MSc Business Analytics
2016-17
Programme handbook
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Programme Director’s Welcome

Welcome to the MSc Business Analytics at the Imperial College Business School.

We have designed the program to be challenging, stimulating, and at the same time to be highly relevant to current business needs. All the classes in the MSc programme have been newly created taking into account the views of our Advisory Board and other inputs from industry. It lays a strong methodological foundation in the core courses and then allows students to get domain-specific industry expertise.

You will be very busy with classes and learning, but we also want you to enjoy the London experience and take advantage of its incredible networking opportunities. We designed a series of activities throughout the year, in collaboration with Careers and Events. Our Programme Manager, Sue Mossey will be in constant touch with you informing you of both interesting events as well as opportunities.

I hope that you enjoy your study period here and find it enriching and fruitful. Your fellow classmates bring an immense diversity of experience and backgrounds; you will find that you learn from each other as much as from the classes. I hope you form strong bonds that will result in life-long friendships.

Sue and I are always available for you to come and talk to and we value and will listen to your feedback carefully. Please feel free to come and talk to us. We will do our best to make your stay here productive, fruitful, rewarding and above all hugely enjoyable.

Best regards,

Kalyan Talluri

Director, MSc in Business Analytics
Professor of Operations Management
BML Munjal Chair on Global Business and Operations
Fellow, KPMG Center for Advanced Analytics
Fellow, Gandhi Center for Inclusive Innovation
MSc Business Analytics Programme Team

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Email</th>
<th>Office Location</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme Director</td>
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<td>Programme Manager</td>
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<td>1st Floor Business School</td>
<td>Ext. 49196</td>
</tr>
</tbody>
</table>

MSc Business Analytics Programme

Programme Aims
The programme aims to enable graduates to understand the challenge of managing large data sets and to provide them with a skill set to meet this challenge. The programme combines academic rigour and practical relevance. There is a careful balance of teaching and learning, individual and group work. Case study methodology and class-based discussions are used to strengthen the conceptual, analytical and problem solving skills of the participants in real situations. In addition, there are regular seminars by external expert speakers.

Learning Outcomes
Students who complete the programme successfully will be able to:

- Create and manage large data sets
- Demonstrate the analytical skills to interrogate large data sets in a business environment
- Demonstrate a critical awareness of current issues in Business Analytics
- Demonstrate that they have obtained a set of personal development and lifelong learning skills applicable to the international business environment.

Knowledge Objectives

- Creating and Managing large data sets
- Analytical skills to interrogate large data sets in a business environment
- Critical awareness of current issues in business analytics
- The business contexts in which large data sets and analytics feature
- The broader macro environments in which the digital economy is emerging
- The role of business analytics in business and other organisations

Skills Objectives

- Integrate, analyse and evaluate new and/or abstract data and situations, using a wide range of appropriate techniques and transform such data and concepts into options and solutions
Use conceptual, analytical and quantitative skills for decision making

Programme Structure
The MSc Business Analytics Programme is structured around 3 main components: the Core Modules, Elective Modules, and the Report Component. The Programme consists of 3 online pre-session modules, workshops, 9 core modules, 5 elective modules, the Capstone Project or Work Placement, and the Business Analytics Report. The programme duration is approximately 12 months, running from September to the following September.

Students take five elective modules*, four of which must be from elective modules specific to the MSc Business Analytics programme. One additional elective may come from the remaining Business Analytics electives, the MSc International Health Management (IHM) programme, OR 2 ten hour electives from Economics and Strategy for Business (ESB).

Online Pre-Session Modules
- Accounting Primer
- Introduction to Finance for Business Analytics
- Pre-Programme Maths (Maths for Business Analytics)

Workshops
- R and Python Workshops
- Career and Professional Development Workshops

Core Module Component
The nine core modules are:
- Data Structures and Algorithms
- Maths and Statistics Foundations
- Fundamentals of Database Technologies
- Analytics in Business
- Statistics and Econometrics
- Optimisation and Decision Models
- Network Analytics
- Visualisation
- Machine Learning

Elective Module Component
Students take five elective modules, four of which must be modules specific to the MSc Business Analytics Programme.

MSc Business Analytics Elective Modules:
- Logistics and Supply-Chain Analytics
- Healthcare and Medical Analytics
- Retail and Marketing Analytics
- Workforce Analytics
- Big Data in Finance
- Digital Marketing Analytics
- Machine Learning
- Advanced Machine Learning (Organised by the Data Science Institute)
- Data Management and Ethics (Organised by the Data Science Institute)

Other MSc Elective Modules (Limited places available in these electives)
- Management Challenges of Healthcare Organisations (MSc IHM Module)
- Managing Change and Innovation in Healthcare (MSc IHM Module)
- Digital Economics and Digital Strategy (10 hour* MSc ESB Module)
- Energy Economics and Strategy (10 hour* MSc ESB Module)
- Strategy Implementation (10 hour* MSc ESB Module)
  * these are shortened modules, students therefore must take 2 x the MSc ESB elective modules to count as one elective choice

**Report Component**

- Capstone Business Analytics Project -OR- Work Placement
- Business Analytics Report
- Students interested in pursuing a PhD programme in the future have the option of completing an alternative Individual Research Report. Speak to the programme team if you would like to learn more about this option.
<table>
<thead>
<tr>
<th>Term/Dates</th>
<th>Module</th>
<th>Module Code</th>
<th>Core/Elective</th>
<th>Dates</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Session</td>
<td>Accounting Primer</td>
<td>BS1893</td>
<td>Compulsory – Pass/Fail</td>
<td>100% Coursework</td>
<td></td>
</tr>
<tr>
<td>July – Aug</td>
<td>Finance Primer</td>
<td>BS1892</td>
<td>Compulsory – Pass/Fail</td>
<td>100% Coursework</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pre-Programme Maths (Maths for Business</td>
<td>BS1894</td>
<td>Optional module</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analytics)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>Data Structures and Algorithms</td>
<td>BS1819</td>
<td>Core</td>
<td>5 Sept – 30 Sept</td>
<td>100% Coursework</td>
</tr>
<tr>
<td>Term</td>
<td>Maths and Statistics Foundations</td>
<td>BS1820</td>
<td>Core</td>
<td>5 Sept – 30 Sept</td>
<td>50% Exam w/c 3 Oct 50% coursework</td>
</tr>
<tr>
<td></td>
<td>R and Python Workshops</td>
<td>-</td>
<td>Optional</td>
<td>5 Sept – 30 Sept</td>
<td>N/A</td>
</tr>
<tr>
<td>Autumn</td>
<td>Fundamentals of Database Technologies</td>
<td>BS1804</td>
<td>Core</td>
<td>10 Oct – 16 Dec</td>
<td>100% Coursework</td>
</tr>
<tr>
<td>Term</td>
<td>Statistics and Econometrics</td>
<td>BS1802</td>
<td>Core</td>
<td>10 Oct – 11 Nov</td>
<td>50% Coursework, 50% Exam</td>
</tr>
<tr>
<td></td>
<td>Optimisation and Decision Models</td>
<td>BS1803</td>
<td>Core</td>
<td>10 Oct – 11 Nov</td>
<td>50% Coursework, 50% Exam</td>
</tr>
<tr>
<td></td>
<td>Analytics in Business</td>
<td>BS1801</td>
<td>Core</td>
<td>14 Nov – 16 Dec</td>
<td>100% Coursework,</td>
</tr>
<tr>
<td></td>
<td>Network Analytics</td>
<td>BS1805</td>
<td>Core</td>
<td>14 Nov – 16 Dec</td>
<td>50% Coursework, 50% Exam</td>
</tr>
<tr>
<td>Examinations for</td>
<td>autumn term modules take place the week of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term</td>
<td>autumn term modules take place the week of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9th Jan, 2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Machine Learning</td>
<td>BS1806</td>
<td>Core</td>
<td>16 Jan – 17 Feb</td>
<td>100% Coursework</td>
</tr>
<tr>
<td>Spring</td>
<td>Visualisation</td>
<td>BS1807</td>
<td>Core</td>
<td>16 Jan – 17 Feb</td>
<td>50% Exam 50% Coursework</td>
</tr>
<tr>
<td>Term</td>
<td>Logistics and Supply-Chain Analytics</td>
<td>BS1808</td>
<td>MSc BA Elective</td>
<td>16 Jan – 17 Feb</td>
<td>100% Coursework</td>
</tr>
<tr>
<td></td>
<td>Management Challenges of Healthcare</td>
<td>BS0437</td>
<td>MSc IHM Elective</td>
<td>16 Jan – 17 Feb</td>
<td>30% Coursework 70% Exam</td>
</tr>
<tr>
<td></td>
<td>Organisations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Managing Change and Innovation in Healthcare</td>
<td>BS0443</td>
<td>MSc IHM Elective</td>
<td>16 Jan – 17 Feb</td>
<td>30% Coursework 70% Exam</td>
</tr>
<tr>
<td></td>
<td>Healthcare and Medical Analytics</td>
<td>BS1812</td>
<td>MSc BA Elective</td>
<td>20 Feb – 24 Mar</td>
<td>100% Coursework</td>
</tr>
<tr>
<td></td>
<td>Retail and Marketing Analytics</td>
<td>BS1813</td>
<td>MSc BA Elective</td>
<td>20 Feb – 24 Mar</td>
<td>100% Coursework</td>
</tr>
<tr>
<td></td>
<td>Advanced Machine Learning</td>
<td>DS10003</td>
<td>MSc BA Elective</td>
<td>20 Feb – 24 Mar</td>
<td>100% Coursework</td>
</tr>
<tr>
<td></td>
<td>Big Data in Finance</td>
<td>BS1811</td>
<td>MSc BA Elective</td>
<td>20 Feb – 24 Mar</td>
<td>100% Coursework</td>
</tr>
<tr>
<td>Examinations for</td>
<td>spring term modules will take place the week</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term</td>
<td>of 24th April, 2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Workforce Analytics</td>
<td>BS1810</td>
<td>MSc BA Elective</td>
<td>8 May – 2 June</td>
<td>100% Coursework</td>
</tr>
<tr>
<td>Summer Term Block 1</td>
<td>Digital Marketing Analytics</td>
<td>BS1809</td>
<td>MSc BA Elective</td>
<td>8 May – 2 June</td>
<td>100% Coursework</td>
</tr>
<tr>
<td>---------------------</td>
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<tr>
<td></td>
<td>Data Management and Ethics</td>
<td>DSI004</td>
<td>MSc BA Elective</td>
<td>8 May – 2 June</td>
<td>100% Coursework</td>
</tr>
<tr>
<td></td>
<td>Digital Economics and Digital Strategy</td>
<td>BS1712</td>
<td>MSc ESB Elective</td>
<td>8 May – 2 June</td>
<td>100% Coursework</td>
</tr>
<tr>
<td></td>
<td>Energy Economics and Strategy</td>
<td>BS1713</td>
<td>MSc ESB Elective</td>
<td>8 May – 2 June</td>
<td>100% Coursework</td>
</tr>
<tr>
<td></td>
<td>Strategy Implementation</td>
<td>BS1711</td>
<td>MSc ESB Elective</td>
<td>8 May – 2 June</td>
<td>100% Coursework</td>
</tr>
</tbody>
</table>

**Summer Term Block 1 is assessed by Coursework only**

<table>
<thead>
<tr>
<th>Summer Term Block 2</th>
<th>Capstone Business Analytics Project -OR- Work Placement</th>
<th>BS1814</th>
<th>Core – choose between two options</th>
<th>20 June – 29 July</th>
<th>100% Coursework</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business Analytics Report</td>
<td>BS1817</td>
<td>Core</td>
<td>Due 2 September</td>
<td>100% Coursework</td>
</tr>
</tbody>
</table>

*Electives run subject to student interest. Imperial College Business School reserves the right not to run electives that do not have sufficient student interest. Imperial College Business School reserves the right to change electives offered.*
## Skills Table for MSc Business Analytics

Throughout the programme, a number of professional skills will be tested and developed through the modules. (See table)

<table>
<thead>
<tr>
<th>Professional Skills Type</th>
<th>Induction</th>
<th>Core Modules(^{(1)})</th>
<th>Electives Modules (^{(2)})</th>
<th>Report (^{(3)})</th>
<th>Career and Professional Development</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Development</strong></td>
<td>Manage resources and time effectively in order to achieve intended goals</td>
<td>Work effectively as a team member and on an individual basis</td>
<td>Consider the elements of effective leadership</td>
<td>Identify your strengths and weaknesses in relation to developing your professional competences</td>
<td></td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Communication in a cross-cultural context</td>
<td>Research and construct reports in a variety of formats: including computer processing, business and analytical reports, and oral presentations</td>
<td>Critically review evidence including its reliability, validity and significance</td>
<td>Prepare and deliver professional and persuasive presentations</td>
<td>Develop interpersonal skills including key communication skills for career progression</td>
</tr>
<tr>
<td><strong>Technical and Analytical</strong></td>
<td>Integrate, analyse and evaluate new and/or abstract data and situations</td>
<td>Apply analytical techniques to the decision making process in business, both systematically and creatively, and present analysis in a clear and persuasive manner</td>
<td>Produce creative and realistic solutions to complex problems</td>
<td>Use contemporary models and techniques to develop strategies</td>
<td>Develop interview techniques for different professional environments</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Participate in managerial decision processes using large data sets</td>
<td>Undertake literature searches</td>
<td>Learn to adapt and apply your skillset within a particular context.</td>
</tr>
<tr>
<td><strong>Ethical</strong></td>
<td>To consider the ethical context of business and analytics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Learn how to adopt a responsible attitude towards big data</td>
<td></td>
</tr>
</tbody>
</table>

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(1) “Core modules” are Fundamentals of Database Technologies, Analytics in Business, Statistics and Econometrics, Optimisation and Decision Models, Network Analytics, Visualisation, Machine Learning

This module specifically focuses on advancement of your professional writing skills.

**BA Careers and Professional Development**

In addition to the assessed taught modules, the programme has been designed to address the specific professional development needs of students entering a wide range of careers.

Our professional development element of the programme has been designed in conjunction with the Business School’s Careers and Employer Relations teams. Students will have access to the Business School’s Career Service through the availability of online sessions as well as 1-to-1 meetings with a Careers Adviser. There will be an integrated series of events that will run in both the autumn and spring terms. These sessions will include employer talks and forums as well as professional development workshops tailored to the programme.

The overall aim of this element of the programme is to help prepare you for your future career and, in particular, to consider and develop the professional competences needed including consideration of leadership competences. Not only will you receive advice on writing successful CVs and applications but also you will have access to a wide range of workshops including on how to make a personal impact (during both interviews and business meetings), how to present persuasively to a variety of audiences and how to effectively network.
Programme Assessment
The Programme is assessed through a mixture of coursework and examination. See table on page 6 for specific module assessments.

Formal examinations
Examinations can take various formats depending on the subject concerned. The format is subject to change and the Module Leader will provide full information during the module.

Examinations for modules taken in the autumn term will take place the week of 9 January 2017.

Examinations for modules taken in the spring term will take place the week of 24 April 2017.

Coursework
Coursework can be individual, team-based or a mixture of both. See individual module outlines for breakdown of coursework.

Study Teams
Teamwork is an integral part of the teaching, learning and assessment strategy for the MSc BA. You will be assigned to a team for all assessed group work associated with the programme. Study teams are responsible for joint work (including assessed work) in the form, for example, case-study analysis, essays, quantitative analysis, and class presentations. While a few of your assignments will be individual assessments, the Business Analytics programme will be assigning team assessment regularly within each term. This is to reflect the reality of working in business today where you often have to work in groups or teams on a project or to collaborate in respect of decision-making. Developing your teamwork skills is considered an essential element for success on this Masters programme. We will start developing your teamwork skills starting on the very first day of the programme - the Induction.

Working in teams, particularly diverse ones, in order to meet tough deadlines is a challenging process and demands maximum effort from all team members to ensure that the team works harmoniously, efficiently and in a mutually supportive environment.

You should be aware that you have a collective responsibility for the integrity of team work submitted for assessment. This means that if part of the work is plagiarised, all team members will be held accountable unless proof can be provided, documenting each member’s contribution. You should, therefore, retain an audit trail of your contribution for this purpose.

Above all, where issues arise between team members, you are expected to adopt a professional approach and work as a team to try to resolve them. The key to successful team work is to consider each other’s strengths and weaknesses and effectively utilize the strengths of each team member in relation to the group task concerned. Each member will differ in relation to their educational background and work experience, and it is critical that your teamwork recognises these differences whilst also maximising the learning experience for all members. You are expected to take turns to facilitate team projects across modules.

You will be allocated to a study team during the first two weeks of term upon joining the programme.
Feedback

Feedback serves two functions. First, it provides a person or team with information about their progress and performance and thus provides a basis for developing a strategy of continuous improvement. Second, it may provide an indication to others about ability and quality.

We place great emphasis on both these elements. Throughout the programme you will receive frequent assessment in relation to coursework, and ultimately in the exams and grading of your project. You will also be asked continuously to assess your learning experience in relation to both modules and lecturers and as a Business School. Further information on assessment feedback can be found in the Academic Regulations and Policies document on the Hub.

Student Feedback

If you have any comments/questions/suggestions to make about the BA Programme, we encourage you to contact us directly by emailing your Programme Manager, Susan Mossey (s.mossey@imperial.ac.uk).

At the end of each module, typically during the last week of a module, you will be requested to complete and return anonymous online questionnaires providing your feedback on the lecturer’s teaching performance on a five point scale. You are also invited to provide constructive comments on each module which we will use to make changes and improvements.

We will also ask you to elect a BA Staff Student Committee during the first term. This committee fulfils a variety of social and pastoral functions. The committee meets formally with the staff on a regular basis, as well as maintains informal contact. One aspect of a committee member’s role is to act as a channel of communication for the cohort’s views and problems.

Staff Student Committee meetings are held once a term. You therefore will have a chance to contact the Student Committee and raise any concerns, questions or make suggestions. These meetings offer an opportunity to both staff and students to provide mutual feedback.

Module Excellence Surveys (MODES)

At the end of every module you will receive a survey (either by e-mailed link or paper hard copy), asking you to provide feedback on the content, instructor, learning environment and module overall. The School issues a survey per instructor and at the end of each term students are also asked to score and comment on the term as a whole.

The MODES feedback is taken very seriously and is used to identify examples of good practice and highlight areas that could be improved. The School really appreciates your support in completing the surveys. If only a small number of students respond, the feedback will not truly reflect the general thoughts of the cohort and therefore be less valid. MODES results are passed onto the lecturers, Programme Directors, Programme Managers, Department Heads, the Dean and the Associate Dean. Your feedback is completely anonymous and is not given to Faculty until they have completed and submitted their marking, so you can be assured that the feedback you provide will have no influence on the grades you receive. Once they have received the feedback, your Programme Director will post a response to the themes and issues raised in the MODES on the Hub.
At the end of each term the programme with the highest average response rate across the modules will be awarded a prize, details of which will be passed on by the Programme Team during the term.
Marking Scheme – MSc Business Analytics

All modules are equally weighted.

There are three components:
- Core Modules Component
- Electives Modules Component
- Report Modules

Pass
- An aggregate mark of 50% or greater across the programme as a whole
- An average of 50% or above in each programme component
- At least 40% in each examination
- At least 50% in each module in the ‘Summer Component’
- At least 50% in all modules assessed by coursework only

Merit
- An aggregate mark of 60% or greater across the programme as a whole
- An average of 60% or above in each programme component
- At least 40% in each examination
- At least 50% in each module in the ‘Summer Component’
- At least 50% in all modules assessed by coursework only

Distinction
- An aggregate mark of 70% or greater across the programme as a whole
- An average of 70% or above in each programme component
- At least 40% in each examination
- At least 50% in each module in the ‘Summer Component’
- At least 50% in all modules assessed by coursework only

Prizes:

Imperial College Business School Prize for Best Overall Performance on MSc Business Analytics Programme

Imperial College Business School Prize for Best End of Year Report on the MSc Business Analytics Programme

Dean’s List for Academic Excellence:

The Dean’s List comprises the top 10% of students (+/- 2%) from each Business School taught programme. Inclusion is subject to satisfactory completion of the award and achievement of a mark of 70% or greater overall.

Dean’s Community Award for Students:

The Dean’s Community Awards encourage and recognise citizenship amongst Business School students who excel in extra-curricular activities.
3.4 Marking Criteria for Examinations and Coursework

At Imperial College Business School, all postgraduate work is marked to the following scheme:

<table>
<thead>
<tr>
<th>Marks</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>85+</td>
<td>Marks represent an exceptional distinction performance</td>
</tr>
<tr>
<td>70 – 84%</td>
<td>Marks represent a distinction performance</td>
</tr>
<tr>
<td>60 – 69%</td>
<td>Marks represent a merit performance demonstrating a clear grasp of the relevant concepts and facts</td>
</tr>
<tr>
<td>50 – 59%</td>
<td>Marks represent a pass performance demonstrating an adequate grasp of most of the relevant concepts and facts</td>
</tr>
<tr>
<td>40 – 49%</td>
<td>Marks represent a fail performance but failure is considered condoned. Students who receive marks within this boundary in any exams are not required to resit provided they achieve an average of 50% overall for the element.</td>
</tr>
<tr>
<td>30 – 39%</td>
<td>Marks represent a fail performance (with significant shortcomings). Students are automatically required to resit any exams for which they receive a mark in this boundary regardless of the overall grade they achieve for the module.</td>
</tr>
<tr>
<td>0 – 29%</td>
<td>Marks represent a fail performance (with major shortcomings). Students are automatically required to resit any exams for which they receive a mark in this boundary regardless of the overall grade they achieve for the module.</td>
</tr>
</tbody>
</table>

In addition, the following guidance is provided to Faculty in relation to projects:

<table>
<thead>
<tr>
<th>70% +</th>
<th>A mark of this level corresponds to a distinction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The Report indicates exceptional success in tackling the Project. All the Project’s objectives have been met as fully as could reasonably be expected. The student has shown initiative and been rigorous in the collection and use of data. Where appropriate, relevant literature has been critically evaluated. The standard of the Report presentation is very high.</td>
</tr>
<tr>
<td></td>
<td>A mark of this level should be reserved for Reports of exceptional merit which has something extra and which surprises. The supervisor will be required to justify why a distinction has been awarded in the section provided.</td>
</tr>
<tr>
<td>60 - 69%</td>
<td>The student has tackled the problem conscientiously and logically and has produced sound conclusions. Presentation is of good standard. <strong>A mark of this level corresponds to a merit.</strong></td>
</tr>
<tr>
<td>50 – 59%</td>
<td>The student’s work has been no more than moderate overall or would have deserved a higher grade but for areas of significant weakness.</td>
</tr>
<tr>
<td>&lt; 50%</td>
<td>The student’s work has failed to reach a satisfactory standard. <strong>A mark below 50% should be used to indicate a “fail” in the Project.</strong></td>
</tr>
</tbody>
</table>
Rules and Degree Classification

The programme is assessed through a mixture of coursework and examination.

The Scheme of Examination

Assignments

As part of the requirements, all assignments may be inspected by the Board of Examiners. We retain copies of work that you submit for this purpose but it is essential that you keep all work that is returned to you until the MSc BA has been completed, should another copy be required.

Your assignments will be submitted via the Hub. Submissions must be accompanied by the plagiarism statement in the submission area.

Assignment Submission Guidelines

Please see the ‘Assignments’ section of the Academic Regulations and Policies document on the Hub.

The Examination Process

All examination scripts will be marked in detail by the Module Leader with a second marker undertaking sample check marking to ensure that the mark awarded by the Module Leader is appropriate. A sample of scripts is then sent to an External Examiner from another institution to ensure that the standard of marking at Imperial College Business School is commensurate with elsewhere in the UK. External Examiners also approve draft examination questions prior to the examination being set.

The following describes the process for examined modules:

The essentials of this process are laid down by the College and are requirements that apply to all taught postgraduate programmes.

The Board of Examiners is made up of all members of the School’s academic staff who teach on the programme (called ‘internal examiners’) plus a number of external examiners drawn from other universities. A representative of the College Registry also normally attends Board meetings. The external examiners are appointed for no more than four consecutive years. They are, or have in the past been, drawn from LBS, Manchester, Cranfield, Lancaster, City, Open University, Universita’ Commerciale La Bocconi, Oxford University, and LSE. Each external is allocated a number of subjects in their area of expertise. The Board Chairman is the Programme Director.

The process is as follows:

- The internal examiner prepares an exam paper for their subject. This is checked for errors and clarity by a different internal examiner.
- The paper is sent to the designated external examiner who further checks for clarity, but also ensures that the paper is appropriate in terms of standard, coverage of the syllabus, consistency with previous papers and generally acts as a ‘watchdog’ for quality and fairness to candidates. Any perceived problems or issues are discussed.
with the internal examiners and, if necessary, with the Chairman, and agreement reached.

- Following the examination itself, the papers (which are identified by candidate number only and not your name) are marked separately by two internal examiners. In the event of a disagreement in the marks, there will be a discussion between the internals, and if necessary a third internal examiner will be consulted. If necessary, there will be adjudication by an external examiner.
- The proposed marks for all candidates together with a sample of scripts are sent to the external examiner. The sample will normally include scripts that are marginal at a pass/fail or merit/distinction boundary and a selection across the range. The purpose of the sample is threefold:
  - to allow the external examiner to ensure that the overall standard of performance is accurately reflected in the marks awarded
  - to give a third (and usually conclusive) judgement in marginal cases
  - to ensure that proper procedures have been followed in the examining process
  - A sample of coursework is also sent to the external examiners for each subject.
- When all marks are available, an Internal Board of Examiners will review the marks prior to the External Examiners’ meeting.

Past examination papers or specimen questions are provided to guide students on content only. The format is subject to change and the Module Leader will provide full information during the module.

To ensure consistency from year-to-year, the Board normally applies the marking guidelines quite rigidly. However, where a candidate has suffered from illness or other circumstances that the Board believes will have had a significantly adverse effect on their performance, the Board may allow the candidate to pass even though their marks would otherwise cause him/her to fail. It is fair to add, however, that the Board has used its discretion in this way only in cases of truly marginal failure.

The external exam board members for the MSc Business Analytics:
Dr. Houyuan Jiang University of Cambridge
Dr. Arne Strauss University of Warwick

The details provided above are for information only. Please note that it is not appropriate for students to contact the examiners directly regarding their studies. Any issues that you have in relation to your assessment should be raised internally with your Programme Team in the first instance or with the College Registry, if necessary. Issues can only be raised with College Registry once the External Examiners’ meeting has taken place and results have been released by Registry.

If candidates have experienced serious illness or other major problems which they consider to have affected their academic performance, they should complete a mitigating circumstances form. Please see the relevant section of the Academic Regulations and Policies document on the Hub.

Candidates who are judged to have failed at this stage are allowed by College regulations ONE further entry to the examinations. Students who need to re-sit will be given the option to either re-sit in the September re-sit period, or during the next academic session. Students with more than one re-sit exam will need to choose whether to re-sit exams either in September or in the next academic year, they will not be allowed to spread them out across both periods.

A candidate may be required to re-sit for the following reasons:
- where failure arises from an examination mark below 40% and the candidate passes on all other criteria. In this instance re-entry is required only in the paper in which less
than 40% is achieved. To pass, the candidate must achieve a mark of at least 40% on re-entry.

- where failure is a result of achieving less than 50% in the average of all the examination and coursework marks. In this instance a candidate must re-sit any examination in which they achieved less than 40%, and is given the opportunity to re-sit any examination in which they have achieved less than 50% in order to increase their overall average above 50%.

Information on re-sitting examinations, resubmitting coursework, examination feedback and reasonable adjustments can be found in the Academic Regulations and Policies document on the Hub. This document also contains information on the format of coursework, penalties for late submission and requesting coursework extensions.

**Plagiarism and cheating**
Plagiarism is the presentation of another person’s words, ideas, judgement or data as though they were your own. For example:

- not referencing the source of your ideas or arguments when they are derived from your reading,
- taking verbatim the words of someone else’s work and putting it into your work without quotation marks and referencing,
- taking whole sections out of books, articles, lecture notes, other reports or students’ work, and including them in your report uncited.

When submitting your assessed coursework, via the Hub or in hardcopy, you will be required to confirm that you have read and understood the definition of plagiarism. Submitting the assignment will certify that the work presented is entirely your own, except where indicated. This includes your final project or essay as well as all other assessed work.

In relation to group work, you should be aware that you have a collective responsibility for the integrity of the piece of group work submitted for assessment. This means that if part of the work is plagiarised, all group members will be held accountable unless proof can be provided by each member of their contribution. You should, therefore, retain an audit trail of your contribution for this purpose.

The College has an online plagiarism module which has been designed to teach you everything you need to know about how to reference correctly and therefore avoid plagiarism. This is a compulsory module and we ask you to take this in the first term so that you reference correctly in your very first set of assignments. This online module contains such important information in helping you to avoid plagiarism that students who have not completed the module by the end of the first term will have their exam results for all modules withheld until the plagiarism module is successfully completed. There are a number of different penalties for plagiarism, dependent on the severity of the case and the weighting of the piece of work. Full information on plagiarism and cheating can be found in the Academic Regulations and Policies document on the Hub.

We strongly advise that you attend the Library referencing sessions and read the Harvard Referencing Guide, which can be found at [http://www.imperial.ac.uk/admin-services/library/learning-support/reference-management/harvard-style/](http://www.imperial.ac.uk/admin-services/library/learning-support/reference-management/harvard-style/) Additional support and guidance is available from the Business Library Team (libbpd@imperial.ac.uk)
SEPTEMBER MODULE OUTLINES
BS1819 DATA STRUCTURES AND ALGORITHMS USING PYTHON
Module Outline

MODULE LEADER
Name: Heikki Peura
E-mail: h.peura@imperial.ac.uk
Room: 394 Business School

MODULE AIMS
This module introduces the students to the basics of algorithms and data structures for developing computational approaches to problem solving. The design of efficient computational methods for analysing large data sets lies in the core of modern technological innovation ranging from search engines and social networks to healthcare, energy and finance. The module will familiarize the students with key algorithm design paradigms (such as divide-and-conquer and greedy algorithms) and data structure design, as well as central concepts of computational complexity and running-time analysis. Students will develop a working knowledge of basic algorithms (such as searching, sorting, and shortest paths) and data structures along with the necessary programming constructs.

The module will also serve as an introduction to the Python programming language, aimed at developing a facility in organizing and writing medium-sized programs for practical problem-solving. The module will be hands-on assisted by teaching assistants and will also teach the students debugging and good programming practices.

MODULE OBJECTIVES
Knowledge Objectives
• Basic algorithms (such as searching, sorting, and shortest paths) broader algorithm design paradigms and their applications
• Concepts of computational complexity and running-time analysis
• Basic data structures (such as arrays, lists, and graphs), as well as key concepts in designing data structures
• Core programming constructs, including loops, program flow, objects and classes

Skill Objectives
Upon the completion of this module, students should be able to:
• Implement and apply basic algorithms and analyse their efficiency
• Implement and apply basic data structures
• Read, organize and write programs in Python in order to solve practical computational problems

LEARNING OUTCOMES
By the end of this module, students should be able to:
• Understand basic data structures (such as arrays, lists, and graphs) and their representation in a programming language
• Understand programming structures (such as objects, conditionals, and loops) and their representation in a programming language
• Understand the workings of basic algorithms such as sorting, searching and shortest paths, as well as why and how to analyse the efficiency of algorithms
• Read and implement algorithms and other medium-sized programs in Python
TEACHING METHODS AND STRUCTURE
The module consists of 20 hours of lectures and 12 hours of tutorials delivered over four weeks. The module is based on self-study, module notes, tutorials, and in-class discussions and workshops. Students are provided with module notes and additional readings on the Hub, and are expected to prepare assigned material ahead of class in order to actively participate in class discussions and exercises.

The lectures combine discussion of key concepts in algorithm and data structure design with workshops where students will learn to implement algorithms and apply them to practical problems.

The tutorials will familiarize the students with the Python programming language through hands-on programming exercises. They will introduce basic programming concepts and their representation in Python. In addition, the tutorials give the students the opportunity to refine their understanding of the class material both in exercises and in discussions with teaching assistants.

ASSESSMENT
The module evaluation is as follows:
Coursework: 100%

READING LIST
Textbook (selected chapters):

Lecture notes and other material will be distributed during the module.
BS1820 MATHS AND STATISTICS FOUNDATIONS
Module Outline

MODULE LEADER
Name: Dr Antoine Vernet
E-mail: a.vernet@imperial.ac.uk

MODULE AIMS
This course provides the foundation of programming in R using a statistics and probability refresher as a conduit for introducing programming tools and concepts. The class covers tools and techniques to get you started on your journey as R users and data scientists. The class reviews probability and statistics concepts that will be helpful to approach any data analysis task. Most of the material covered will be called upon again in other classes this year, therefore it is essential that you master it. The tools and techniques you will learn are important if you want to pursue a data science career or if you want to work with data scientists.

While R is the tool used in this class, programming tools and principles that you will learn will be useful for work you do using other languages (e.g. python, ruby, java, C++).

MODULE OBJECTIVES
Knowledge objectives:
- Probability distributions
- Statistics tests
- Linear regression
- Introduction to research design and hypothesis testing
- Tackling a programming assignment
- Tackling a data analysis assignment

Skill objectives:
- R programming basics (data structures and syntax)
- Code writing and commenting (good practices)
- Fundamentals of version control (tracking, committing, branching)
- Basics of literate programming (taking notes while analysing data)
- Using graphs and tables to explore data (basic graphics and ggplot2)
- Programming and reporting workflow (collaboration)

Learning outcomes
- Ability to program in R to solve data analytics problems.
- Knowledge of the fundamentals of probability and statistics required to follow future course in the programme, such as Advanced Econometrics

In order to make the most of this class, you will have to do several hours of independent studies every week. Programming is a skill that requires practice and the only way for you to become proficient is to challenge yourself and struggle through programming tasks. I will
provide some “challenges” that you can pick from in order to enhance your skills. Those are not graded but it is highly recommended that you attempt them in order to improve your skills. The effort expanded on them will pay off when you work on the group assignment and the exam.

TEACHING METHODS AND STRUCTURE

The class is a mix of theory and practice. Most of the sessions will introduce probability and statistics concepts and illustrate their use with examples in R.

The class will provide you when plenty of code examples. You are encouraged to read the code provided and code from other sources to develop as a statistic software writer.

ASSESSMENT

The assessment will be a mix of quizzes, an exam and a group project around analysing a dataset. Both the exam and the group project will require that you put the statistical knowledge gained during the class into practice. The quizzes will directly ask you about statistical and probability concept learned during the class.

The exam will take place in the week of the 3rd of October 2016. The group report is due at the end of the week of the 10th of October 2016.

Assessment details:

- **Exam (50%)**: the exam will consist of MCQs testing your understanding of the concepts of the class and a programming exercise. For the programming exercise, you will be provided with a computer in one of the college’s computer room.

- **Coursework (50%)**
  
  **Quiz**: there will be 1 graded quiz during week 3 of the class.
  
  **Project**: there will be a small data analysis project to do in syndicate groups, forcing you to collaborate with your classmates to produce a report on a dataset.
CORE MODULE OUTLINES

(Note: the outlines are tentative, the final versions will be provided on the Hub at the start of each module)
BS1804 FUNDAMENTALS OF DATABASE TECHNOLOGIES

Module Outline

MODULE LEADER
Name: Dr Piotr Migdal
E-mail: pmigdal@gmail.com

MODULE AIMS
This module introduces students to practical usage of databases with the main emphasis on SQL and related technologies.

SQL is a time-tested solution to a wide range of business and engineering problems. Being able to efficiently interact with it is a core skill for all professions dealing with storing and retrieving data. In particular, forming SQL queries is often the starting point for any data analysis. Moreover, many database and data processing solutions are strongly influenced by SQL philosophy and design, for example data frames (as found in Python and R).

As big data problems are more and more prevalent for business, this module introduces basics of their processing with Apache Spark - a versatile, big data processing engine. For pragmatic reasons the main focus will be on SparkSQL.

This module will use PostreSQL - one of the most popular and powerful object-relational database management systems. Spark and SparkSQL exercises will be held in Python, within the Jupyter Notebook interactive environment.

MODULE OBJECTIVES
Knowledge Objectives
- Core concepts of relational databases
- SQL query syntax for typical analytic tasks
- Technicalities characteristic for PostgreSQL
- JSON format
- Basics of Spark with emphasis on SparkSQL, within Python

Skill Objectives
Upon the completion of this module, students should be able to:
- Retrieve business relevant information with SQL queries
- Express data in a tabular format and store it in a relational database
- See SQL philosophy in other objects, e.g. data frames
- Understand possibilities and challenges of processing big data

LEARNING OUTCOMES
By the end of this module, students should be able to:
- Interact with SQL databases for management and analytic purposes
- Use PostgreSQL database for data storage and retrieval
- Understand queries written by others
- Know basics of big data processing

TEACHING METHODS AND STRUCTURE
This module will consist of lectures (30% of time) and exercises on computers (70% of time). The focus will be on practical interaction with SQL and other databases. The majority of class time will be spent by students on solving problems based on real data and data which strongly resembles real data. Exercises will be performed with local installations of PostgreSQL & Apache Spark, and with public remote services offering access via SQL or SQL-like syntax. SparkSQL examples will be held in Python via interactive Jupyter Notebook environment. However, for all assessments another language may be used (e.g. R or Scala).

**ASSESSMENT**
The module evaluation is as follows:
Coursework: 100%

**READING LIST**
Lecture notes and other material will be distributed during the module. Lecture notes will be self-sufficient. Supplementary references will be provided.
MODULE LEADER
Name: Wolfram Wiesemann
Email: ww@imperial.ac.uk

MODULE AIMS
This module introduces the students to Operations Research, which is the study of advanced analytical and computational methods to support effective and informed managerial decision-making based on data. The principal idea in Operations Research is to formulate managerial decision problems as mathematical problems, which can subsequently be solved with analytical or numerical techniques. Typical applications include revenue management (e.g. revenue-maximal pricing of train and airline tickets), logistics (cost-effective transport of products in a supply chain), financial portfolio management (construction of asset portfolios with a good return/risk trade-off) and production planning (e.g. reduction of late deliveries or inventory holding costs).

The module will explore various mathematical techniques to formalise and solve managerial decision problems. The use of these methods will be illustrated with applications in diverse disciplines, including supply chain design and production planning, supplier selection, revenue management and finance.

MODULE OBJECTIVES
Knowledge Objectives

The module will cover the following topics:

1. **Linear Optimisation** (approx. 2 weeks, with 2 tutorials)
   - Formulation of Linear Programs, Applications of Linear Programs
   - Sensitivity analysis and duality theory (shadow prices, formulation and interpretation of a dual problem, weak and strong duality)
   - Overview of solution techniques (graphical solution method, Simplex algorithm, interior-point methods)
   - Stochastic programming and robust optimisation

2. **Integer Optimisation** (approx. 2 weeks, with 2 tutorial)
   - Formulation of Integer Binary, Integer and Mixed-Integer Programs, Applications
   - Overview of solution techniques (branch-and-bound, cutting planes)

3. **Nonlinear Optimisation** (approx. 1 week, with 1 tutorial)
   - Introduction to convex analysis
   - Special classes of convex problems: Quadratic Programs, Second-Order Cone Programs
   - Applications of Nonlinear Programs
   - Overview of solution techniques
Skill Objectives

By the end of the module, the students will be able to:

- identify, analyse and understand the quantitative aspects of decision-making
- formalise managerial decision problems as mathematical problems, and use state-of-the-art techniques to solve these problems
- critically assess the feasibility and practical implications of the emerging solutions

LEARNING OUTCOMES

Upon completion of the module, students will be able to:

- identify managerial decision problems that are amenable to a quantitative solution
- model managerial decision problems as mathematical problems, and apply the methods and techniques of Operations Research to solve these problems
- judge the power and limitations of analytical methods to managerial decision-making, and appreciate the relative strengths and weaknesses of different approaches to solving managerial decision problems

STRUCTURE

The module will consist of 15 hours of lectures and 5 hours of tutorials that are delivered over 5 weeks. The tutorials give the students the opportunity to test their understanding of the class material in various exercises, as well as to discuss any questions with the lecturer or the teaching assistants. We expect one guest speaker from industry.

TEACHING METHODS

The module is based on self-study, lectures, module notes, tutorials and in-class exercises. The lectures are illustrated with examples of analytics problems faced by major international firms. Students are provided with module notes that are based on the books listed below. Students are expected to engage in class discussions and exercises related to the topic of each session.

ASSESSMENT

The course will be assessed as follows:

10% tests
40% coursework
50% final exam

The group coursework will consist of a real-life case study that should be solved in groups of at most six students.

READING LIST

BS1802 STATISTICS AND ECONOMETRICS
Module Outline

MODULE LEADER
Name: Jiahua Wu
E-mail: j.wu@imperial.ac.uk
Room: 382 Business School

MODULE AIMS
This module covers the statistical tools needed to analyse data in economics and management. It focuses on parameter estimation and hypothesis testing within the framework of the classical linear regression model. Advanced topics include panel data methods, instrumental variables estimation, limited dependent variable models, as well as regression analysis with time series data. Considerable attention is devoted to applications of the techniques in economics, finance and management.

MODULE OBJECTIVES
Knowledge Objectives
Students will learn about the specification and estimation of the linear regression model, from model assumptions, coefficient estimation to model inference and predictions. Using empirical applications drawn from economics and related fields, the module will demonstrate how these approaches can be successfully applied in practice.

Skill Objectives
- Be able to construct econometric models, and evaluate the fit of the model
- Be able to estimate model parameters and interpret the estimators
- Be able to analyse the problem that arises when basic assumptions are violated
- Be able to answer managerial questions by drawing inference from estimators

LEARNING OUTCOMES
By the end of this module, you should have a working knowledge of econometrics and its applications. You are expected to be able to

- construct statistically correct estimators and parameters from data
- understand and interpret statistical concepts
- apply statistical and econometric concepts to data, and be able to explain the concepts and implications to senior management

TEACHING METHODS AND STRUCTURE
The module consists of two lectures a week for five weeks. The module is based on self-study, module notes, and in-class discussions. Key concepts in econometrics will be discussed during lectures, as well as their application in economics, finance and management. Module notes and additional readings will be uploaded to the Hub. Students are expected to read the assigned material beforehand to be able to follow and actively participate in the lecture.

Weekly Schedule: Overview
Week 1:
Introduction to econometrics and data structures
The simple regression model

Week 2:
Multiple regression analysis: estimation and inference

Week 3:
Multiple regression analysis: analysis with dummy variables, large-sample asymptotics, heteroskedasticity, model specification and data issues

Week 4:
Panel data analysis
Instrumental variables estimation
Limited dependent variable models

Week 5:
Regression analysis with time series data

ASSESSMENT

The module evaluation is as follows:
Individual homework 50%
Final exam 50%

The individual homework will consist of exercises that are designed to facilitate your understanding of the key concepts in econometrics. The exam will resemble individual homework and focus on questions probing whether you are able to construct correct estimators, and interpret various statistical concepts.

READING LIST

You are required to prepare the following readings:
• Additional articles and readings
• Module notes
BS1801 ANALYTICS IN BUSINESS
Module Outline

MODULE LEADER
Name: Dr Mark Kennedy
E-mail: mark.kennedy@imperial.ac.uk
Room: 282 Business School

MODULE AIMS
This module lays the “Business” foundations for your MSc Business Analytics degree. As a complement to the technical skills you will be gaining, we will cover some basic topics in business to which new kinds of data and analytics are being applied along with advances in analytics that are changing how business is done. Featured topics include:

<table>
<thead>
<tr>
<th>Business Topic</th>
<th>Analytics</th>
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<tbody>
<tr>
<td>Motivation and Incentives</td>
<td>Workforce analytics</td>
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<tr>
<td>Individual and team decision-making</td>
<td>Study design</td>
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<tr>
<td>Teams and leadership</td>
<td>Social networks / graph analytics</td>
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<tr>
<td>Culture and Ethics</td>
<td>Predictive analytics</td>
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<tr>
<td>Digital marketing</td>
<td>Propensity scoring, real-time auctions</td>
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<tr>
<td>Presentation skills for analytics</td>
<td>Social networks / team assignment*</td>
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<tr>
<td>Managing and developing people</td>
<td>Performance assessment</td>
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MODULE OBJECTIVES

Overall Knowledge. You will learn keys to designing, delivering, and managing analytics capabilities that create value for business.

Skills. You will gain skill at the following elements of designing, delivering and managing business analytics projects and capabilities:

- **Strategy**: ability to spot and define projects that will create value
- **Incentives**: ability to design smart incentives, recognition, and effective monitoring
- **Networks**: Learn how to collect and analyse social network data to build better teams
- **Culture**: ability to hold your own in debates about limiting access to data, analytics
- **Marketing**: ability to make sense of the fast-changing landscape of digital marketing
- **Presenting**: skill at translating analytics into effective communication, persuasion
- **Management**: greater skill at doing the difficult conversations of management

STRUCTURE
The module will be taught in 2 weekly workshops.

ASSESSMENT
Coursework: 100%
BS1805 NETWORK ANALYTICS

MODULE LEADER
Name: Kalyan Talluri
E-mail: kalyan.talluri@imperial.ac.uk
Room: 387A, Tanaka Building

COURSE AIMS
Networks arise in many different contexts and a vast amount of networked data is now generated. For instance social networks such as Facebook and twitter generate immense amount of data that is invaluable to marketers and businesses to obtain product feedback and do targeted marketing. Traffic patterns and origin-destination analysis is invaluable for real-time logistics planning. In this course we cover algorithms, analysis and interpretation of network data and relationships.

This class is somewhat theoretical in nature, even if it uses a lot of programming and data. The applications side will be continued in the Digital Marketing Analytics elective.

COURSE OBJECTIVES

Knowledge Objectives
Learn the language of graph theory and some basic graph algorithms such as shortest path and matching
Learn notions of influence and behaviour modelling on social and economic networks
Matching and markets
Models of diffusion on networks as well as estimation
Skill Objectives
Ability to hook up to Social Media APIs
Learn software to handle network analytics
Programming network data structures

(INdicative)
Week 1:
Review language of networks – graph theory
Representations of graphs and uses
Simple metrics of Centrality, Power and Influence

Week 2:
HW1 due (material of week 1)
Finding most influential groups
Community detection in graphs

Week 3:
Quiz 1 (20 minutes, in-class + 10 minutes solution; covers all material in Week 1 and 2)
Markets and Matching models
Stable matching model

Week 4:
HW2 due (material on weeks 2 and 3)
Spread of epidemics
Models of viral marketing

Week 5:
Quiz 2 (20 minutes, in-class + 10 minutes solution; covers all material in Week 3 and 4)
Network Product Diffusion Models
Network econometrics

HW 2 due (material on weeks 4 and 5)

ASSESSMENT

Coursework: 50%
There will be two in-class quizzes counting for 25% of your grade, and two individual/group home-works counting for 25%.

Final Exam: 50%

RECOMMENDED READING
Around 80% of the topics can be found in the following (freely downloadable) books:
EK: “Networks, Crowds and Markets” by David Easley and Jon Kleinberg

ZAL: “Social Media Mining” by Zafarani, Abbasi and Liu
BS1807 VISUALISATION

MODULE LEADER
Name: Marc Streit
E-mail: marc@streit.com

Name: Andy Kirk
E-mail: andy@visualisingdata.com

MODULE AIMS
The aim of this module is to equip students with a comprehensive and practical understanding of data visualisation: a multi-disciplinary recipe of art, science, math, technology and many other interesting ingredients. The emphasis of the module is to instil the necessary critical thinking required to best judge the many analytical, practical and design decisions involved in this activity.

The module will offer a blend of academic and applied perspectives, covering the full suite of conceptual, theoretical and practical capabilities required to master this multidisciplinary pursuit. Teaching content will be supplemented by case study demonstration and experience from real-life applications. In-class exercises and course assignments will further embed this learning process.

MODULE OBJECTIVES
Knowledge Objectives
• Familiarity with a range of contemporary data visualisation techniques suitable for a business context
• Understand the theories of visual perception and the relevance to data visualisation
• Understand the main principles of good visualisation design
• Enhance data, statistical and graphical literacy
• Acquire a more sophisticated language for defining, describing and evaluating visualisation designs
• Practical understanding of relevant design concepts such as colour theory and user interface design
• Refine the necessary instincts of an effective analyst

Skill Objectives
• Be able to apply a practical data visualisation design workflow to take on any data visualisation challenge with greater confidence
• Be able to best judge the appropriate analytical and design decisions required for different contextual circumstances
• Working knowledge of Matplotlib, Tableau and Excel and their role in data visualisation

LEARNING OUTCOMES
By the end of this module, you will be able to manage the process of creating the most effective data visualisation solutions in the most efficient way. You will leave with a broad visualisation vocabulary that will enable you to respond to serve the analytics needs associated with any business context.
TEACHING METHODS AND STRUCTURE
The material will be covered in the form of 10x2hr lectures combined with hands-on examples, exercises and discussions. Students are advised to read recommended material and participate with all non-assessed exercises (within and between class) to be able to follow and actively develop knowledge from the module teaching. Lectures 1-5 are with Marc Streit, lectures 6-10 are with Andy Kirk

Lecture 1 - Fundamentals of Data Visualisation
Starting with a brief tour through the history of visualisation and then introducing the goals of data visualisation and its relevance in a business environment. Continuing with a systematic discussion of the different data types and characteristics with respect to data visualisation.

Lecture 2 - Conceiving your Visualisation Design
Covering visual perception and colour theory and discussing design principles that need to be considered in order to create effective visualisations. The second part of this lecture will introduce visual marks and channels - the alphabet of visualisation. In practical exercises students will learn how to critically think about existing visualisations and also how to deconstruct visualisations in order to identify the visual marks and channels used.

Lecture 3 - Data Encoding (1)
This lecture looks at basic statistical charts such as box plots and line charts and discusses in which situations the different chart types should be used. Continuing with a discussion of visualisation techniques for multi-dimensional data. Through an in-class exercise, students will learn how to construct visualisations using the Python plotting library Matplotlib.

Lecture 4 - Data Encoding (2)
Continuing the introduction of visualisation techniques from Lecture 3, this lecture will look at the repertoire of visualisations by data type, covering graphs and trees, spatial data (maps), time-dependent data, and textual data.

Lecture 5 - Fundamental Concepts, Infrastructure, and Case Studies
Discussing fundamental visualisation and interaction concepts that are applied in many different contexts, such as superimposition, abstraction, and view coordination. Continuing with a discussion of available tools and libraries, including Data-Driven Documents (D3.js). Finishing with a discussion of selected case studies from stock market analysis and cancer research.

Lecture 6 - Visualisation Design Workflow
Introducing the data visualisation workflow - the ‘game of decisions’ - providing an overview of the stages involved and the general workflow principles to support critical thinking. Undertake the first stage of the design workflow ‘Formulating your brief’ concerned with the planning and defining of your visualisation work: Context and vision.

Lecture 7 – Working with Data
Detailing the practical steps involved in developing an intimate understanding of the availability, quality and potential of your data - acquisition, examination, transformation and
exploration. Covering the key aspects of enhancing data, statistical and visualisation literacies and including an overview of the key tools (plus demos in Excel and Tableau).

Lecture 8 – Editorial Thinking
Covering the vital discipline of ‘editorial thinking’, explaining its influence on the visualisation process and unpicking the editorial perspectives that shape all outputs: angle, framing and focus. This lecture will also include an extensive in-class practical exercise to embed the learning so far.

Lecture 9 – Design Applications (1)
Understanding the influence of the preparatory stages on design thinking, this lecture looks in detail at the broad options available across the visualisation design anatomy and discusses how to make the best the choices. This first of two ‘design application’ lectures looks at data representation, interactivity and annotation.

Lecture 10 – Design Applications (2)
Continuing the theme of lecture 9, this second of two ‘design application’ lectures looks at practical design thinking about colour usage and composition. There will be an overview of the production cycle, moving from concept, to development, through production, launch and, finally, evaluation. To wrap up the module a detailed case study will be presented to draw together all the critical thinking covered through these lectures.

ASSESSMENT
The module evaluation is as follows:
Module Assignment 50%
Module Examination 50%

READING LIST
You are recommended to prepare the following readings:
Additional articles and readings as provided in class.
BS1816 MACHINE LEARNING
Module Outline

MODULE LEADER
Name: Wolfram Wiesemann
Email: ww@imperial.ac.uk

MODULE AIMS
This module aims to enable students to learn basic analytics skills and methodologies for
large-scale data analysis. Also, we will focus on the practical use of these skills and
methodologies to solve real world problems. The goal of the module is to educate students
to be data-savvy, analytically minded and coding-literate problem solvers.

LEARNING OUTCOMES
On successful completion of the module, students should:
· Have an understanding of popular data analysis and machine learning methods and
technologies including an appreciation of what situations are best to apply such methods.
· Be able to solve practical problems, where appropriate, using different analytical
techniques such as: statistical test, dimension reduction, clustering, classification, pattern
discovery and time series analysis.
· Use learning systems such as neural networks, decision tree, support vector machine,
clustering tools and deep learning tools.
· Use the machine learning capabilities of R and/or Python

LECTURE SUMMARY
Lectures 1-5:
- K-nearest neighbour algorithm, decision tree, Cart-algorithm, Naïve Bayes algorithm
- Regression: logistic regression and regularisation (LASSO method)
- Support Vector Machines
- Neural Networks: nonlinear regression, neural networks, deep learning introduction

Lectures 6-7:
- Clustering: concept of clustering and clustering algorithms
- Dimension Reduction: Principal Component Analysis (PCA)

Lectures 8-10:
- Text mining: bag-of-words, topic analysis, sentiment analysis (mainly using
packages)

TEACHING METHODS AND STRUCTURE
Students are expected to read assigned material beforehand to be able to follow and actively
participate in teaching sessions.

ASSESSMENT
The course will be assessed 100% by a coursework.

READING LIST
Below is an indicative list of literature. The textbooks used in the course will be announced in the first lecture.

BUSINESS ANALYTICS ELECTIVE MODULES
Module Outline

Module Leader
Name: Jiahua Wu
E-mail: j.wu@imperial.ac.uk

Module Aims
Supply chains are networks of organizations that supply and transform materials, and distribute final products to customers. Supply chain management represents a great challenge as well as tremendous opportunity for most firms. If designed and managed properly, supply chains are a crucial source of competitive advantage for both manufacturing and service enterprises. This module focuses on models and analytic tools, which are useful in the design and operations of logistics and supply chains. Strong emphasis is placed on how specific tools can be used to improve the performance and/or reduce the total cost of a supply chain.

Module Objectives
Knowledge Objectives
The following topics will be discussed:
- supply chain network design: formulating facility location problems as mixed-IPs, numerical solution of mixed-IPs;
- demand forecasting, and management: linear regression models, discrete choice models, time series analysis;
- supply chain planning: formulating aggregate supply planning as LPs, numerical solution of LPs;
- inventory planning, management, and control: understanding cycle inventories, safety inventories, and the newsvendor model;
- transportation planning, management, and operations: network analysis and its connection to inventory planning, routing and scheduling.

Skill Objectives
- Be able to examine and improve the flow of materials through a network of suppliers, manufacturers, distributors and retailers using analytic tools.
- Be able to make decisions on the following fundamental supply chain performance drivers: facilities, inventories, and transportation.
- Be familiar with techniques for measuring and managing supply chain uncertainty.
- Understand the essential trade-offs in the design of supply chain solutions for real-world problems.

Learning Outcomes
On successful completion of this module, you should be able to
- understand the nature and business problems in logistics and supply chains;
- familiarize yourself with the domain-specific analytic tools;
- address the main analytic questions arising in logistics and supply chains.

Teaching Methods and Structure
The module consists of two lectures a week for five weeks. The module is based on self-study, module notes, and case discussions. We will make heavy use of examples from industry to illustrate the applications of analytic tools in practice. It emphasizes the use of quantitative
analysis in making logistics and supply chain decisions. Module notes and additional readings will be uploaded to the Hub. Students are expected to read the assigned material beforehand to be able to follow and actively participate in the lecture.

ASSESSMENT
The module evaluation is as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Individual homework</td>
<td>40%</td>
</tr>
<tr>
<td>Group projects</td>
<td>60%</td>
</tr>
</tbody>
</table>

The individual assignments focus on understanding the mechanics of analytic tools. Team projects are more extended and include real data.

READING LIST
You are required to prepare the following readings:

- Additional articles and readings
- Module notes

Other optional supply chain textbooks that may be of interest:

- Inventory Management and Production Planning and Scheduling, by Edward Silver, David Pyke and Rein Peterson.
- Production and Operations Analysis, by Steven Nahmias.
DSI003 ADVANCED MACHINE LEARNING
Module outline

MODULE LEADER
Name: Yike Guo (subject to confirmation)
E-mail: y.guo@imperial.ac.uk

MODULE AIMS
This module aims to enable students to learn basic analytics skills and methodologies for large-scale data analysis. Also, we will focus on the practical use of these skills and methodologies to solve real world problems. The module will cover a wide spectrum of technology with a holistic and humanist approach to this fast growing area. The goal of the module is to educate students to be data-savvy, analytically minded and coding-literate problem solvers.

LEARNING OUTCOMES
On successful completion of the module, students should:

- have an understanding of concept learning
- have an understanding of natural language processing, and machine learning methods and technologies including an appreciation of what situations are best to apply such methods.
- be able to solve practical problems, where appropriate, using different analytical techniques including:
  - decision trees
  - neural networks
- be able to implement such methods using R & Python
- how to use visualisation tools, including line plot, histograms, scatter plot matrix, heatmap, distributions
- have experience of applying such techniques to appropriate case studies.

MODULE STRUCTURE
This module aims to teach students how to explore data with data analytics and machine learning techniques including:

1. Basics of data analysis, including: correlations and what to ask about your dataset (source of the data, bias, outliers, measurement errors)
2. Supervised learning and predictive modelling
   i) Regression
   ii) SVM and kernel methods
   iii) Rule-based learning
3. Deep learning introduction
4. Text mining: parsing, n-grams, classification and clustering, sentiment analysis
5. Appropriate case studies

TEACHING METHODS AND STRUCTURE
The material will be covered in the form of lectures, where appropriate combined practical sessions during which students can apply what they have learned. The practical sessions will be held within lecture time. In the practical session, an example data set will be given to illustrate how the data analytics is performed with data analysis tools using the taught algorithms.

Students are expected to read assigned material beforehand to be able to follow and actively participate in teaching sessions.

**ASSESSMENT**

100% coursework
BS1811 BIG DATA IN FINANCE
Module Outline

MODULE LEADER
Name: Tarun Ramadorai
E-mail: tramadorai@imperial.ac.uk

MODULE AIMS
In this module we examine how the combination of large datasets, empirical techniques including machine learning, and insights from behavioural finance are helping market participants make more efficient financial decisions. Three areas in which progress has been especially rapid are credit analytics, asset management, and understanding investor demand for financial assets.

In the credit analytics part of the module we will examine various issues surrounding the prediction of consumer default, as well as how various techniques (including machine learning) used to predict default in a variety of credit markets including credit cards, auto loans, and peer to peer lending. We will also examine how these techniques can be used to construct and manage a portfolio of loans. We then turn to perhaps the largest retail credit market – the mortgage market, and examine models of mortgage choice, mortgage refinancing, and mortgage default. Our attempt will be to keep up with the rapid pace of innovation in B2C lending markets in this part of the module.

We then move to another area in which the use of large unstructured datasets and new techniques is generating significant innovation, namely, asset management. We begin by understanding the fundamental inputs into portfolio construction, and will consider new techniques used to predict variations in asset prices in the time series and cross-section. These techniques are useful in quant hedge fund portfolio construction as well as in the management of retail assets. In our final part of the module we return to B2C markets, considering how best to understand investors’ decision making models and learning techniques. These insights are increasingly proving to be a critical input into roboadvising strategies.

Throughout, students will work on assignments that require hands-on interaction with finance datasets, and help to reinforce course learning objectives.

MODULE OBJECTIVES

Knowledge Objectives
- Gain familiarity with important use cases of business analytics techniques in the finance domain, and gain an understanding of new trends and areas in finance where these techniques are likely to grow in importance.
- Deepen understanding of credit markets and gain experience with models and techniques used in the industry to evaluate and manage credit risk.
- Understand the objectives of asset managers, and learn how to construct quantitative models as inputs into trading strategies.
- Learn techniques to estimate investors’ asset demands and investment decision-making models.
Skill Objectives

- Be able to set up a model of default prediction given data on historical defaults on demographics and loan characteristics
- Be able to construct trading strategies using datasets of asset returns and asset characteristics.
- Be able to assess the performance of asset managers
- Be able to estimate simple models of positive feedback trading

LEARNING OUTCOMES

By the end of this module, you should be able to understand, analyse, and model credit default in a range of markets. You will also have an understanding of new quantitative techniques that are being used to build trading strategies and estimate investor demand function.

TEACHING METHODS AND STRUCTURE

The material will be covered in the form of lectures combined with hands-on assignments. Students are advised to read recommended material beforehand to be able to follow and actively participate in the lecture.

ASSESSMENT

The module evaluation is as follows:

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Group Assignment</td>
<td>30%</td>
</tr>
<tr>
<td>In-class Quiz</td>
<td>10%</td>
</tr>
<tr>
<td>Individual Final Project</td>
<td>60%</td>
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READING LIST

- Journal articles and readings
- Lecture notes
BS1809 DIGITAL MARKETING ANALYTICS
Module Outline

MODULE LEADER
Name: Kalyan Talluri
E-mail: kalyan.talluri@imperial.ac.uk
Room: 383 Business School

MODULE AIMS
The objective of the module is to consider the problems that arise in digital marketing and the models and business requirements of digital marketing. The module will consist of hands-on practical analysis of two to three digital marketing specific data sets using the methodologies learned earlier in the programme.

MODULE OBJECTIVES

Knowledge Objectives
• Digital business operations and data and their business analytics questions
• Understand the metrics and methodologies of the digital analytics businesses
• familiarize themselves with the domain-specific software and algorithms

Skill Objectives
• Using Excel to solve models
• Modelling probability distributions and uncertainty
• Excel Analysis Toolpack and Solver
• Monte-Carlo simulations

LEARNING OUTCOMES
Students learn
• Digital marketing analytics

MODULE STRUCTURE
Session 1
Web site analytics: log analytics, tagging, channel management
Google Analytics
Metrics
Segmenting and Targeting

Session 2
Keyword advertising, bidding, optimization
Keyword analysis
Display ads and Ad exchanges

Session 3
Digital Campaign Optimization
Targeted personalized marketing
Pricing Promotions and Repricing

Session 4
Recommendation Systems
Online Reviews
Sentiment and trend analysis

Session 5
Mobile marketing analytics
Location based marketing
Multi-channel campaigns; Campaign optimization

**ASSESSMENT**
Students are expected to hand in individual exercises and excel-based data analytic homework.

Coursework: 100%

**RECOMMENDED READING**
The course material, including articles and cases, will be available online to you through the Hub. In addition, further readings will be posted.

**TEACHING METHODS AND STRUCTURE**
The material will be covered in the form of lectures, where appropriate combined practical sessions during which students can apply what they have learned. The practical sessions will be held within lecture time. In the practical session, an example data set will be given to illustrate how the data analytics is performed with data analysis tools using the taught algorithms.

Students are expected to read assigned material beforehand to be able to follow and actively participate in teaching sessions.
DSI004 DATA MANAGEMENT AND ETHICS
Module outline

MODULE LEADER
Name: Dr Yves-Alexandre de Montjoye
E-mail: TBC

LEARNING OUTCOMES
On successful completion of the module, students should:
- Have a detailed knowledge of data acquisition through to data cleaning/curation and digital preservation.
- Have experience of data processing using MapReduce
- Be able to display informed critical thinking with regard to issues of data ethics and privacy

MODULE STRUCTURE

1. Data Loading & Cleaning
   a) ETL for Data
   b) Data Cleaning
2. Data Challenges:
   a) The CAP theorem
   b) NoSQL systems
   c) Graph storage, for example neo4j
3. Data Security
   a) Data encryption
   b) Anonymisation
   c) Secure storage & transfer
   d) Access management
4. Data Processing
   a) MapReduce programming model/Spark
5. Data Integration
   a) Ontology
   b) Data modality
   c) Semantic Web
   d) Linked data
6. Ethics and privacy
   a) Scale of data collection and tracking
   b) The ethics of experiments
   c) Consumers, Data Privacy & Data Ownership
   d) Data security and the cloud
   e) The law

ASSESSMENT
100% coursework
BS1810 WORKFORCE ANALYTICS

MODULE LEADER
Name: Tufool Alnuaimi
E-mail: t.alnuaimi@imperial.ac.uk

MODULE AIMS
This module runs as a workshop during which students will explore and manipulate data in Python. The aims are threefold. Firstly, to advance Python programming skills by working with real-world data. Secondly, to understand how workforce data can be generated and stored. Finally, to explore how analytics can be implemented in the workplace to make decisions related to recruitment, promotions, performance evaluation and team building.

LEARNING OUTCOMES
On successful completion of the module, students should:

Understand the importance and impact of applying analytics in the workplace.

Be familiar with the different ways of storing data about firms, people and projects.

Be able to deal with the data to make predictions on workplace outcomes using analytic techniques learnt in previous modules.

Improve Python programming skills through hands on data manipulation and exposure to new algorithms (e.g., entity extraction and fuzzy name matching).

LECTURE SUMMARY

SESSION 1: INTRODUCTION TO WORKPLACE ANALYTICS (2-hours)

In this session, I will give an overview about the concepts that will be discussed in each class. I will also describe the datasets which we will use to answer to questions that are presented in each session.

SESSION 2: COMPETITIVE ANALYTICS (4-hours)

In this workshop, I will introduce different methods that can be implemented to understand the competitive landscape. Then, using python, we will implement entity extraction to measure competition and relate that to various workplace metrics.

SESSION 3: WHO WILL LEAVE NEXT? (4-hours)

Employee turnover is common. However, firms sometimes witness high rates of (sudden) turnover, which is costly. Many different factors can help predict when employees will leave and who is at risk of leaving. Using regression analysis, we will make predictions about employee mobility.

SESSION 4: BUILDING EFFICIENT TEAMS (4-hours)
The success of teams depends on how well members communicate, collaborate and coordinate activities. We will explore predictors of the success of collaborative efforts, which ultimately help organizations to build effective teams.

SESSION 5: EMPLOYEE ASSESSMENT (4-hours)

In this lecture, we will explore which data can be collected to evaluate employees and understand who should be promoted and when.

SESSION 6: CONCLUSIONS AND GROUP PRESENTATIONS (2-hours)

The final lecture presents a summary the topics which were covered in the course, and an overview of how it has been applied to individual projects.

**ASSESSMENT**

The module evaluation is as follow:

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<table>
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<tbody>
<tr>
<td>Individual project</td>
<td>70%</td>
</tr>
<tr>
<td>Group project</td>
<td>30%</td>
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</tbody>
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BS1812 HEALTHCARE AND MEDICAL ANALYTICS
Module Outline

MODULE LEADERS
Name: Dr Laure Preux and Jamie Unwin

*Outline shown is from 2015/16. Content subject to change*

MODULE AIMS
The objective of the module is to consider the problems that arise in health-care and the models and business requirements for health-care ecosystems to succeed. The module will provide a mixture of theory and hands-on practical analysis of medical and health-care analytic specific data sets using the methods learned earlier in the programme.

We will delve into diverse datasets that relate to (1) patients (2) healthcare providers and (3) pharmaceutical firms. We will also discuss policy, security, information governance and privacy issues specific to this domain.

LEARNING OUTCOMES
On successful completion of the module, students should be able to:

- Understand the metrics and questions of interest for the medical health-care industry
- Apply the statistical, econometric and machine learning techniques learned in earlier classes.
- Analyse impact of various data sets and their implication on correlating health-care policy.
- Understand and deal with medical data and the associated privacy issues

LECTURE SUMMARY
1. Introduction to Healthcare and Medical Analytics
   This lecture will provide context and definition to healthcare and medical analytics, introducing current practices in the management of health data sets and also provide a history of health-care informatics.

2. Methods
   This lecture will provide a comprehensive technical survey of the methods that we will use in the course. How is the healthcare industry using data analytics and what are the strengths, challenges and opportunities in these approaches?

3. Patients I:
   This lecture will discuss different types of patient data. These include electronic health records, consumer wearable data and unstructured data from historical patient histories.

   a. Case Study: Care.Data – What are the challenges in implementation of the Health and Social Care Information Centre’s programme to extract data from GP surgeries? What insights can be derived from existing data sets and what recommendations would you make to enhance the programme implementation?
   b. Project: Patients have been increasingly relying on web based forums to share stories with others who have similar conditions. These forums are used to gain a better understanding of their illness and also to gain emotional support. We will use content analysis to trace the use of different drugs to treat the same illness and disease. We will then use sentiment analysis to gauge patient reactions to the different drugs.
4. **Patients II: Monitoring outbreaks from Social Media**
   This lecture will explore the importance of social media in the healthcare industry. How has it been used? What are the advantages and disadvantages/limitations of social media and the limitations of methods used, particularly in tracking social media across countries/geographies?
   a. Case Study: http://ebolatracking.org
   b. Project: Development of a twitter based outbreak disease monitor.

5. **Providers I: How do we derive insights to determine quality care?**
   This lecture will examine how hospitals and regulators monitor quality of care and use information trends in order to analyse individual doctor performance through performance at the trust level.
   a. Case Study: Atlas of Variation – NHS Atlas of Variations provide datasets to explore trends and indicators across the NHS ecosystem. This case will explore the NHS Atlas of Variation in Diagnostic Services in order to explore differences in rates of diagnostic testing across the UK.
   b. Project: The Francis Inquiry was established to report on the failings at the Mid Staffordshire Foundation Trust. We will use datasets available in 2005 in order to test what could have been predicted and what learnings we could use to develop real-time indicators of poor care quality.

6. **Providers II: Industry Lecture TBD**

7. **Pharmaceuticals I: Drug production and marketing**
   This lecture will explore post-clinical trial drug production and the issues in using market research, real world evidence and data sources (primary care, patient data, social media, medical records) to influence product distribution. We will analyse loyalty to drugs through analysis of customer purchase behavior, market research data, shipping and inventory data and trust data. How these factors influence CRM and salesforce analytics will be discussed to analyse the data points considered by pharmaceuticals in product marketing.
   a. Case Study: TBD
   b. Project: TBD

8. **Pharmaceuticals II: Industry Lecture TBD**

9. **Data Security, Information Governance and Policy Considerations**
   This lecture will analyse the privacy and policy implications of healthcare data. It will explore issues of data anonymisation and the threats and challenges posed by mass aggregation of healthcare datasets.
   a. Case Study: CQC GP Reports – The Care Quality Commission has developed reporting in order to analyse the standard care provided by general practices across England. This case will explore the challenges and opportunities in this implementation from an information governance and policy perspective.

10. **Consolidation: Healthcare and Medical Analytics Project Delivery**
    This lecture will consolidate theory and application from previous modules and evaluate frameworks for the management of healthcare data projects.
    a. Case Study: Apple Watch – How is Apple using ResearchKit to collect, retrieve and transfer healthcare data to provide individual health insights and what big data applications could be leveraged in the aggregate?
    b. Project: The final project will provide students an opportunity to demonstrate methods explored in the course and implement a healthcare and medical analytics...
solution that makes use of datasets and provides a real-world use to analyse healthcare trends.

TEACHING METHODS AND STRUCTURE
The material will be covered in the form of lectures combined with case studies and practical's. Students are expected to read assigned material beforehand to be able to follow and actively participate in lecture.

ASSESSMENT
The module evaluation is as follow:
Final project 70%
Group Case Studies 30%
BS1813 RETAIL AND MARKETING ANALYTICS
Module Outline

MODULE LEADER
Name: Catarina Sismeiro
E-mail: sismeiro@imperial.ac.uk

MODULE AIMS
Retail sales are a very important economic indicator because consumer spending drives much of our economy. Think of all of the people and companies involved in producing, distributing, and selling the goods you use on a daily basis like food, clothes, fuel, and so on. When consumers open their pocket books, the economy tends to hum along.

With this module, we will study this important sector of the economy taking the perspective of data analytics. You will learn to how to identify, evaluate, and capture retail analytics opportunities that create value. Toward this end, you will learn basic models and analyze case studies on organizations that successfully deployed these models. The course will be organized around specific research problems facing retail companies including pricing and the estimation of price elasticities, the optimization of promotional actions and the measurement of performance, the estimation of customer lifetime value, the prediction of store choice, brand decisions and quantities to be purchased.

You will acquire a good theoretical background but also hands-one experience on using real datasets to solve real problems. You will be required to apply the learnings from the core courses to solve specific retail problems as if you were in a consulting position. You might need to think not just about the best models to fit specific data but also what is the data you would like to obtain to solve those problems. The central part of the course will be based on a problem-oriented approach.

Finally, this module will look at the vast amounts of retail (scanner) data and the analytics used for such. It will look at the analysis of scanner as well as panel data and the various models and their estimation and subsequent use in decision-making. The module will rely on econometric and statistical techniques learned earlier.

Topics we will cover in the course will include:

- The Retail Equation --- ability to analyse footfall, store choice, and brand sales
- Estimating lifetime value
- Analysing promotional activities and markdown optimization
- The role of customer segments and customer demographics
- Price analytics, estimation of price elasticities, and optimization
- Conjoint and survey analytics
- Product analytics, merchandising, and targeting

Retail analytics are now an integral part of modern retail management and this course will provide you with the foundation you need to understand and apply these methods to drive value.
MODULE OBJECTIVES

Knowledge Objectives
On successful completion of the module, students should be able to:

- Understand retail problems and become familiar with the specific terminology and key principles of retail management
- Understand the types of available data in a retail environment, the advantages and disadvantages of different data formats and structures, and the potential for their use in retail analytics
- Understand the metrics and models used in the retail industry, their applicability in a variety of contexts, and their impact to decision making in retail
- Know how to communicate with business users and in the retail domain and translate their needs into research questions to be answered through data analytics
- Know the domain-specific software and algorithms

Skill Objectives
On successful completion of the module, students should be able to:

- Estimate the models used in the retail industry and interpret the results
- Transform model results into applicable metrics and how to use these metrics in decision making
- Apply the statistical and econometric techniques learned in earlier classes to research problems specific to the retail industry
- Build quantitative models using real data through hands-on experience

LEARNING OUTCOMES
By the end of this module, you should be able to understand, analyse, and model retail problems from the perspective of the retail manager. You will have a solid understanding of quantitative techniques around assessing a variety of topics connected to retail management including pricing, estimating customer lifetime value, predict footfall and purchase.

TEACHING METHODS AND STRUCTURE
The teaching methods will be a combination of lectures, hands-on examples, and exercises. The lectures will be dedicated to the consolidation of concepts, terminology, and retail problems. We will also review several major models and data structures essential to help retail managers understand the retail equation. Finally, we will apply these models using real data and real retail problems. Students are advised to read recommended material beforehand to be able to follow and actively participate in the lecture.

ASSESSMENT
The module evaluation is as follows:

- Individual Final Project: 70%
- Group Coursework: 30%
MSc IHM and MSc ESB Electives

Limited spaces available in these electives.

NB: MSc ESB electives are weighted as 0.5 of a full MSc Business Analytics module, therefore students must take two of these electives.
MODULE LEADER
Name: Dr Tim Heymann
Email: t.heymann@imperial.ac.uk
Location: 378
Phone: 020 7594 9131

MODULE AIMS
To module aims to draw on theory and practical examples from hospitals and other industries to provide students with a theoretical and practical understanding of the challenges in the management of healthcare providers and how the product they offer is evolving.

Knowledge objectives
Key concepts and future trends in:
- Services operations
- Demand management
- Quality management and reengineering
- Inventory management and contracting
- Negotiation management and decision making

Skill objectives
- Communication skills: aural, oral and written
- Team working through class and syndicate discussions
- The application of knowledge in practical contexts

Learning outcomes
Students who complete the module successfully will be able to:
- explain the issues of demand management in healthcare
- describe and evaluate quality initiatives in the delivery of healthcare
- identify good practice in service delivery and inventory management in healthcare
- understand the patient journey

TEACHING METHODS
The module is designed to be practical in its intent and will draw on examples from healthcare and other industries to demonstrate the practical implementation of concepts that will be covered through lectures, case studies, class discussion and practical exercises.

ASSESSMENT
Examination (70%)
Coursework: Group project (30%)
MSc IHM: BS0443 MANAGING CHANGE AND INNOVATION IN HEALTHCARE
Module outline

MODULE LEADER
Name: Professor James Barlow
Email: j.barlow@imperial.ac.uk
Location: 394
Phone: 020 7594 5936

MODULE AIMS
Healthcare is one of the most complex and fast moving sectors of the economy. New technologies are driving new services and practices, but they are often hard to introduce and hard to spread across health systems. The module introduces the latest thinking in why this is the case and how to manage healthcare innovation more effectively. Using real-life examples of technology and service based innovations in healthcare from the UK and other countries, you will:

- learn why innovation in healthcare services and policy is critical, and perhaps even more today so given the new economic circumstances
- develop an appreciation of leadership, strategic, organisational and team-based skills necessary for driving innovation processes in healthcare
- learn why it is not enough simply to adopt innovation – embedding it within everyday practices on a sustainable basis is more important, but more challenging

Module objectives
To provide students with a theoretical and practical understanding of the challenges in managing organisational and technological innovation within healthcare systems.

Knowledge objectives
You will learn about key concepts in:
- healthcare innovation trends and their impact on services
- adoption, implementation and diffusion of healthcare innovation
- basic tools for managing innovation, such as project management
- measurement of innovation impacts

Skill objectives
- communications skills: aural, oral and written
- team working through class and syndicate discussions
- the application of knowledge in practical contexts

Learning outcomes
Students who complete the module successfully will be able to:
- explain the issues of innovation management in healthcare
- describe and evaluate challenges in the implementation of healthcare innovations
- identify good practice in innovation management in a healthcare setting
TEACHING METHODS
The module will involve a combination of lectures on key topics in innovation management and syndicate group work. Some lectures will include guest speakers with practical experience in implementing innovative healthcare projects, subject to their availability. Module notes are distributed to students via The Hub for note taking at each lecture. Students are expected to engage in class discussions and exercises related to the topic of each week’s session.

Structure
The module will address the following topics:

- What are the big healthcare challenges that require innovative thinking, both in the developed and developing countries?
- What do we know about innovation processes in general? The fundamentals from the research literature.
- Is healthcare ‘different’ and does this impact on its innovation processes?
- Looking to the future – what are the big new innovation trends in healthcare?
- What mechanisms are used to stimulate innovation in healthcare? Is ‘open innovation’ beneficial? What is the role of government?
- How can we ensure healthcare innovations are embedded into organisations and practices? Why do we have a problem with ‘pilot’ projects in healthcare?
- Learning from healthcare innovations developing countries – can we transfer lessons from India and elsewhere to developed health systems?

ASSESSMENT
Closed book final examination (70%)
Group coursework (30%)
MSc ESB: BS1711 STRATEGY IMPLEMENTATION
Module Outline

MODULE LEADER
Name: Dr Sarah Otner
Email: s.otner@imperial.ac.uk

MODULE AIMS
While much of strategy deals with strategic analysis, any practising manager will immediately agree that any strategy is only as good as its execution. The question of strategy implementation is therefore a key challenge for managers and will form the focus of this module. Strategy implementation involves balancing the strategic and operational goals of the organisation while appreciating the interconnectedness of strategy, structure and systems. It involves gaining the commitment of organisational members to a new strategy as well as managing processes of organisational change, both of which deal with the complex dynamics of people, power and politics.

In this module, we will examine how managers can anticipate, understand and resolve different problems that arise when a new strategy is implemented. In general, a different area of strategy execution will be explored during each class. Class discussions, exercises and readings from the textbook and business press will be used to link conceptual material we will consider with real world issues and problems. Case analysis and discussion are integral parts of the module and I will expect all students to have carefully prepared the assigned cases before class. The cases are designed to test and sharpen the ability of students’ to identify module concepts in actual business settings and apply these concepts in decision-making but the case approach only works if students prepare properly for class.

MODULE OBJECTIVES
Knowledge Objectives
- Understand the central concepts in strategy implementation
- Understand how to develop a plan for the implementation of a strategy
- Understand the sorts of challenges and barriers that may pose problems for strategy implementation

Skill Objectives
- Ability to apply concepts and frameworks from strategy implementation to business cases and real-life firms
- Ability to identify problem areas when implementing a strategy and use theory to develop potential solutions
- Enhanced skills in written and verbal communication, teamwork, analytical thinking, decision-making, project planning and general management

LEARNING OUTCOMES
Upon completion of the module students will have developed a deep understanding of the challenges of implementing strategy and will understand how strategy implementation is a central part of the strategy process.

ASSESSMENT  The module evaluation is as follows:
Group project  100%
MSc ESB: BS1712 DIGITAL ECONOMICS AND DIGITAL STRATEGY
Module Outline

MODULE LEADERS
Name: Dr Helen Weeds

MODULE AIMS
The aim of the module is to explore how the digital revolution is transforming business and consumer behaviour. The emphasis in this module is on our applied understanding of theory and concepts and, hence, the module will consist of talks by industry speakers from both established and start-up organisations, including Vodafone and Google, to illustrate the type and nature of the various challenges faced by organisations operating in a digital environment.

MODULE OBJECTIVES
Knowledge Objectives
During the module, participants should develop the ability to:

- understand the factors that influence competition and competitive advantage in technology-intensive industries including the nature and emergence of technical standards and platforms as well as the role of network effects
- consider the evolution of online technologies and the impact of mobile technology on business
- appraise the digital value chain and new digital business models

Skill Objectives
Participants should be able to:

- apply tools and concepts to an organisational setting

LEARNING OUTCOMES
By the end of this module participants will have developed an understanding of the key factors relevant to operating in a digital sector or environment.

STRUCTURE
The module will consist of five 2-hour sessions in the summer term including an external visit to focus on current digital industry practice.

ASSESSMENT
Group coursework: 100%
BS 1713 ENERGY ECONOMICS AND STRATEGY
Module Outline

MODULE LEADER
Name: Dr. Iain Staffell
E-mail: i.staffell@imperial.ac.uk

MODULE AIMS
The aim of the module is to explore how energy companies are responding to the need to provide secure, affordable, supplies of energy while minimising its environmental impact. It will emphasise the role of technology in expanding the options available to us, and the way in which technological features of different energy sectors affect their business models and economic performance.

MODULE OBJECTIVES
Knowledge Objectives
During the module, participants should develop the ability to:
- understand the key factors affecting energy businesses in both the oil and gas sector and the utility (electricity and gas distribution) sector
- assess the impact of low-carbon policies on all types of energy business
- explain the trade-offs between the cost of energy supplies, their security and their environmental impact

Skill Objectives
Participants should be able to:
- apply tools and concepts to an organisational setting

LEARNING OUTCOMES
By the end of this module participants will have developed an understanding of the key factors relevant to operating in the energy sector.

STRUCTURE
The module will consist of five 2-hour sessions in the summer term.

ASSESSMENT
Group module work: 100%
BS1814 CAPSTONE BUSINESS ANALYTICS PROJECT
Module Outline

MODULE LEADER
Name: Professor Kalyan Talluri
E-mail: k.talluri@imperial.ac.uk
Room: 383, 3rd Floor Business School

MODULE AIMS
The Capstone Business Analytics Project to develop your managerial and consulting capabilities by applying your acquired theoretical knowledge, analytical and managerial skills to the real business situation. The focus is on managing a consulting project from inception to completion, drawing on your knowledge from other modules you have completed on the programme and combine it with your competences and skills developed through the professional development programme.

MODULE OBJECTIVES
Knowledge Objectives
During the module, participants should develop the ability to:
- analyse a real consultancy problem
- apply their knowledge from other modules to solve a real-life consultancy problem
- integrate theoretical knowledge with practical skills relevant to an industry

Skill Objectives
Participants should develop the ability to:
- conduct research and analysis at both the industry- and firm-levels together with evaluating the implications of this analysis
- analyse and interpret real-life business problems
- deliver value through the project to the client

LEARNING OUTCOMES
By the end of this module participants will develop:
- problem solving skills in an applied business situation
- consulting competences in relation to working with and managing a client
- project management skills to deliver to a pre-assigned set of requirements and external time frame
- report writing skills to produce a report, useable to managers and industry practitioners

STRUCTURE
The project options will be announced in the summer term and students will undertake the major intensive consultancy task in June/July. The final report will be submitted at the end of July. At that time students will also present their results and recommendations to a panel of judges and clients.

ASSESSMENT
Group Coursework: 100%
This will consist of a 3,000 word project (50%) and a group presentation (50%).
BS1815 WORK PLACEMENT
Module Outline

MODULE LEADER
Name: Professor Kalyan Talluri
E-mail: k.talluri@imperial.ac.uk

MODULE AIMS
Work Placements contribute to the development of the student’s analytical potential by applying problem solving techniques to a challenging business situation in which the student is fully immersed. The focus is on developing the students’ skills in managing real business tasks in one specific business context, drawing on the knowledge and skills achieved in other modules of the MSc Business Analytics programme. The module will give students who have had little or no exposure to the corporate environment, the opportunity to experience and operate in a real world situation.

MODULE OBJECTIVES
Knowledge Objectives
Participants should develop the ability to:
- analyse real business related problems
- apply their knowledge from other modules to solve real business tasks
- integrate theoretical knowledge with practical skills relevant to industry

Skill objectives
Participants should develop the ability to:
- carry out business related tasks and analysis and evaluate their results
- analyse and interpret real world business problems
- manage line manager’s, peer and clients’ expectations
- deliver value through the completion of tasks to the organisation they work for

LEARNING OUTCOMES
Upon completion of the module, participants will have developed:
- Problem solving skills in a business situation
- Analytical skills to select and use relevant information for a given task
- Communication / presentation skills to produce a report
- Project management skills to deliver to a pre-assigned set of requirements, external time frame and the highest ethical values.

STRUCTURE
Those students who choose to take this module must secure their own work placements and submit details of their work placement to the Programme Team by the end of April. The Programme Director, in consultation with the Careers and Development Team, will vet all proposals by evaluating if the work placement is relevant to the programme and its learning outcomes and is carried out by a credible organisation.

ASSESSMENT
Individual portfolio containing sufficient evidence and self-evaluation of the achievement of each learning outcome.
BS1817 BA REPORT
Module Outline

MODULE LEADER
Name: Professor Kalyan Talluri
E-mail: k.talluri@imperial.ac.uk

MODULE AIMS
The BA Report requires students to conduct independent research and write an individual report/essay on a topic of their own choice that relates to one of five broad themes reflecting the overall programme content. The aim of the module is to further develop students’ theoretical understanding of a particular topic of their interest through advancing their research and professional writing skills necessary for business success. Students will be supported with additional workshops throughout the year in relation to developing both their research and writing skills.

MODULE OBJECTIVES
Knowledge Objectives
Participants should develop the ability to:
- apply and extend their knowledge acquired during other modules throughout the year to analyse a theme related to the programme’s content
- understand and contextualise theories and frameworks within the broader academic literature

Skill Objectives
Participants should develop the ability to:
- carry out, interpret, evaluate and synthesise existing literature related to a business/managerial theme
- effectively express in writing their opinion and critical evaluation on a business/managerial theme
- present their ideas to both inform and persuade an audience on a particular topic
- carry out research and other tasks unsupervised, managing time effectively throughout

LEARNING OUTCOMES
Upon completion of the module, participants will develop:
- a deeper, critical understanding of theories and frameworks
- a better understanding of how to conduct a research process on a given topic; improve familiarity with the sources and the use of both literature and secondary data
- analytical skills to select and use relevant information for the purpose of producing an extended essay with practical managerial relevance
- to present ideas to a professional standard in a limited time frame without supervision

STRUCTURE
- Students will conduct research and write their BA Report unsupervised during August.

ASSESSMENT
Coursework: 100% Individual Report (5000 words)
Report Due: Friday, 1 September, 2017

READING LIST
There is no recommended text, although books which might be useful include the following: