea, where you can keep your books, folders, calculator and stationery all in one place.

Assignments

When attempting assignments, remember that they are supposed to test whether you understand what you have been taught. So your first port of call if you are stuck should be the lecture notes. From them you can get the definitions of words used, and maybe even worked examples similar to the questions you have been set. Many students are tempted by the lure of the internet, and type in likely looking words to see if they can find the answers somewhere. There are several pitfalls to doing this. First, if you don’t actually understand the mathematics involved, you’re probably unlikely to be able to use what you find to answer the questions. Secondly, there is no quality control on the internet and pages are often full of errors. And finally, on the whole, you won’t be able to find the answer to the question, because the odds of someone somewhere choosing to answer that exact question and out of the goodness of their heart post the answer on their webpage are vanishingly small. It’s far better to concentrate on what you have actually learned in lectures as a starting point. If you are having difficulties, ask the lecturer for guidance. Note that plagiarism is an offence which we take very seriously – your answers for an assignment should be all your own work, so you must not
copy from another student. It is also an offence to allow another student to copy your work. See the section on plagiarism for more details.

Meeting Deadlines
Everyone knows that if you have a task to do, it’s best to tackle it bit by bit, start well before the deadline and give yourself lots of leeway over when you finish so that if the unexpected happens, such as illness, you still have time to finish. This is as true for studying as for anything else. Try to set aside regular times when you are going to study, work on assignments and so on. It is much easier to do coursework at a relaxed pace while it’s fresh in your mind than at midnight the day before the deadline when it’s 3 weeks since you were studying the topic in class. It is important to hand in work on time, as the College coursework policy means that late coursework scores a maximum of 40%, even if every question is correct. Coursework usually accounts for 20% of the marks for a module, which may not seem much, but there are examples of students failing modules because they didn’t hand in coursework. You have been warned!

‘Skills for Study’ Programme
The Students’ Union has designed a series of ‘Skills for Study’ workshops on weekday evenings. Sessions include: essay writing skills; presentation skills; reading skills, effective note taking; time management; revision skills; exam skills, time and stress management. Further information from administrator@bcsu.bbk.ac.uk, tel: 020 7631 6335.

Provisional Timetable
This timetable covers all modules that students reading this handbook could conceivably do in their first year of study. Lectures are held from 6-9pm. Room allocations are not usually complete until September – you will be given locations at that stage. You should always carry your Birkbeck Student ID card; you may be asked to show it, particularly if your lecture is not in the main Malet Street building. In the Summer Term revision lectures will be held. You will receive more information about this nearer the time. Note that the module Problems in Mathematics is essay-based; there will be four lectures over the course of the year which will be held in weeks when there are no other lectures, so that there will be no timetable clashes. More details on the dates/times of these lectures will be provided when available but they are likely to be in weeks 6 and 11 of the Autumn and Spring Terms.

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<tr>
<th>Day</th>
<th>Autumn &amp; Spring Terms Unless Otherwise Stated</th>
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<tr>
<td>Monday</td>
<td>Financial Accounting (Spring Term Only)</td>
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<td>Games, Choice and Optimization (next runs 2017/18)</td>
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<td>Number Theory and Geometry (not in 2017/18)</td>
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<td>Wednesday</td>
<td>Management Accounting (Summer Term Only)</td>
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<td>Management Studies I (Autumn) and II (Spring)</td>
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<td>Probability &amp; Statistics</td>
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<td>Algebra 2</td>
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<td>Thursday</td>
<td>Advanced Mathematical Methods (Autumn)</td>
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<td>Calculus 2</td>
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<td>Introduction to Economics</td>
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<td>Probability Models and Time Series</td>
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Modules
In this section you will find more detail about individual modules. All modules are worth 30 credits unless indicated otherwise. Unless otherwise stated it is not compulsory to buy the recommended texts. For most modules everything you need to know will be covered in lectures. Several copies of each recommended book are available in the college library and are an extra resource if you want more practice of the work covered in lectures. Full details about each module, along with course materials such as assignments, are posted online at http://www.ems.bbk.ac.uk/for_students. Course materials for some modules may be placed on Birkbeck’s virtual learning environment Moodle. To access these you will need to be registered for that module, and have your Birkbeck username and password. Then just login at moodle.bbk.ac.uk.

Advanced Mathematical Methods (BUEM004S6)

- **Compulsory for:** Graduate Cert/Dip Statistics
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Calculus 1
- **Teaching:** 18 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** This module will equip you with the methods of calculus and linear algebra which are essential to the study of statistics at graduate level. You will study calculus in the Autumn Term and Linear Algebra in the Spring Term.
- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**
  1. Review of single variable methods.
  2. Functions of more than one variable.
  3. Partial differentiation and its applications.
  4. Multiple integrals.
  5. Differential Equations.
  7. Determinants.
  8. Real Vectors.
  10. Markov Chains
  11. Linear Programming.

- **Recommended Books:**
  - Adams, RA *Calculus of several variables*, Addison-Wesley
  - Adams, RA, *Calculus: A complete course*, Addison-Wesley
  - Harris, K, *Discovering Calculus with Maple*, Wiley
  - Kolman, B. *Introductory Linear algebra with Applications (6th edition)*, Prentice Hall
Algebra 1: Techniques and Applications (EMMS097S4)

- **Compulsory for:** All BSc programmes, Cert/Dip HE Maths
- **Core for:** All BSc programmes, Cert/Dip HE Maths
- **Level:** 4
- **Prerequisites:** ‘A’-level mathematics, or equivalent
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** Introduces matrices and vector methods and their application to problems in the natural and social sciences. Sets, functions and permutations are also studied.
- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**

  **Set Theory:** subsets, power sets, complements, intersection, union and difference of two sets, Venn diagrams, partitions.

  **Mappings:** domain, codomain, range, injective, surjective and bijective mappings, composition of mappings, invertible mappings, induced mappings and restrictions.

  **Permutations:** composition of permutations, inverses, cycle notation, order, transpositions, even and odd permutations.

  **Elementary Cryptography:** cryptosystems, encryption and decryption, examples of ciphers, attacks on cryptosystems.

  **Matrices & Systems of Linear Equations:** operations on matrices, types of matrix, matrix form of a system of linear equations, solving a system of linear equations, inverting a square matrix.

  **Determinants:** cofactors, evaluating the determinant of a square matrix, properties of the determinant.

  **Real Vectors:** the dot product, linear combinations, spanning subspaces, bases, the angle between two vectors, orthogonal bases.

  **Eigenvalues & Eigenvectors:** definitions, the characteristic equation, diagonalization and powers of square matrices.

  **Markov Chains and Linear Programming:** transition matrices, state vectors, Markov matrices, regular transition matrices, steady state vectors. Linear inequalities, formulation of a linear programme, graphical solutions, introduction to the simplex method.

- **Recommended Books:**
Algebra 2: Theory and Structure (EMMS094S6)

- **Compulsory for:** BSc Mathematics
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Proof & Structure in Mathematics
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** In this course you will encounter algebraic structures such as groups, rings, fields and vector spaces. The importance and usefulness of the axiomatic approach will be stressed. Groups will be studied in the most depth, and you will see some of the fundamental results and their consequences Theorem. You will become familiar with many different examples of groups, rings, fields and vector spaces, which are ubiquitous in pure mathematics. Applications of some of the concepts introduced will be given, for example error detecting and error-correcting codes (such as barcodes and ISBNs).
- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**

**Group Theory:** revision of group axioms, properties and basic results; further examples of groups; structure of groups of order $p$ and $2p$ for $p$ prime; cosets, normal subgroups, homomorphisms, isomorphisms, correspondence between normal subgroups and kernels of homomorphisms.

**Group Actions:** definition of G-sets; orbits and stabilisers; the Orbit-Stabiliser Theorem; applications to conjugation of elements and subgroups; the Orbit-counting Lemma; applications to colouring problems

**Rings, Fields and Vector Spaces:** Definition of a ring; examples; subrings and ideals; zero divisors and units; factorisation; integral domains and Euclidean domains; fields; characteristic of a field; vector spaces and their properties; dimension of a vector space, bases and results; application to error-correcting and error detecting codes.

- **Recommended books:**
Calculus 1: Single Variable (EMMS096S4)

- **Compulsory for:** All BSc Programmes, Cert/Dip HE Mathematics
- **Core for:** All BSc Programmes, Cert/Dip HE Mathematics
- **Level:** 4
- **Prerequisites:** ‘A’ level mathematics or equivalent
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** After consolidation of material on differentiation and integration, the module develops more advanced calculus methods required for mathematics and statistics.
- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**

**Algebraic Methods:** polynomials, the Factor Theorem, polynomial equations, exact solutions to linear and quadratic equations, the Binomial Theorem, partial fractions, inequalities, complex numbers.

**Coordinate Geometry:** straight lines, perpendicular lines, circles, tangent to a point on a circle, equation of a circle, finding the centre and radius of a given circle.

**Real Functions:** the properties of exponential, logarithmic and trigonometric functions, inverses, trigonometric identities.

**Sequences & Series:** definitions, intuitive idea of a limit of a sequence, sigma notation, arithmetic and geometric progressions.

**Differentiation:** derivatives of standard functions, the chain rule, product rule, quotient rule and inverse function rule, implicit differentiation, logarithmic differentiation.

**Integration:** integrals of standard functions, definite integration and the area under a curve, integration by substitution and by parts, integration of rational functions.

**Methods of Approximation:** the bisection method, the Newton-Raphson method, the Trapezium rule, Simpson’s rule, Maclaurin and Taylor approximations, power series of standard functions.

**Applications of Calculus:** tangents, stationary points, maxima, minima and points of inflexion, curve sketching, rates of change, motion in a straight line, arc length, volumes of revolution, first order ODEs: variables separable and integrating factors.

- **Recommended Books:**
  - D. J. Booth, *Foundation Mathematics*, Addison-Wesley.
Calculus 2: Multivariable and Differential Equations (BUEM001S5)

- **Compulsory for:** All BSc programmes, Dip HE Mathematics
- **Core for:** none
- **Level:** 5
- **Prerequisites:** Calculus 1
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** This module aims to develop the ideas and techniques of calculus introduced in *Calculus 1: Single Variable* to functions of more than one variable. It also covers exact and numerical solutions of ordinary differential equations, as well as modelling problems using differential equations.
- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**

**Partial Differentiation** Limits, formal definition of the derivative, partial differentiation, tangent planes, directional derivatives, stationary points, Lagrange multipliers, the chain rule, Taylor polynomial approximation of a function.

**Integration** Double integrals, splitting the integral, changing order of integration, polar coordinates.

**Hyperbolic and Special Functions** Hyperbolic functions, sinh, cosh and tanh, gamma functions, beta functions, properties of hyperbolic and special functions, application of hyperbolic and special functions to evaluate certain integrals.

**Ordinary Differential Equations** First order differential equations, variable separable, exact differential equations, integrating factors, homogeneous differential equations, some special families of first order differential equations, second order differential equations, homogeneous and non-homogeneous differential equations with constant coefficients, some special families of second order differential equations numerical methods for finding approximate solutions of a differential equation.

**Mathematical Models** Applications of calculus including simple harmonic motion, damped and forced oscillations and population models.

- **Recommended Books:**
  Adams, RA *Calculus of several variables*, Addison-Wesley
  Adams, RA, *Calculus: A complete course*, Addison-Wesley
  Harris, K, *Discovering Calculus with Maple*, Wiley
Calculus 3: Transforms and Models (BUEM021S6)

- Compulsory for: none
- Core for: none
- Level: 6
- Prerequisites: Calculus 1, Calculus 2
- Teaching: 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- Overview: This module develops further the ideas covered in Calculus 2. The important ideas of the Laplace Transform and Fourier series will be introduced, and their applications in solving other problems in Calculus will be considered. Systems of differential equations will be studied, and used to model and investigate problems in the natural and social sciences.
- Assessment: 20% coursework; 80% exam.
- Syllabus:

Laplace Transforms The Laplace transform of elementary functions, properties of the Laplace transform, inversion of the Laplace transform, solving differential equations using Laplace transforms, the convolution of two functions, some families of integral equations, the z-transform and discrete systems.

Fourier Series Periodic functions, the Fourier series of a function, finding the coefficients of a Fourier series, the range of validity of a Fourier series, even and odd functions and their Fourier series, half range Fourier series and the relationship between them and the corresponding Fourier series, application of Fourier series in the solution of partial differential equations, the Fourier transform.

Dynamical systems Systems of linear differential equations, coupled systems, autonomous systems, stability, critical points, phase plane analysis, trajectories, fixed solutions, periodic solutions, chaotic systems.

Models The methods introduced in the module will be to model and interpret problems in the natural and social sciences covering some the following: mixing problems, tests for diabetes, nutrient exchange in the placenta, competing species, predator-prey models, the Lotka-Volterra equations, the transfer of heat, the arms race and combat, finance and economics.

- Recommended Books:
  W.E. Boyce and R.C. DiPrima, *Elementary Differential Equations and Boundary Value Problems*
  Wiley.
Computational Mathematics (BUEM010S6)

- **Compulsory for:** none
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Calculus 1; Algebra 1; Discrete Mathematics
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** This module introduces the mathematics of computation, and involves the implementation and analysis of both exact and numerical algorithms. Ideas introduced in earlier modules will be developed in greater depth, giving a deeper and more thorough understanding of the topics covered, and illustrating the inter-relationships between different branches of mathematics.
- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**

  **Sorting:** Algorithms for sorting a list: exchange sort, insert sort, merge sort, quick sort, heap sort; divide and conquer algorithms, rooted trees, binary trees, sifting procedures.

  **Asymptotic behaviour of functions:** Comparing the growth rates of two functions, Big O notation, partial orders on a set of functions based on their growth rate, the maximum rule, the relationship between the growth rate of two functions f and g and the limit of f(n)/g(n) as n tends to infinity, other asymptotic concepts: Omega and Theta notation.

  **Time complexity of an algorithm:** Analysis of an algorithm through counting significant operations, analysis of sorting algorithms, analysis of algorithms from linear algebra and graph theory, worse case and average case time complexity.

  **Computational Complexity:** Comparison of polynomial and exponential growth; P, NP and NP-complete problems; examples of problems that are in P, examples of problems that are in NP but not known to be in P, examples of NP-complete problems; the SAT problem.

  **Errors:** Sources of error: rounding errors, truncation errors, underflow and overflow; representing approximations of a real number and fixed point arithmetic, ill-condition problems.

  **Systems of linear equations:** Gauss elimination and its computational time complexity; errors arising due to rounding; LU decomposition and iterative refinement; matrix and vector norms and error estimation; tests for determining ill conditioned equations; the Jacobi and the Gauss-Seidel iterations and conditions for their convergence.

  **Nonlinear equations:** Methods for finding the approximate root of a nonlinear equation: bisection, fixed point iteration, Newton-Raphson; tests for the convergence of these methods and the speed of convergence, the order of a process; roots of polynomials and the Horner scheme.

  **Polynomial interpolation and quadrature:** Approximating a function by a polynomial, Lagrange polynomials, divided differences, forward differences, numerical integration: the rectangular rule, the trapezium rule, Newton-Cotes Formulas, composite rules, error estimation.
Discrete Mathematics (BUEM002S5)

- **Compulsory for:** BSc Mathematics, BSc Mathematics and Accounting/Economics/Management/Statistics, Dip HE Mathematics
- **Core for:** none
- **Level:** 5
- **Prerequisites:** Algebra 1
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** This module aims to develop the ideas and techniques of combinatorics and graph theory, and use them for modelling problems.
- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**

**Sequences and Counting:** Arithmetic and geometric progressions, the rule of sum, the rule of product, \( r \)-sequences, \( r \)-permutations, \( r \)-combinations, \( r \)-multisets, distribution problems, binomial coefficients, the pigeon hole principle, the inclusion-exclusion theorem.

**Generating Functions:** Power series, finding the generating function of a problem, finding the coefficients of a generating function, application of generating functions to sequences.

**Difference Equations:** Linear difference equations, homogeneous difference equations, first order difference equations, second order linear difference equations with constant coefficients, modelling simple problems in finance and economics using difference equations, population models, cobweb diagrams, the discrete logistic equation, Catalan numbers, using generating functions to solve difference equations.

**Basic Graph Theory:** Vertices and edges, simple graphs, the degree of a vertex, the degree sequence of a graph, the handshaking lemma, subgraphs, isomorphic graphs, null and complete graphs, cycles and paths, platonic graphs, connectedness, planar graphs, trees, weighted graphs, digraphs, networks.

**Trees:** Trees and forests, characterisations of a tree, spanning trees, minimum connector, Kruskal’s and Prim’s algorithms, labelled trees, Cayley’s Theorem for labelled trees.

**Traversability:** Cycles, Eulerian graphs, Fleury’s algorithm, semi-Eulerian graphs, Hamiltonian cycles, Ore’s Theorem, Dirac’s Theorem, the travelling salesman problem

**Path problems:** Paths, connectedness, vertex and edge-disjoint paths between two vertices, separating sets, Menger’s Theorem, networks, shortest path problem, longest path problem, scheduling problems, flows on a network, cuts in a network, the maximum flow-minimum cut theorem.

**Matching Problems:** Pairings, matchings in graphs, bipartite graphs, perfect, complete, maximal and maximum matchings in a graph, Hall’s Theorem, stable matchings, optimal assignments, the Hungarian algorithm, the bottleneck problem.

- **Recommended Books:**
Financial Accounting (MOMN007H5)

- **Compulsory for:** BSc Mathematics/Statistics and Accounting/Management
- **Core for:** BSc Mathematics/Statistics and Accounting
- **Level:** 5
- **Prerequisites:** none
- **Teaching:** One evening of lectures a week for one term.
- **Overview:** This module aims to provide the principles and practice of financial and management accounting. It intends to enable students to
  1. understand the fundamental principles of financial accounting prepare key financial statements from basic information
  2. understand how subsidiary accounts are consolidated
  3. analyse and interpret company accounts
  4. classify different types of costs and conduct break even analysis
  5. understand the different ways in which overheads can be allocated
  6. prepare budgets and interpret variances from budget
- **Assessment:** Final unseen exam (100%)
- **Syllabus:** By the end of the course, students will be able to:
  identify the financial information relevant to a wide range of business issues, use this information effectively for decision making, and also recognise the limitations of such information.

- **Recommended Books:**

Please note that reading lists may be altered: you will be informed in the first class which books you should purchase. The main text for this module is likely to be:

Accounting: An Introduction, McLaney & Atrill, 6th edition
Financial Institutions and Markets (EMEC023S5)

- Compulsory for: none
- Level: 5
- Prerequisites: none
- Teaching: 10 evenings of lectures, including a revision evening.
- Overview: The aim of this module is to provide a general introduction to the financial institutions and markets. The UK financial system is used as an illustration in the discussion of the institutional structure of a financial system, but major aspects of other markets and economies are also covered. The module provides a balanced cover of the major aspects in this area.
- Assessment: A coursework will count for 20%. In June, students will sit a three-hour formal examination based on the overall syllabus which will count for 80% of the module mark.
- Syllabus: By the end of this course students will understand the basic economic principles and the role of savings and investments in the economy; the function of banks and other financial intermediaries in lending and borrowing; the types of banks and banking activities. Students will also know about the financial markets, the types of traded securities and the function of the various parties involved. They will also be aware of the function and role of central banks and the governments and the regal and regulatory framework.

On successful completion of this course, students should have a clear understanding of:

1. the financial system and its role in mobilising saving and investment;
2. the differing requirements of the principal types of end user of the financial system in the personal, corporate and public sectors;
3. the roles of the principal types of financial institutions in the retail, wholesale and international banking, building society, and finance house sectors;
4. the principal investment institutions: general insurance and life assurance organisations, pension funds, unit trusts, investment trusts and open-ended investment companies;
5. the structure and operation of the principal UK financial markets: equity, bond, money, foreign exchange, futures and options markets;
6. the relationship between the UK and European financial markets;
7. the major issues involved in the regulation of financial markets and the role of the state and the central bank.

- Recommended Books: The following texts are required reading.

Financial Reporting (MOMN075S6)

- **Compulsory for:** BSc Mathematics & Accounting, BSc Statistics & Accounting
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Financial Accounting and Management Accounting
- **Teaching:** One evening a week in autumn and spring terms.

**Overview:** This module focuses on the key accounting concepts which underpin the development of financial reporting. In this module you will learn how to account for complex accounting transactions in accordance with International Financial Reporting Statements and International Accounting Standards.

The aims of this module are to:

- Develop an understanding of the theory and practice of accounting.
- Critically assess accounting practices.
- Develop technical accounting skills to an advanced level.
- Prepare and analyse financial statements including the preparation of consolidated accounts and the preparation of accounts from incomplete financial data.
- Gain an understanding of the current regulatory framework surrounding accounting, including the provisions of a selection of accounting standards and the statement of principles.
- Develop communication skills, both oral and written.
- Develop skills in summarising and critically assessing professional reports and statements and academic articles.

**Assessment** Tests (2 x 12.5%) and examination (50%)

- **Syllabus:**
  - prepare consolidated accounts and understand when group accounts should be prepared and when companies can be excluded from consolidated accounts;
  - understand and critically assess accounting concepts including historic cost accounting;
  - understand and critically assess the objectives of accounting, users of accounting and characteristics of accounting;
  - understand and critically assess accounting for changing prices;
  - understand and critically assess economist's interpretations of income;
  - understand and critically assess accounting for intangible assets including accounting for goodwill, research and development and impairment review;
  - understand and critically assess the concepts of off balance sheet finance and substance over form;
  - understand and critically assess the accounting of construction contracts;
  - understand and critically assess standard setting in the UK, since it was introduced in the 1970s and;
  - appreciate public speaking and presentation, through group discussion and case study

- **Recommended Book:**
**International Finance (EMEC027S6)**

**Not running in 2015/16**

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**Prerequisites**

All students that enroll in the option International Finance are expected to have taken the following courses:

- A course in **Quantitative Techniques**, to the level of e.g. Jacques, *Mathematics for Economics and Business* or Chiang & Wainwright, *Fundamental Methods of Mathematical Economics*.
- A course providing an **Introduction to Economics**, to the level e.g. of Stiglitz & Driffield, *Economics* or Mankiw, *Principles of Economics*.
- A course covering the **Principles of Finance**, to the level of e.g. Bodie, Kane & Marcus, *Investments* or Brealey, Myers & Allen *Corporate Finance*.

**Course Objectives**

By the end of the course students will understand Balance of Payments accounting, the functioning of foreign exchange rate markets, various parity conditions and models for exchange rate determinations, the relation between exchange rates and monetary and fiscal policy, and have a basic understanding of the role of exchange rates for corporations and investors.

**Learning Outcomes**

At the end of the course students should be able to demonstrate that they

- understand the relationship between the balance of payments (BoP) accounts and the national income accounts and understand the mechanics of balance of payments accounting;
- understand how the foreign exchange market functions and know common parity conditions in the foreign exchange market including purchasing power parity, covered interest parity and uncovered interest parity;
- are able to analyse the effects of monetary and fiscal policy in an open economy and understand how market participants’ beliefs about future monetary policy affect the current exchange rate;
- can discuss various issues in international finance relating to investors and financial management.

**Recommended Texts**

The course is based around the following textbook:


For some topics the course will refer to:


The course will also draw from a range of readings from other sources which will be announced in class.

**Course Assessment**

Coursework counts for 10% and a three-hour formal examination (around June) counts for 90%.
Games, Choice and Optimization (BUEM022S6)

- **Compulsory for:** none
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Calculus 1, Algebra 1, Calculus 2
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** This module introduces the relatively modern mathematical areas of Game Theory, Choice Theory and Linear Programming, and the relationships between them. The theory and techniques of each area is developed, and applications of them to economics, business and politics are explored.
- **Assessment:** Of the final course mark, 80% is based on a three-hour exam in the summer term and the other 20% is from assessed coursework. Coursework will consist of short, problem based assignments. You will have around three weeks to complete each one. The examination in the summer term will consist of 8 short (5 mark) questions, which are compulsory, and 4 long (20 mark) questions from which candidates must answer two.
- **Syllabus**

**Linear Programming** Expressing a problem using a linear programme, graphical methods, the simplex algorithm, duality, sensitivity analysis.

**Individual Choice** Menus, reflexivity, completeness, transitivity, utility functions, continuity, rationality, choice under uncertainty.

**Social Choice** Social choice procedures, plurality, the Hare system, the Borda count, sequential pairwise voting, approval voting, dictatorships, Pareto condition, Condorcet’s criterion, monotonicity, independence of irrelevant alternatives, social welfare functions, Arrow type theorems.

**Static Games** Matrix form, movement diagrams, saddle points, mixed strategies, zero-sum games, graphical methods for solving games with one player having two strategies, von Neumann’s minimax theorem, using linear programming to find the solution of a game, nonzero-sum games, the prisoner’s dilemma, chicken, battle-of-the-sexes, Nash’s theorem and Nash equilibria, Pareto optimality, graphical representation of a two player game.

**Dynamic Games** Game trees, backwards induction, imperfect information, patent races, bank runs, the Leontieff wage-labour negotiations, the duopoly problem—classical model, Cournot model, Stackelberg model, collaboration and side payments.

**Voting Games** Proper and strong games, monotonicity, weighted games, weighted games, swap-robustness, trade-robustness, power indices, bloc voting, qualified majority voting in the EU Council of Ministers.
Introduction to Economics (EMEC0013S4)

- **Compulsory for:** BSc Mathematics & Economics, BSc Statistics & Economics
- **Core for:** BSc Mathematics & Economics, BSc Statistics & Economics
- **Level:** 4
- **Prerequisites:** none
- **Teaching:** 25 evenings of lectures.
- **Overview:** The aim of this course is to introduce core issues in economics, with a particular emphasis on the role of evidence, contemporary and historical, and fundamental economic principles. This is Year 1, so the course will not attempt to provide final answers, or complete coverage of the subject: among other things, we will be setting the scene for what you will learn in subsequent modules. It will reflect the consensus, and absence of it, on economic theories and evidence, and the problems of establishing what might be true in this area.
- **Assessment:** A three-hour Final Exam in June, based on the full course, will count towards 80% of the course unit mark.
- The remaining 20% will be based on your work throughout the course. There will be weekly problems to solve, some of which you may be required to hand in or present, as well as regular compulsory online quizzes and occasional in-class tests. All of this material will potentially count towards your final mark.

**Syllabus:**

The course will be centred on an exciting development: the Core Economics Project, the result of continuing collaboration among major universities throughout the world to produce a new course, more relevant to the modern world and to the lives of today's students. It is currently being used at UCL, Kings College London, Bristol University, Columbia University (New York), the Central European University (Budapest), Sciences Po (Paris), the University of Chile, in Sydney, and in many other places. It is continuously evolving in response to current developments and student feedback.

Core provides a combination of a textbook (in interactive e-book form, or in pdf format), videos and interactive exercises. All the material can be accessed from a pc or a smart phone. Note that it is not accessed via Moodle. But it is straightforward to register at http://www.core-econ.org/ (you do not need any authorisation from Birkbeck: it is all open access).

At various points in the course we may also make use of some supplementary teaching materials that will usually be provided online.

The Core e-book has 18 units (see http://www.core-econ.org/our-ebook/): we shall work through most of this material over the course of the two terms, but we will also at points introduce supplementary material, often in light of recent economic events.

- **Recommended Books:**
Macroeconomics (EMEC011S6)

- **Compulsory for:** BSc Mathematics & Economics, BSc Statistics & Economics
- **Core for:** none
- **Level:**
- **Prerequisites:** Introduction to Economics
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** Macroeconomics is the part of economics that studies the behaviour of the economic system as a whole. This course aims to develop a macroeconomic framework, to provide microfoundations for macro relationships, to emphasize interactions within economies, and to examine some topical issues in policy design.
- **Assessment:** An in-class test in the Spring term counts for 20% and a three-hour examination counts for 80%. If the mark in your final examination is higher than the mark in the mid-term test, the marks for the mid-term test will be discarded, and your final grade will come entirely from the final examination.
- **Syllabus:** On successful completion of the course, students will be able to demonstrate that they can:
  1. form their own economic view on current macroeconomic problems;
  2. understand the interrelationships between different macroeconomic policies;
  3. understand macroeconomic data and statistical relationships;
  4. present macroeconomic analysis both verbally and in written form;
  5. construct and write answers to macroeconomic analytical questions;
  6. undertake further study in the different areas of macroeconomics such as international finance, monetary economics, growth theory, etc.

- **Recommended Books:**

  Required reading (course text)

  - Stephen D Williamson, Macroeconomics, 2nd edition, Addison Wesley
    Web site: http://wps.aw.com/aw_williamson_macroecon_1

  Recommended Reading

  - N Gregory Mankiw, Macroeconomics, 5th edition, Worth Publishers
    http://www.worthpublishers.com/mankiw/
    http://wps.aw.com/wps/media/access/Pearson_Default/279/285984/login.html
Management Accounting (BUMN037H5)

- **Compulsory for:** BSc Mathematics/Statistics and Accounting/Management
- **Core for:** BSc Mathematics/Statistics and Accounting
- **Level:** 5
- **Prerequisites:** none
- **Teaching:** One evening of lectures a week for one term.
- **Overview:** The module covers the nature and classification of costs, break-even analysis, allocation of overheads; preparing and using budgets, variance analysis and investment appraisal.
- The aims of this module are to:
  1. To develop in students an understanding of the use of accounting data and information in the planning and control functions of management and the decision making process;
  2. To give students an appreciation of the role of management accounting within the overall function of management;
  3. To develop students’ knowledge and understanding of the application of different management accounting techniques.
- **Assessment:** Final unseen exam (100%)
- **Syllabus:**
  - Explain the role of management accounting within an organisation and the needs for management information;
  - Understand the principles of costing and apply them in straightforward scenarios;
  - Understand the basic principles of performance management; and
  - Understand the basic principles of budgeting and apply them

- **Recommended Books:**

Please note that reading lists may be altered: you will be informed in the first class which books you should purchase. The main text for this module is likely to be:

*Accounting: An Introduction, McLaney & Atrill, 6th edition*
Management Studies I (BUMN077H4)

- **Compulsory for:** BSc Mathematics and Management, BSc Statistics and Management
- **Core for:** BSc Mathematics/Statistics and Management
- **Level:** 4
- **Prerequisites:** none
- **Teaching:** One evening a week for one term.
- **Overview:** This module provides an introduction to management theory and practice. It serves as a foundation upon which Management Studies II and more specialised modules are built, and covers theoretical models of management; the fundamentals of resource management and allocation; planning, strategy and decision-making; and organization culture and structure.
- **The aims of this module are to:**
  - Introduce the social scientific study of management.
  - Provide students with a good understanding of basic management concepts and practices and the role and function of management across a wide range of organisations.
  - Equip students with a range of tools that will enable them to relate their work and management experiences to current management concepts and theories.
- **Assessment:** Coursework (30%) Two Hour Written Exam (70%). The word limit of the coursework is 1,500 words (the first submission word limit is 500 words and second submission word limit is 1,000 words).
- **Syllabus:** On successful completion of the course, the student will:
  1. Understand the ways in which different aspects of management behaviour have been analysed by social scientists.
  2. Appreciate different ways of thinking about contemporary issues in management and organizations.
  3. Understand the importance of management in organisations and the connections between different management functions.
  4. Better understand current practices in their own organisations.
- **Recommended Book:**
  - Other readings will also be made available in class.
Management Studies II (BUMN078H4)

- **Compulsory for:** BSc Mathematics and Management, BSc Statistics and Management
- **Core for:** BSc Mathematics/Statistics and Management
- **Level:** 4
- **Prerequisites:** Management Studies I (BUMN077H4)

- **Teaching:** One evening a week for one term.
- **Overview:** This module explores a range of issues around current management theory and practice. With Management Studies I it serves as a foundation upon which more specialised modules are built, and covers human resource management; leadership; teams; marketing; change management; innovation; e-business; corporate governance and social responsibility; financial management and performance measurement.
  - The aims of this module are to:
    - Build on the topics covered in Management Studies I.
    - Provide students with a good understanding of basic management concepts and practices and the role and function of management in a wide range of organisations.
    - Equip students with a range of tools that will enable them to relate their work and management experiences to current management concepts and theories.
  - Learning objectives

- **Assessment:** Coursework (30%) and two-hour written exam (70%). The word limit of the coursework is 1,500 words.
- **Syllabus:** On successful completion of the course, the student will:
  1. Understand the ways in which different aspects of management behaviour have been analysed by social scientists.
  2. Appreciate different ways of thinking about contemporary issues in management and organizations.
  3. Understand the importance of management in organisations and the connections between different management functions.
  4. Better understand current practices in their own organisations.

- **Recommended Book:**
  - Other readings will also be made available in class.
Microeconomics for Business (MOMN012H5)

- **Compulsory for**: BSc Mathematics and Accounting/Management, BSc Statistics and Accounting/Management
- **Core for**: none
- **Level**: 5
- **Prerequisites**: None
- **Teaching**: one evening a week for one term
- **Overview**: This module analyses the most useful and relevant topics in microeconomics for business decision making.
- **Assessment**: 1 mid-term written exam in week 5 of the spring term (30%) and a 2-hour written examination (70%).

**Syllabus**:

Managerial Economics 1 covers basic microeconomics concepts and models: demand, supply, and market equilibrium analysis; production and cost analysis; profit maximisation in various market structures; strategic interaction; and market failures.

This module aims:

To introduce the basic microeconomic concepts that describe the behaviour of economic agents (consumers, firms) and markets, thus supporting a more rigorous understanding of the economic forces shaping real-world business decisions.

To help students to become better planners of business strategy, by demonstrating the use of microeconomic models in support of business decisions.

At a more general level, to strengthen the analytical and critical thinking skills of undergraduate students in management programmes.

On successful completion of the module, students should:

1. Have appreciated the practical utility of traditional and modern microeconomic tools to identify and implement appropriate business strategies in a given situation.
2. Have developed widely transferable analytical and critical thinking skills.

**Recommended Books**:

A textbook will be advised before the start of the module.

A good textbook to browse in advance (available from the library) is:

Macroeconomics for Business (MOMN033H5)

- **Compulsory for:** BSc Mathematics and Accounting/Management, BSc Statistics and Accounting/Management
- **Core for:** none
- **Level:** 5
- **Prerequisites:** none
- **Teaching:** one evening a week for one term
- **Overview:** This module analyses the most useful and relevant topics in microeconomics for business decision making.
- **Assessment:** One mid-term written exam in week 5 (30%) and a two-hour written examination (70%)
- **Syllabus:**

This module analyses the most useful and relevant topics in macroeconomics for business decision making. The module covers the basic concepts of managerial economics under the macroeconomic perspectives: business cycle, balance of payment and national account identity, exchange rate and purchasing power parity, monetary policy, fiscal policy and credit market under asymmetric information.

The aims of this module are to:

- At a specific level, to train undergraduate students in management programmes to understand the macroeconomic view in which business are operating;
- At a more general level, to strengthen the analytical and critical thinking skills of undergraduate students in management programmes

On successful completion of the module, students should:

1. appreciate the practical utility of modern macroeconomic tools to identify and implement appropriate business strategies in a given situation;
2. be able to apply economic theory to specific macroeconomic scenarios;
3. develop the widely transferable analytical and critical thinking skills.

- **Recommended Books:**

A textbook will be advised before the start of the module. A couple of good textbooks to browse in advance (available from the library) are:

Williamson S D (2008), Macroeconomics, Pearson International Edition. Any edition is fine. I recommend to read the first three chapters

Keith Pilbeam (2006) “International Finance” Palgrave macmillan. Any edition is fine. I recommend to read the first two chapters
Microeconomic Theory and Policy (EMEC012S6)

- **Compulsory for:** BSc Mathematics & Economics, BSc Statistics & Economics
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Introduction to Economics
- **Teaching:** one evening per week in the autumn term
- **Overview:** The purpose of this course is to provide a foundation of intermediate level microeconomics. In addition to developing and extending topics familiar to students from their first year, such as consumer and producer theory, the course introduces important concepts such as asymmetric information, game theory, general equilibrium, public goods, externalities, welfare economics.
- **Assessment:** The assessment will be based for 20% on coursework (a take-home assignment) and for 80% on a three-hour formal examination to be held in June.

**Learning Objectives**

On successful completion of this course, students should have:

- a critical perspective on the assumptions underlying microeconomic models;
- a good understanding of core microeconomic concepts such as efficiency, welfare, externalities, public goods, strategic interaction and asymmetric information
- the ability to apply these concepts to a diverse range of markets and economic settings.

**Lecture Schedule**

- Consumer and producer theory: a revision
- Decision making under uncertainty
- Strategic decision making
- Asymmetric information
- General equilibrium and welfare: externalities and public goods

**Recommended Books:**

- Varian, Intermediate Microeconomics, Norton, latest edition
- Pindyck and Rubinfeld, Microeconomics, Prentice Hall, latest edition
Number Theory and Algebra (BUEM048S6)

- **Compulsory for:** none – only available on Grad. Cert/Dip Mathematics
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Proof & Structure in Mathematics, Algebra 1, or equivalent
- **Teaching:** Algebra: Introductory lecture (1.5 hours) plus 4 full evenings in the Autumn Term. Number Theory: 8 evenings in the Spring Term plus 1 revision lecture in Summer Term. Then 2 revision lectures (one on Algebra, one on Number Theory) in the Summer Term.
- **Overview:** Graduates of quantitative degrees (for example Science or Economics) without enough pure mathematics to go straight to the MSc Mathematics will be advised to take either the one year Graduate Certificate or (if they need to cover a lot of ground) the two year Graduate Diploma. The ideal module for getting up to speed with the relevant undergraduate mathematics would normally be Algebra 2. However we are only able to run this module in alternate years. Therefore we have designed Number Theory and Algebra to run in the years when Algebra 2 does not run. It combines the Number Theory half of the “Number Theory and Geometry” module with a specially designed one-term Algebra component – based on guided reading with four evenings of lectures – which will cover all the essential algebra prerequisites for the MSc Mathematics. The aims of this module are to enable students on the Graduate Cert/Dip programmes to be exposed to precisely the higher level pure mathematics that is required for further study at postgraduate level. You will study number theory and algebra, including groups, rings and fields – the main algebraic structures encountered on a BSc Mathematics programme. You will gain practice in the formal and rigorous techniques of mathematical proof which are fundamental to the study of mathematics at level 6 and 7.
- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**

**Number Theory**

1. Numbers with names: polygonal numbers, Fermat primes, Mersenne primes, perfect numbers.
2. Number theoretic functions, including Euler’s φ function.
3. Fermat's little theorem and applications to public-key cryptography.

**Algebra**

1. Consolidation of basic material on groups, discussion of several examples from numbers, geometry and linear algebra.
2. Normal subgroups, homomorphisms, isomorphisms, conjugacy.
3. Rings and fields, with definitions, examples and basic properties.
4. Vector spaces and linear transformations.

**Recommended Books**

Number Theory and Geometry (EMMS093S6)

- **Compulsory for:** none
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Proof & Structure in Mathematics, Algebra 1
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** This is a two-part course aiming to provide you with an introduction to two important areas of pure mathematics, number theory and geometry.

The number theory section will cover types of numbers such as polygonal numbers and perfect numbers, followed by number theoretic functions, including Euler's φ function. We will prove Fermat's little theorem and study quadratic congruences as well as Pythagorean triples and sums of squares.

The section on geometry will devote time to vector geometry, affine geometry and Euclidean geometry. Curves arising from conic sections, such as the ellipse and the hyperbola, will also be studied and their properties derived from first principles, with some applications and generalisations. Finally there will be a look at the geometry of the complex plane.

- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**

**Number Theory**
1. Numbers with names: polygonal numbers, Fermat primes, Mersenne primes, perfect numbers.
2. Number theoretic functions, including Euler's φ function.
3. Fermat's little theorem and applications to public-key cryptography.

**Geometry**
1. Vectors; affine transformations; dot products; Euclidean geometry; some basic theorems.
2. Conics: Circles, parabolas, ellipses, hyperbolas; equations of conics; properties of conics; applications; generalisations.
3. Geometry in the Complex Plane: Lines and Circles; the extended complex plane; Möbius transformations.

- **Recommended Books**
Probability and Statistics (EMMS098S5)

- **Compulsory for:** BSc Mathematics, BSc Mathematics & Statistics, BSc Statistics and Accounting/Economics/Management, Dip HE Mathematics
- **Core for:** none
- **Level:** 5
- **Prerequisites:** ‘A’-level mathematics, or equivalent
- **Teaching:** 16 evenings of lectures spread over the Autumn and Spring Terms, plus four separate computing sessions in the autumn term, plus two revision lectures in the Summer Term.
- **Overview:** The module provides an introduction to the analysis of statistical data and to probability theory. The statistical computer package MINITAB is introduced and used especially for the parts of the module that deal with the statistical analysis of data. Please note that the statistical software being taught may change for 2015/16.
- **Assessment:** 20% coursework (2 assignments); 80% exam.
- **Syllabus:**
  1. An introduction to the statistical computer package Minitab.
  2. Descriptive statistics and graphical methods.
  3. The elements of mathematical probability theory.
  4. Bayes’ Theorem and its applications.
  5. Discrete random variables and probability distributions, including the binomial and Poisson distributions.
  6. Mean and variance of probability distributions.
  7. Continuous random variables and probability distributions, including the normal distributions.
  8. Populations, random samples and sampling distributions, including the t and chi-square distributions.
  9. Estimation, confidence intervals and hypothesis testing with special reference to samples from normal distributions and estimates of proportions.
  10. Chi-square tests of goodness of fit.
  11. Two-way contingency tables.
  12. An introduction to non-parametric methods.

- **Recommended Books:**
  - The following tables are recommended and will be provided in the examination: *New Cambridge Statistical Tables (Second Edition)*, D. V. Lindley and W. F. Scott, Cambridge University Press, 1995. You may find it helpful to buy a copy.
Probability Models and Time Series (BUEM023S6)

- **Compulsory for:** BSc Mathematics and Statistics, BSc Statistics and Economics, BSc Statistics and Management
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Statistics: Theory and Practice
- **Teaching:** 14 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** This module will train you in the theory and application of discrete time stochastic processes, and in continuous time stochastic processes whose dynamics can be analyzed by an appropriately embedded discrete time process.

We will explore relevant applications of such processes in a management science/operational research context. We will develop problem solving techniques for selected problems within stochastic operational research that yield useful results based on theoretical calculations. You will also be given an introduction to the analysis of time series data using Box-Jenkins ARIMA modelling.

- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**
  1. Introduction to Stochastic Processes
  2. Random vectors and probability theory
  3. Convergence results for sequences of random variables
  4. The Poisson process
  5. Introduction to Markov Chains
  6. Stationary processes and autocorrelations
  7. The properties of AR(1) and MA processes
  8. General autoregressive processes
  9. ARMA and ARIMA processes
  10. Fitting an ARIMA model
  11. Diagnostic checking
  12. Forecasting

- **Recommended Books:**
  - Poisson process and Markov Chains
  - Time Series
  - The S-PLUS statistical package

- **Statistical Tables**
  - We will use the following statistical tables:
    - D. V. Lindley & W. F. Scott, New Cambridge Statistical Tables.

  These are the ones that will be available at examination.
Problems in Mathematics (BUEM009S6)

- **Compulsory for:** BSc Mathematics
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Algebra 1, Calculus 1, Discrete Mathematics, Proof & Structure in Mathematics
- **Teaching:** 4 evenings of lectures, each on a different topic.
- **Overview:** This course aims to allow students to engage with some of the important problems which have shaped mathematics. Problems will be put in their historical context and will be used to illustrate the development of different areas of mathematics. You will have the opportunity to tackle more open-ended work and make links between the many branches of mathematics that have been studied on the degree programme.
- **Assessment:** This module is entirely coursework based; split into 40% for problem sheets and 60% for essays. Over the course of the year there will be four evenings of lectures. Each evening will concentrate on one topic (the choice of topics will vary each year). At the end of each lecture evening, students will be given a problem sheet to complete. Each problem sheet will count 10% towards the final mark for the module. In addition, at the end of each lecture students will be given a short list of suggestions for essays with each topic. Over the course of the year students must choose any two of these questions to complete; each essay should be roughly 2,500 words and no more than 4,000 words. Each essay counts 30% giving a total of 60%.
- **Syllabus:** Topic choices will vary from year to year according to the specialisms of staff, current research etc. You will be given more detail when you take the module of the topics for that year.

**Recommended Texts:**
- The History of Mathematics, John Fauvel and Jeremy Gray, Palgrave Macmillan (1985)
- Unknown Quantity: A Real and Imaginary History of Algebra, John Derbyshire (2007)
Proof and Structure in Mathematics (EMMS095S5)

- **Compulsory for:** BSc Mathematics, BSc Mathematics and Accounting/Economics/Management/Statistics
- **Core for:** BSc Mathematics; BSc Mathematics and Statistics
- **Level:** 5
- **Prerequisites:** ‘A’-level mathematics or equivalent
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** Introduces main methods of mathematical proof, such as induction, contradiction, contrapositive proofs, logical connectives, quantifiers, properties of integers, rational, real, complex numbers, binary operations, groups.
- **Assessment:** 20% coursework (4 assignments); 80% exam.
- **Syllabus:**

  **The language of mathematics:** Statements; theorems; definitions; logical connectives; truth tables; quantifiers; negation; contrapositive proofs; counterexamples; proof by contradiction; proof by induction.

  **The number sets: integers, rationals and real numbers:** The well ordering property; the division theorem; the fundamental theorem of arithmetic; the Euclidean division algorithm; algebraic properties of the natural numbers and integers; congruence; linear congruences; rational and real numbers; boundedness; the completeness axiom.

  **Complex numbers and Infinite Sequences:** arithmetic of complex numbers, polar form, De Moivre’s Theorem. Definition of a sequence; null sequences; convergence, limits; monotonic sequences; divergent sequences; infinite series.

  **Binary relations, Binary operations and Groups:** binary relations and equivalence relations; binary operations and their properties; operation multiplication tables; definition of a group and examples; cyclic groups and abelian groups; orders of elements and groups; subgroups; Lagrange’s Theorem.

- **Recommended Books:**
Real and Complex Variable (BUEM008S6)

- **Compulsory for:** BSc Mathematics
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Calculus 1, Proof and Structure in Mathematics
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** This module provides the theoretical background calculus, formally defining the idea of a limit, continuity and differentiability of a function and the Riemann integral. The second half of the module extends these ideas to the complex plane. It develops further the need for formal proof in mathematics and the understanding of abstract mathematics.
- **Assessment:** 20% coursework; 80% exam.
- **Syllabus:**

### Real Variable
Number systems: real numbers; supremum and infimum; epsilon notation. Sequences: divergence and convergence; limits; subsequences. Series: divergence and convergence; tests for divergence and convergence. Functions: limits; continuity; tests for continuity and discontinuity. Differentiation: Rolle’s Theorem; Mean Value Theorem; l’Hôpital’s rule. Integration: Riemann integral; lower and upper Riemann sums. Power Series: Taylor polynomial; Taylor’s Theorem.

### Complex Variable
Complex numbers: real and complex parts, modulus, argument, geometrical interpretations. Sequences and series: relationships between complex and real sequences, Cauchy sequences, convergent and absolutely convergent series. Topology of the complex plane: open and closed sets, properties of open and closed sets, convergent sequences in open and closed sets. Complex functions: continuity, boundedness, power series, radius of convergence, ratio and root tests, the exponential function. Differentiation: Cauchy-Riemann equations, functions defined by power series, holomorphic functions. Integration: Integration of a function along a path, Cauchy’s Theorem, Cauchy’s integral formula, results on integrating holomorphic functions, entire functions, Liouville’s Theorem and its application to the roots of polynomials, Singularities. Laurent Series: Computing Laurent series, the residue theorem, calculating residues of functions with simple poles, using the residue theorem to evaluate real integrals.

### Recommended Books

#### Real Analysis

#### Complex Analysis
- *Complex Analysis*, Stewart and Tall
- *Introduction to Complex Analysis*, Priestley.
- *The Complex Problem Solver*.
- *Complex Variables and applications*, Brown and Churchill.
Statistical Modelling (EMMS083H6)

- **Compulsory for:** BSc Mathematics and Statistics, BSc Statistics and Economics, BSc Statistics and Management
- **Core for:** none
- **Level:** 6
- **Prerequisites:** Statistics: Theory and Practice
- **Teaching:** 14 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.
- **Overview:** The aims of this module are: To provide a basic introduction to the concepts and techniques of multivariate data analysis. To extend knowledge within the area of regression modelling from multiple linear regression to generalized linear modelling. To provide a working knowledge of how basic multivariate analysis and some types of generalized linear modelling can be implemented in a high level statistical package such as S-PLUS and applied to realistic data sets.
- **Assessment:** 20% coursework; 80% exam.

- **Syllabus:** Additional Mathematics and Statistics in preparation for introducing multivariate data analysis (for e.g. relevant matrix algebra) and generalized linear modelling (for e.g. review of multiple linear regression and maximum likelihood).

**PART A** (Multivariate Analysis)

- Covariance and Correlation Matrices
- Principal Components Analysis
- Procedures based on The Multivariate normal distribution
- Discriminant Analysis

**PART B** (Generalized Linear Modelling)

- Use of log-linear models for the analysis of contingency tables in two or more dimensions
- Modelling Binary Response Data
- Numerical procedures for parameter estimation

**Recommended Books:**

Statistics: Theory and Practice (BUEM003S6)

- **Compulsory for:** BSc Mathematics and Statistics, BSc Statistics and Accounting/Economics/Management, Grad Cert/Dip Statistics

- **Core for:** none
- **Level:** 6
- **Prerequisites:** Probability and Statistics
- **Teaching:** 16 evenings spread over the Autumn and Spring Terms, plus 2 revision lectures in the Summer Term.

- **Overview:** This module follows on from the Probability and Statistics module to give a more in-depth understanding of the main theoretical ideas that fundamentally underpin uses of the theory of statistics. For those focusing on statistics, the module will provide some of the necessary pre-requisite knowledge for modules found on final year undergraduate and Masters programmes in Statistics. It can also serve as a more complete „stopping-off” point for mathematicians who wish to push their statistical knowledge beyond an introductory level. On the computational side, by studying this module you will gain a working knowledge of a high-level statistical programming language, such as S+.

- **Assessment:** 20% coursework; 80% exam.

- **Syllabus:**

  Joint distribution of several variables and likelihood functions: with special emphasis on the effects of the variables being i) mutually independent, or ii) drawn from the same distribution, or both; multivariate normal distribution, with particular attention to the bivariate normal;

  Further distribution theory: sums of independent Chi-squared random variables, F-distributions, and how they relate to analysis of variance techniques;

  Introduction to S+;

  Design and analysis of simple experiments: to include (but not necessarily restricted to) one and two-way completely randomized designs;

  Introduction to the theory of statistical inference: likelihood, sufficiency, estimation, hypothesis testing; Simple and multiple linear regression.

- **Recommended Texts**

  o W. Krzanowski An Introduction to Statistical Modelling. [All Editions suitable].

  You may also want to dip into:

  o R. V. Hogg & E. A. Tanis Probability and Statistical Inference. [Virtually any of the available editions would be fine].
  o D. C. Montgomery Design and Analysis of Experiments. [3rd to 7th editions are all suitable].

  We will use the following statistical tables:

  o D. V. Lindley & W. F. Scott New Cambridge Statistical Tables, CUP.
Assessment

Mathematics and Statistics Coursework

Our coursework policy may be updated from time to time. The latest version is always available at http://www.ems.bbk.ac.uk/for_students/bsc_maths.

Coursework is a key component within all of our programmes. It provides the opportunity for students to assist their learning through the feedback provided by marked assignment scripts, as well as taking away some of the pressure from the written examinations in the summer. We also consider it important that you should be encouraged to manage time properly during your busy time at Birkbeck: it is our experience that those who do, are the ones likely to benefit the most from our programmes, and pick up the best marks!

To help support you in these desired aims and objectives, we have put in place an official policy on how items of coursework are to be dealt with. (The rules covering late submission of work are governed by the College-wide coursework policy.) This policy primarily covers assignments: however, other items of coursework are treated in a similar way.

- You will be allowed a minimum of 3 weeks to complete each assignment.
- Every assignment will be placed on the web as well as being distributed in lectures.
- Where possible we will return work within 4 weeks of the submission date. If this cannot be done, we will give notice of the likely return date either by email or via the webpage associated with the module or programme.

Submission and Receipt of Coursework

- Coursework should be neatly written or typed in black or blue ink on A4 paper.
- You should submit your work by placing it inside the Assignment Box (which is opposite the main lifts and by the window, on the 7th Floor, Malet Street).
- Plastic documents wallets, folders, etc. are non-returnable.
- The Assignment Box will be emptied in the morning and any assignment scripts found there will be stamped with the date of the previous working day.
- You can to check that your work has been received by looking your name up on a list (on the noticeboard next to the lifts on the seventh floor). It is your responsibility to check that submission has been acknowledged; lists are displayed on the noticeboard the day after the deadline date.
- If you cannot deliver the assignment personally, then you can, at your own risk, either arrange for somebody else to do it for you, or have it sent in by post. Note that irrespective of the date of posting, the date of arrival will be deemed to be the date of submission. Electronic submission of coursework (for e.g., via fax, or as an email attachment) is not acceptable and such submissions will not be considered eligible for examination.
- Only the first submission of an item of coursework will be considered. Later substitutes, or additions, to the original submission will not be accepted or considered for examination except by the invitation of the relevant examiner.
- You must keep a copy of your assignment for your records.
You are advised to have marked coursework returned to you in person only. Requests to have work left in the student pigeon hole must be made by email to the mathematics and statistics administrator; it is understood that work that is returned via the pigeon hole is done so at your own risk.

All marked coursework will need to be returned to the mathematics and statistics administrator during the summer term, for moderation by the visiting (external and/or intercollegiate) examiners. You will be contacted in writing and asked to return your marked coursework. After moderation you may collect coursework if you wish; any coursework not collected will be destroyed.

Late Submission

If you submit work late (but not more than 14 days late), your mark will be capped at the pass mark for your programme, 40% for undergraduate programmes, 50% for postgraduate programmes. That is, your work will be marked as normal and you will be told this mark, which is the ‘real’ mark that would have been awarded if the work had not been late. If the work is not of a pass standard this is the mark that will be awarded. However, if the work is of a pass standard, you will be given the capped pass mark of 40% or 50%.

If there are mitigating circumstances you can request that the penalty be lifted. You must do this in writing by submitting a statement outlining the reasons for special consideration to be given, along with relevant supporting documentation (e.g. medical certificate, employer statement etc.) to your programme administrator. If the statement and documentation are all found to be in order, this will then be sent for consideration by a sub-committee meeting of the relevant (sub-)Board of Examiners (which normally takes place twice a year, in the Spring and Summer Terms). If no such documentation is received prior to the meeting the ‘real’ mark will not be considered and the penalty mark will stand.

If the assignment is handed in late by more than 14 days, for whatever reason, then it cannot be considered for examination. If this is the case, or the assignment is not handed in at all, then the default position is that the assignment will be given a score of 0 (zero). If there is a case to be made for being awarded a ‘nominal substitute’ mark for an assignment falling into this category, then, as for submission up to 14 days late, you will need to put this case in writing for consideration.

Note: Any part of this policy may be suspended, or modified, on a case-by-case basis, in line with disability provision, upon advice from appropriate College authorities.

Revision and Exam technique

Studying for Examinations

• Little and often is better than 8 hour marathon sessions the night before the exam. Draw up a study timetable and stick to it.
• Be active. Don’t just read through the notes. Test yourself on definitions and theorems. Try out methods and theorems with your own examples.
• Use the syllabus and learning outcomes to get an idea what to emphasise in your revision.
• Learn all the definitions. Practise writing out definitions and results from memory until you are word perfect.
• Learn the statements of all theorems from lectures. Read the proofs and try to understand them. Learn the proofs, especially the short ones that you might be asked to reproduce.
• Practise by doing questions from lecture notes, questions in books, past exam questions (where available) or even make up questions! Because the mathematics and statistics programmes have been redesigned recently, some modules you take will be new, and have
no past papers. If this is the case, lecturers will provide a sample exam paper to give you an idea of the style and level of the exam. Where modules have run before, past papers are available on the Library website. Solutions to past exams are not automatically available as exam questions may sometimes be set as coursework in following years; however some lecturers do make solutions available on their websites.

- Make use of lecturers! Contact us as soon as possible if you are having difficulties. Make a list to take with you of the points which are causing you difficulty so you can tackle them one by one.

**Exam Technique**

- Arrive in good time and do your best to keep calm.
- Make sure you have read the rubric and know exactly how many questions you need to answer and which questions are compulsory. Most of the exams have a compulsory section of short questions, then a section of longer questions where there is some choice about which ones to answer.
- Look through the whole examination paper to size it up. Maybe the last question is exactly what you’ve just revised. Starting with a question you feel confident about can help you relax and do better in the rest of the exam.
- If marks are allocated for questions, this gives a guide as to how much time you should devote to them. Don’t spend 20 minutes trying to answer a 1 mark question.
- If you think there is an error on the exam paper, let an invigilator know as soon as possible. All exams are thoroughly checked by at least three people, but very occasionally mistakes happen. The invigilator will contact the examiner who can confirm whether or not there is an error and correct the question if appropriate.
- Write clearly and use as much space as you need. Explain what you are doing so you can get partial marks for a correct method even if the final answer is wrong.
- Number your questions carefully, especially if you come back and answer, say, 3(b) at the end of the exam, when 3(a) and (c) are in a completely different place in your answer book. Ideally you would write a little note to the examiner saying “for 3(b), see end of script”.
- Try and leave some time at the end to check over your answers and make sure you have attempted all the compulsory questions.

**Registration for Examinations**

Every year you will be emailed a computer link which you will need to access to confirm the modules you are taking. Once you have entered your ITS username and password the exams you are entered for will be listed. You need to check carefully that the information is correct, then confirm the modules online. This is essential because without this, you will not be allocated a Candidate Number. Later in the year you will be emailed an examination admission notice which you need to print off and bring with you to each exam, together with your Birkbeck student ID card, in order to gain admittance to the examination room. You will need to write your Candidate Number on your examination script. When examination results are issued (normally late July), you will be emailed, and you will then be able to go online to your “My Studies at Birkbeck” page to check your results. **You will not be sent a paper copy of your results: they will only be available online. Official transcripts of your results will be sent out by the Exams department on completion of your studies.**

Students can obtain transcripts from the exams department, before completion of studies, at a cost. [http://www.bbk.ac.uk/mybirkbeck/services/administration/your-transcript?searchterm=transcr](http://www.bbk.ac.uk/mybirkbeck/services/administration/your-transcript?searchterm=transcr)

The examination timetable will be available in the spring. It is your responsibility to check the dates and times of your exams and make sure you are down for the correct exams and that there are no clashes. If you find you have a clash, you should inform the registry as soon as possible. If you are
late for an exam you may not be permitted to take it, as people may already have left the exam room. So be on time!

You may attempt an examination a maximum of three times. Once you have confirmed your intention to study, then failure to take the exam, even if you subsequently withdraw from the module, this would count as one of your attempts (unless you have mitigating circumstances, see below). Therefore it is very important to make sure you have correctly entered your choice of modules.

If you have to withdraw for some reason before the exam, you must inform Registry of this and get permission to withdraw. Simply not turning up on the day (unless you later provide a doctor’s note or similar to explain your absence) will count as one of your attempts at the examination.

Permission to defer the examination or any part of the examination, including submission of an essay, project, dissertation or other written work, may only be granted for reasons judged adequate in the particular case at the discretion of the College. Application for permission to defer examination(s) must be made in the case of summer examinations at least 14 days in advance of the first examination or by 1 May whichever is the earlier. You need to complete an application form (these can be obtained from the mathematics and statistics administrator). The form must then be given to the Programme Director of your degree programme. Such applications are granted or refused at the discretion of the Programme Director and you may be asked to submit documentary evidence in support of your application.

If you are unable to attend an exam due to illness or any other unforeseen reason you must complete a mitigating circumstances form at the earliest opportunity, and at the latest 7 days after the final examination for your programme for the year. If you submit this form after this time without good cause then your claim will not be considered. Degree Examination Boards may, at their discretion, set an absolute deadline after which no application for consideration of mitigating circumstances will be considered. Claims that do not include relevant information or documentary evidence will not be considered. All information submitted as a claim of mitigating circumstances will be treated as confidential.

Calculators
You will need a scientific calculator for examinations. It should have trigonometric functions (with degrees and radians), roots and powers, exponents, logarithms, factorials, combinations and permutations. A fraction key is also useful. You do not need a graphical calculator. Some people borrow calculators for exams. This is not a good idea because you will not be familiar with it and you shouldn’t waste time in exams learning how to work your calculator. The following calculators are approved for use in all undergraduate Mathematics & Statistics examinations.

Casio calculators: The following calculators are approved. The first of these is recommended; the last two will be removed from this list over the next three years.

- Casio fx-83 GT Plus Scientific Calculator
- Casio fx-83 ES Scientific Calculator
- Casio fx-83 GT Scientific Calculator

Sharp calculators: The following calculators are approved. As Sharp seem to produce a number of versions of essentially the same calculator, the word series is used to indicate any model with the preceding text at the start of its model name.

- Sharp EL–501 series
- Sharp EL–511 series
- Sharp EL–520 series
- Sharp EL–531 series
**Other Calculators:** If you want to use any other calculator in the examinations then you must get it approved in advance. To do this, you need to fill in a calculator approval form and get it signed by the Chair of the Mathematics & Statistics Sub-board, currently Dr Andrew Bowler.

**Note:** programmable calculators, graphical calculators and any calculator with a keyboard or capable of doing symbolic algebra **will not** be approved.

**Plagiarism**
Plagiarism is the presentation of another person’s ideas as if they were your own. It is a serious academic offence, and could result in marks for assessment being capped or the assessment being failed. Students who plagiarise more than once could have their registration with the College terminated.

In the mathematics and statistics programmes you are required to complete assignments for most modules consisting of exercises to test your understanding of the material covered. Your answers for an assignment should be your own work. If you copy all, or part, of another student’s answers this would constitute plagiarism, and could result in you being awarded a mark of zero for the assignment. Note that it is also an offence to allow another student to copy your work.

For other types of assessment, like the essays in *Problems In Mathematics*, you will have to include details of other people’s work. When you do this it is important that you clearly reference the work, and give a detailed list of references, including information from websites, at the end of your work. If you do not do this then it counts as plagiarism and you are likely to fail the assessment.

Remember you should not plagiarise; it is a form of cheating. If you are in *any doubt* about what is permissible then you should consult your lecturer or programme director.

**Reassessments and Retakes**
The pass mark for modules on undergraduate programmes is 40%. Students are allowed up to three attempts at each module. An “attempt” occurs when a student registers for a module and does not subsequently formally withdraw from that module before the published deadline. So, failure to submit coursework by the deadline or failure to attend the examination without accepted mitigating circumstances will count as a failed attempt. If you fail a module on your first or second attempt one of two paths will normally be offered:

- **Reassessment** (in individual elements, such as exam only, or the whole module) means you will be assessed again on the failed element or elements, without having to attend lectures. The reassessment will not count towards the total number of modules taken in any one year – this is limited to 90 credits worth. Reassessment decisions will be made by the exam sub-board of examiners. It will either be at the next normal assessment opportunity (i.e. when the module is next taught) or before the start of the following academic year. Reassessment is not compulsory; you may choose to retake instead. You will be told the form and timing of the reassessment before you need to make the decision.

- **Retake** means that you will re-enrol on the module, attend lectures and retake all assessment associated with that module (both coursework and exam). The module will count as one of the total modules taken in any one year. This may mean that your programme will take longer to complete, as the maximum number of credits that can be taken in one year is 90.

*Any element of assessment that is submitted as a reassessment and for which no application for consideration of mitigating circumstances has been accepted will be awarded a mark of no more than 40%.* Where an application for consideration of mitigating circumstances is accepted, and a re-assessment awarded by the sub-board the work may be submitted without penalty and the reassessment will not be capped at the pass mark.
There is currently no charge for reassessments.

The final result for a module will be a weighted average of the marks obtained in all elements. For any element of assessment taken more than once, the highest mark obtained will be used. You will be offered three attempts at passing any element, including a maximum of one reassessment opportunity. Note that you cannot retake or be reassessed on individual elements of a module if you have gained an overall pass in the module. If a module is no longer available you can agree a replacement module with the Programme Director.

If you fail a core module three times, unfortunately you will not be able to attain the award for that programme. However you may be able to transfer to a different programme for which the module in question is not core.

Module marks appear on your MyBirkbeck Profile, along with a record of how many times each module has been attempted. You may see a code next to the mark — codes are defined at the bottom of the profile page, but the main ones to be aware of are P, F, FR and DR. The code P means you have passed the module. The code F means you have failed the module by some margin and so will not be offered a reassessment opportunity. You may need to retake the module if it is core or compulsory. The code FR means you have failed the module, but will have the option to be reassessed. If the FR is against your exam mark, this means you will be reassessed in the exam. If the FR is against the coursework mark, this means you will be reassessed in the coursework (normally just one coursework, covering all assignments). Technical point: when a mark appears as FR, the system assumes until told otherwise that you will accept the offer to do a reassessment, so adds 1 to the number of attempts in preparation for the reassessment mark to be inputted. So if you failed your first exam attempt with 33%, you would see 33 FR, and 2 attempts recorded, the second one being the reassessment (usually in September). If you turn down the chance at a reassessment the code will change to F, and 1 attempt will be recorded.

The code DR will appear if a mitigating circumstances claim you submitted was accepted and you are being offered a reassessment. What you are offered a reassessment in, will again depend on what this code is displayed against. Other codes you may see are P (pass), W (withdrawn) and NS (no show at exam).

Pass Requirements and Award Classification
This section describes the pass requirements and method of calculation of final overall marks for each programme of study. Please note that these are the regulations at the time of going to press. However, the college reserves the right to alter existing schemes, without notice, on the advice of the External examiners or otherwise and with the approval of the appropriate College authority.

Full examination and assessment regulations are available on the Birkbeck student intranet at http://www.bbk.ac.uk/reg/assessment.

Cert HE Mathematics
To qualify for this award you must pass a total of 120 credits (4 modules), including the core modules Algebra 1 and Calculus 1, from the modules available on your programme. The (mean) average mark over your four modules is calculated. If this result is 40% or over, you will pass and gain the award. If the result is 70% or over, you will pass with distinction. As an example, suppose Student A gets the following marks:

<table>
<thead>
<tr>
<th>Student A</th>
<th>Algebra 1</th>
<th>Calculus 1</th>
<th>Probability &amp; Statistics</th>
<th>Calculus 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60%</td>
<td>55%</td>
<td>76%</td>
<td>49%</td>
</tr>
</tbody>
</table>
The overall result will be \( \frac{1}{4} (60 + 55 + 76 + 49) = 60\% \) so Student A will gain a pass.

**Dip HE Mathematics**

To qualify for this award you must:

- Pass a total of 240 credits (8 modules), including the core modules Algebra 1 and Calculus 1, from the modules available on your programme.
- Take, but not necessarily pass, all compulsory modules for the programme.
- Pass at least three modules (90 credits) at level 5 or above (the level of each module is given in the Modules section of this handbook).

The overall result for the Diploma is calculated from the average of all the marks for modules at level 5 or above. If the result is 40% or over, you will pass. If the result is 70% or over, you will pass with distinction.

As an example, suppose Student B gets the following marks:

<table>
<thead>
<tr>
<th>Student B</th>
<th>Algebra 1 (level 4)</th>
<th>Calculus 1 (level 4)</th>
<th>Probability and Statistics (level 5)</th>
<th>Calculus 2 (level 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>85%</td>
<td>88%</td>
<td>91%</td>
<td>76%</td>
<td></td>
</tr>
<tr>
<td>Discrete Maths (level 5)</td>
<td>Proof &amp; Structure in Maths (level 5)</td>
<td>Real &amp; Complex Variable (level 6)</td>
<td>Computational Maths (level 6)</td>
<td></td>
</tr>
<tr>
<td>79%</td>
<td>64%</td>
<td>66%</td>
<td>84%</td>
<td></td>
</tr>
</tbody>
</table>

The overall result is \( \frac{1}{6} \times (91 + 76 + 79 + 64 + 66 + 84) = 77\% \), so Student B will pass with distinction.

Note that although marks for the level 4 modules (namely Algebra 1 and Calculus 1) do not contribute to the final award classification, you must still pass these modules as they are core to the programme.

**BSc programmes**

Your degree programme consists of 360 credits (usually 12 modules), from the modules available on your programme. To gain the award:

- You must take, and get a mark of at least 30% for, modules to the value of at least 360 credits at credit level 4 or above, including at least 240 credits at level 5 or above and 120 credits at level 6.
- You must pass (i.e. take and gain a mark of at least 40% for) modules to the value of at least 300 credits, including at least 90 credits at level 6.

In addition, you must take and pass all the core modules for your degree programme. You must take, but not necessarily pass, all the compulsory modules for your degree programme. For each module, in the Modules section, it is stated for which degree programmes it is core or compulsory.

The final degree classification is derived from the weighted average of marks for individual modules. Level 4 modules have a weighting of 0, level 5 modules have a weighting of 1, and level 6 modules have a weighting of 2. The level of each module on your programme is given in the Modules section.

If a module has zero weighting, this means that the mark does not count in the final degree classification. However, these are core modules which you must pass in order to obtain a degree. Also, they provide a vital foundation for work in later years, so it is important to be competent in the material covered.

Degree classifications are awarded based on overall weighted percentage mark as follows:

- 40 – 49% Third Class (III)
- 50 – 59% Lower Second Class (II(ii))
- 60 – 69% Upper Second Class (II(i))
- 70% and over First Class (I)
As an example, suppose that Student C is studying BSc Mathematics, and gains the following marks:

<table>
<thead>
<tr>
<th>Student C</th>
<th>Module</th>
<th>Level</th>
<th>Mark M</th>
<th>Weight W</th>
<th>W × M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra 1</td>
<td>4</td>
<td>73%</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Calculus 1</td>
<td>4</td>
<td>61%</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Proof &amp; Structure in Maths</td>
<td>5</td>
<td>58%</td>
<td>1</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Calculus 2</td>
<td>5</td>
<td>53%</td>
<td>1</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Discrete Maths</td>
<td>5</td>
<td>62%</td>
<td>1</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>Probability &amp; Statistics</td>
<td>5</td>
<td>49%</td>
<td>1</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Computational Mathematics</td>
<td>6</td>
<td>55%</td>
<td>2</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Real &amp; Complex Variable</td>
<td>6</td>
<td>47%</td>
<td>2</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Problems in Maths</td>
<td>6</td>
<td>64%</td>
<td>2</td>
<td>128</td>
<td></td>
</tr>
<tr>
<td>Algebra 2</td>
<td>6</td>
<td>56%</td>
<td>2</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td>Calculus 3</td>
<td>6</td>
<td>50%</td>
<td>2</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Number Theory &amp; Geometry</td>
<td>6</td>
<td>37%</td>
<td>2</td>
<td>74</td>
<td></td>
</tr>
</tbody>
</table>

The weighted average is then given by the sum of the \( W \times M \) values, divided by the sum of the weights. Here \( \sum W \), the sum of the weights, is 16, and \( \sum W \times M = 840 \).

Therefore the overall degree result is \( (\sum W \times M) / (\sum W) = 840 \div 16 = 53\% \) (to the nearest percentage point). Thus Student C gains a lower second class degree (II(ii)).

**Graduate Certificates in Mathematics or Statistics**

To gain one of these awards you must pass 60 credits (2 modules) at level 6 from the modules available on your programme. Your result is the average mark for these modules, and from this the award is classified as follows.

- **Pass**: 40% or above, but less than 60%;
- **Merit**: 60% or above, but less than 70%;
- **Distinction**: 70% or above.

As an example, suppose that Student D is studying the Graduate Certificate in Statistics, and gets the following marks:

<table>
<thead>
<tr>
<th>Student D</th>
<th>Advanced Mathematical Methods</th>
<th>Statistics: Theory &amp; Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75%</td>
<td>51%</td>
</tr>
</tbody>
</table>

The overall result will be \( \frac{1}{2} (75 + 51) = 63\% \), so Student D will pass with merit.

A merit or distinction for the Graduate Certificate in Statistics will qualify you to proceed, if you choose, to one of Birkbeck’s MSc programmes in Applied Statistics. More information about these is available online or in the postgraduate prospectus. Gaining a merit (60% average mark) or better in the Graduate Certificate or Graduate Diploma in Mathematics could qualify you to proceed directly onto Birkbeck’s MSc Mathematics, but this would also be dependent on your choice of modules. Usually *Algebra 2* or *Number Theory and Algebra* needs to be one of the modules you take.

**Graduate Diplomas in Mathematics or Statistics**

To gain one of these awards you must pass 120 credits (4 modules) at level 5 or 6 from the modules available on your programme. At least 90 credits (3 modules) of these must be at level 6.

Your result will be the mean average of all the level 6 modules you have taken, and from this the award is classified as follows:

- **Pass**: 40% or above, but less than 60%;
**Merit**: 60% or above, but less than 70%

**Distinction**: 70% or above.

As an example, suppose that Students E and F are studying the Graduate Diploma in Mathematics, and take the following modules.

<table>
<thead>
<tr>
<th>Student</th>
<th>Discrete Mathematics (level 5)</th>
<th>Algebra 2 (level 6)</th>
<th>Computational Maths (level 6)</th>
<th>Calculus 3 (level 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student E</td>
<td>75%</td>
<td>75%</td>
<td>65%</td>
<td>73%</td>
</tr>
<tr>
<td>Student F</td>
<td>Problems in Maths (level 6)</td>
<td>Algebra 2 (level 6)</td>
<td>Computational Maths (level 6)</td>
<td>Calculus 3 (level 6)</td>
</tr>
<tr>
<td></td>
<td>59%</td>
<td>75%</td>
<td>65%</td>
<td>73%</td>
</tr>
</tbody>
</table>

Student E’s result is: \( \frac{1}{3} \times (75 + 65 + 73) = 71\% \), a distinction.

Student F’s result is \( \frac{1}{4} \times (59 + 75 + 65 + 73) = 68\% \), a merit.
Quick Reference

Useful Contacts

Contacts in Economics, Mathematics and Statistics

<table>
<thead>
<tr>
<th>Name</th>
<th>Room</th>
<th>Telephone</th>
<th>Email Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Office</td>
<td>717</td>
<td>020 7631-6442</td>
<td>-</td>
</tr>
<tr>
<td>School Fax</td>
<td>717</td>
<td>020 7631-6416</td>
<td>-</td>
</tr>
<tr>
<td>Cassie Fernandes (MSc, BSc Maths/Stats administrator)</td>
<td>717</td>
<td>020 7631-6442</td>
<td><a href="mailto:c.fernandes@bbk.ac.uk">c.fernandes@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Charles Graham-Dixon (Grad cert/dip Maths/Stats administrator)</td>
<td>717</td>
<td>020 7631-6418</td>
<td><a href="mailto:c.graham-dixon@bbk.ac.uk">c.graham-dixon@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Yunus Aksoy</td>
<td>732</td>
<td>020 7631-6407</td>
<td><a href="mailto:y.aksoy@bbk.ac.uk">y.aksoy@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Brad Baxter</td>
<td>755</td>
<td>020 7631-6453</td>
<td><a href="mailto:b.baxter@bbk.ac.uk">b.baxter@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Andrew Bowler</td>
<td>751</td>
<td>020 7631-6443</td>
<td><a href="mailto:a.bowler@bbk.ac.uk">a.bowler@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Anthony Brooms</td>
<td>750</td>
<td>020 7631-6439</td>
<td><a href="mailto:a.brooms@bbk.ac.uk">a.brooms@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Ben Fairbairn</td>
<td>754</td>
<td>-</td>
<td><a href="mailto:b.fairbairn@bbk.ac.uk">b.fairbairn@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Isabella Gollini</td>
<td>738</td>
<td>020 7631-6441</td>
<td><a href="mailto:i.gollini@bbk.ac.uk">i.gollini@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Sarah Hart</td>
<td>753</td>
<td>020 7631-6437</td>
<td><a href="mailto:s.hart@bbk.ac.uk">s.hart@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Kenjiro Hori</td>
<td>728</td>
<td>020 7631-6424</td>
<td><a href="mailto:k.hori@bbk.ac.uk">k.hori@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Simon Hubbert</td>
<td>756</td>
<td>020 7631-6404</td>
<td><a href="mailto:s.hubbert@bbk.ac.uk">s.hubbert@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Steven Noble</td>
<td>728</td>
<td>020 7631-6417</td>
<td><a href="mailto:s.noble@bbk.ac.uk">s.noble@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Georgios Papageorgiou</td>
<td>735</td>
<td>020 7631-6410</td>
<td><a href="mailto:g.papageorgiou@bbk.ac.uk">g.papageorgiou@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Maura Paterson</td>
<td>748</td>
<td>020 7631-6440</td>
<td><a href="mailto:m.paterson@bbk.ac.uk">m.paterson@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Rosalba Radice</td>
<td>731</td>
<td>020 7631-6795</td>
<td><a href="mailto:r.radice@bbk.ac.uk">r.radice@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Amarpreet Rattan</td>
<td>734</td>
<td>020 7631-6576</td>
<td><a href="mailto:a.rattan@bbk.ac.uk">a.rattan@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Emanuela Sciubba</td>
<td>727</td>
<td>020 7631-6450</td>
<td><a href="mailto:e.sciubba@bbk.ac.uk">e.sciubba@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Anne Sibert</td>
<td>733</td>
<td>020 7631-6420</td>
<td><a href="mailto:a.sibert@bbk.ac.uk">a.sibert@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Martin Sola</td>
<td>731</td>
<td>020 7631-6411</td>
<td><a href="mailto:m.sola@bbk.ac.uk">m.sola@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Roald Versteeg</td>
<td>752</td>
<td>020 7631-6451</td>
<td><a href="mailto:r.versteeg@bbk.ac.uk">r.versteeg@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Stephen Wright</td>
<td>701</td>
<td>020 7631-6448</td>
<td><a href="mailto:s.wright@bbk.ac.uk">s.wright@bbk.ac.uk</a></td>
</tr>
</tbody>
</table>

Birkbeck Administrative Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Telephone</th>
<th>Email Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>My Birkbeck Helpdesk</td>
<td>0845 601 0174</td>
<td><a href="mailto:info@bbk.ac.uk">info@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Birkbeck Switchboard</td>
<td>020 7631-6000</td>
<td></td>
</tr>
<tr>
<td>ITS Helpdesk</td>
<td>020 7631-6543</td>
<td><a href="mailto:ITS-helpdesk@bbk.ac.uk">ITS-helpdesk@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Disability Office</td>
<td>020 7631-6315</td>
<td><a href="mailto:disability@bbk.ac.uk">disability@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Library Enquiries</td>
<td>020 7631-6063</td>
<td><a href="mailto:library-help@bbk.ac.uk">library-help@bbk.ac.uk</a></td>
</tr>
<tr>
<td>Students' Union</td>
<td>020 7631-6335</td>
<td><a href="mailto:administrator@bcsu.bbk.ac.uk">administrator@bcsu.bbk.ac.uk</a></td>
</tr>
<tr>
<td>SU Advice Centre</td>
<td>020 7631-6335</td>
<td><a href="mailto:advice@bcsu.bbk.ac.uk">advice@bcsu.bbk.ac.uk</a></td>
</tr>
</tbody>
</table>

Security

In an emergency, dial 555 from any phone in college. When you arrive for a lecture take a moment to familiarise yourself with the fire exits. If there should be a fire alarm during a lecture or at any time when you are on the premises, leave the building by the nearest fire exit and get well away from the building until you are told it is safe to go back in. Do not stop to collect up all your belongings.
Term Dates

Term dates and holiday closing for 2016/2017

<table>
<thead>
<tr>
<th>Term</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Autumn</td>
<td>Monday 3 October 2016-Friday 16 December 2016</td>
</tr>
<tr>
<td>Christmas and New Year closure</td>
<td>College will close at 6pm on 22 December, and normal services will resume from 9am on 3 January.</td>
</tr>
<tr>
<td>Spring</td>
<td>Monday 9 January 2017-Friday 24 March 2017</td>
</tr>
<tr>
<td>Easter closure</td>
<td>College will close at 6pm on 12 April, and normal services will resume from 9am on 19 April.</td>
</tr>
<tr>
<td>Summer</td>
<td>Monday 24 April 2017-Friday 7 July 2017</td>
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</tbody>
</table>

NB: Mathematics and Statistics lectures usually start in the SECOND week of term and finish in the TENTH week of term.

The Greek Alphabet

Letters from the Greek alphabet are often used in mathematics, so for reference here it is.

<table>
<thead>
<tr>
<th>Lower case</th>
<th>Upper Case (if used)</th>
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<tbody>
<tr>
<td>α</td>
<td>Gamma</td>
</tr>
<tr>
<td>β</td>
<td>Delta</td>
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<tr>
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<td>Theta</td>
</tr>
<tr>
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How to find Birkbeck