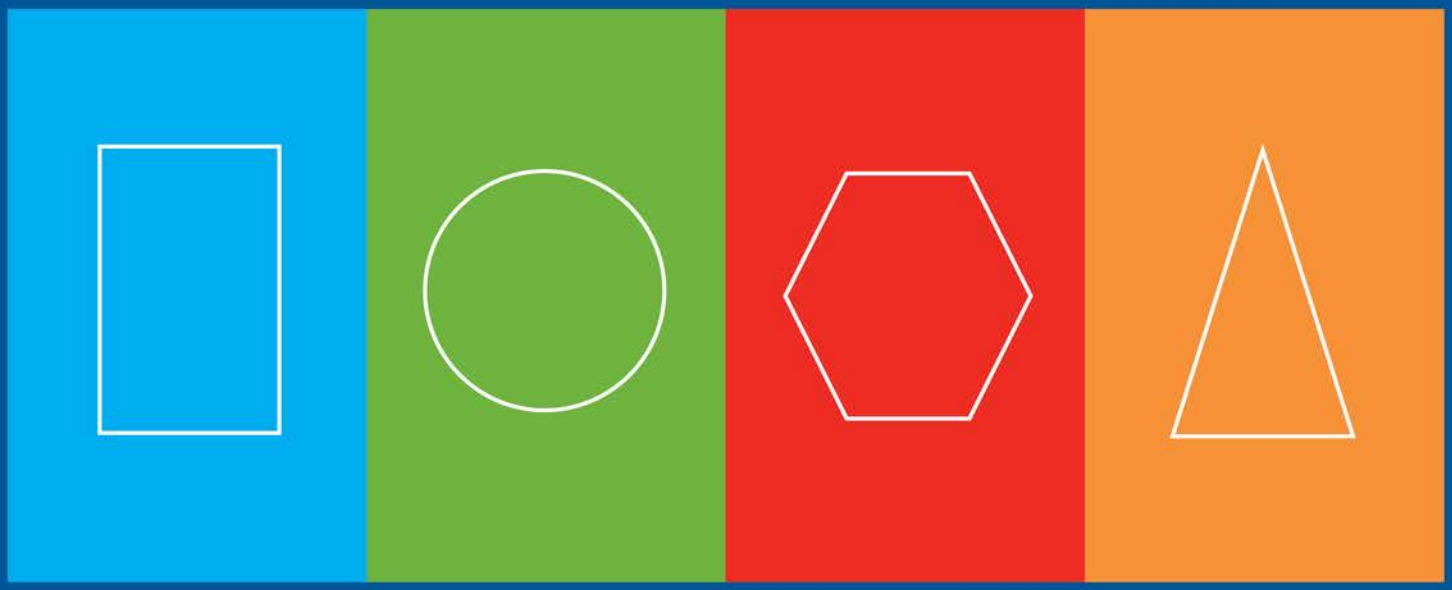

An Assessment of the Current and Planned Domestic Supply of Big Data/Data Analytics Skills in Ireland

Forfás/EGFSN Paper

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Forfás

Expert Group on Future Skills Needs

Current and Planned Domestic Education and Training Supply of Big Data and Data Analytic Skills in Ireland

Introduction

This paper was prepared as an input into the research work of the Forfás / EGFSN Study: *"Assessing the demand for Big Data and Analytics Skills in Ireland 2013-2020"*, which was published May 2014. (http://www.skillsireland.ie/). The data analytics education and training supply provision outlined in this paper was the position as at the start of January 2014.

The supply of Big Data and Analytics dedicated third level courses within Ireland is still at an early stage, mainly because the demand for data analytics talent has only come to the forefront in the past three years. This paper looks at current and planned course provision for data analytics and related skills available in Ireland at NFQ levels 6/7 and 8/9/10. This analysis includes, where available, the total numbers enrolled for the 2011/2012 period and also the most recent graduate output, in most cases for 2011 (the year most data is available from the Higher Education Authority). Course provision is divided into several categories as follows:

- Dedicated Big Data & Analytics Programmes
- Programmes that include significant training/elements in data analytics
- Maths, Statistics and Science programmes
- Computer Science Programmes
- Engineering Programmes
- Physics Programmes
- Data Analytics Programmes Northern Ireland
- Private Data Analytics Programmes
- Online Education in Data Analytics

Big Data and Analytics Course Provision

(a) Dedicated Big Data & Analytics Programmes (Table 1)

There are fifteen dedicated data analytics courses in Ireland with an enrolment of approximately 500 students. These are mainly at Level 8 and Masters Level/ NFQ level 9. As most of these programmes have only recently been set up only four had graduates completing for year 2011. There are plans to commence four further dedicated data analytics courses in 2014 or 2015.

NFQ Level 8/9 Award programmes

DCU commenced an MSc in Computing in Data Analytics in September 2013. The programme was designed in collaboration with IBM to help graduate students develop critical IT skills for urban analysis, consumer behaviour, social networks, sentiment analysis, healthcare, and cyber and network security. Students have access to real-world IBM case studies from cities and organisations around the world. The course is jointly delivered between industry experts from IBM and DCU academics.[1]

[1] http://www.dcu.ie/news/2013/jul/s0713s.shtml

Dublin Institute of Technology (DIT) MSc in Computing in Data Analytics is designed to create 'hybrid technologists' i.e. graduates with deep technical skills (in data management, data mining, probability and statistics, and machine learning), but also with softer skills (in communications, research and problem solving). This programme is run jointly by the School of Computing and the school of Mathematical Sciences.[2]

University College Cork (UCC) has a Master's programme in Data Science and Analytics that is run jointly between the Department of Computer Science and the School of Mathematical Sciences. The course aims to impart graduates with the key principles of Data Science and Analytics. The programme concentrates on data science, probability theory and statistics and provides graduates with an opportunity, through development of a research project, to investigate the more applied elements of the disciplines.[3]

Smurfit Business School, University College Dublin, run an MSc in Business Analytics, which is designed for candidates from Information Systems, Engineering, Maths, Economics, Science and Computing backgrounds. The programme allows students to evaluate real management problems with companies as part of their dissertation. The course is offered on both a full-time and part-time basis. Core modules within the curriculum include Quantitative Methods, Numerical Analytics and Software, Project Management and Decision Analytics and Applied Probability and Statistics. Students have the option of choosing four electives from a range of modules including Simulation Modelling and Analysis, Analytical Business Modelling, Network Software Modelling, Decision Support and Business Intelligence and Data Mining Techniques & Models.

The Management Science and Information Systems Studies (MSISS) degree at Trinity College Dublin is for students that enjoy solving complex problems and are interested in both technology and business. The four year course offers students the opportunity to build up skills in quantitative techniques, such as mathematics, statistics, probability and data mining in conjunction with business concepts in management, finance and operations management. Statistical analysis and data mining modules are compulsory for final year students.[4]

The Irish Management Institute in conjunction with University College Cork, offer a Higher Diploma leading to an MSc in Data Business. The programme is designed as an executive education programme for professionals who have technical experience and want to develop a more business/holistic view of data strategy and for non-technical professionals who need to have a strategic understanding of how to manage data and collaborate with the data analysts. The programme content was developed in collaboration with EMC and SAS.

There are two NFQ level 8, year-long, ICT Conversion programmes[5] specialising in data/ business analytics available, one in Cork IT and the other in the National College of Ireland (NCI). A further two NFQ Level 8 Springboard[6] courses are running – one in NCI and the other in NUI Galway. These courses are suited to jobseekers with a background in cognitive and analytical disciplines and those with strong numerical ability. They aim to provide students with technical skills in areas such as statistics, programming, database management and web mining in order to extract insight from

[2] http://www.dit.ie/postgrad/programmes/dt228adt228bmscincomputingdataanalytics/
[3] http://www.ucc.ie/en/media/studyatucc/postgrads/applicationdocuments/MScDataScienceAnalytics.pdf
[4] http://www.tcd.ie/courses/undergraduate/az/course.php?id=DUBCS-MSIS-1F09
[5] NFQ Level 8 Conversion are full time courses open to job – seekers. They are designed to address areas of ICT recruitment difficulties and developed by public and private higher education providers in collaboration with industry partners.
[6] Springboard is a part-time programme at various NFQ levels which provides opportunities for unemployed people to gain new higher education qualifications in areas of identified skills need. The courses are also developed by public and private higher education providers in collaboration with industry partners.

large amounts of raw data. Springboard programmes include a career bridge module which aims to build students' job-seeking skills. DIT also offers a Continuing Professional Development Diploma through Springboard in the related field of Financial Mathematics and Analytics. The Diploma is at NFQ level 8 and is geared towards students with a previous qualification in Engineering or IT. It combines elements of financial mathematics, statistics and modelling, together with the technical skills to perform the analytical requirements particular to the financial and business sectors.

NFQ Level 6 / 7 Programmes

The Institute of Technology Tralee offer a NFQ level 7 Springboard Certificate in Social Media and Web Analytics. Students will gain the appropriate skills to undertake advanced data analysis of critical back-end information to support businesses in measuring, monitoring and bench-marking website performance against that of key industry players. Students will also gain a better understanding of customer needs and behaviours required in order to develop stronger relationships with clients.

There is also an NFQ level 6 Certificate in Programming for Data Analytics available through the Springboard initiative in Blanchardstown IT. This course is designed as a stepping stone for those wishing to pursue a career in data analytics. It is two semesters long and aims to impart fundamental skills for database design, SQL, statistics and data analysis.[7]

Online Programmes

Online options are available suited to professionals already in the ICT industry who wish to up-skill or convert to data analytics. UCD have introduced an online professional diploma in data analytics. Students are given videos, online demonstrations, and interactive games to enhance their learning, with regular feedback and interaction via course tutors through the UCD website. The course aims to help students analyse and understand large data sets that are regularly being created via the huge growth in freely available online information.[8] The Institute of Technology Blanchardstown (ITB) offers a two-year online MSc in Computing (Business Intelligence and Data Mining. Core modules include Data Pre-processing and Exploration; Business Intelligence; Data Mining Algorithms; Text Mining & Web Content Mining; Business Intelligence and Data Mining Applications; and Multimedia Mining. It is primarily designed for graduates from a computer science background (NFQ Level 8 or Graduate Diploma). The course aims to provide students with the aptitudes for the selection, application and evaluation of business intelligence and data mining techniques to generate knowledge that can add value to a company. The course which has been running since 2010 currently has 35 students enrolled. Many students are already working in related fields, and choose the course to facilitate their career advancement in data analytics. The part-time course was designed in collaboration with industry to meet their requirements for graduates in data analytics. According to the Institute, there is a strong industry demand for these skills. ITB are also involved in the SAS Academy programme.

[7] https://www.springboardcourses.ie/Certificate-in-Programming-for-Data-Analytics/Science-Mathematics- and-Computing/Computing/Computer-Science/ViewItem.aspx?ItemTypeID=2&ItemID=1679
[8] http://www.ucd.ie/science/graduate_studies/downloads/UCD_ProfessionalDiplomainDataAnalytics.pdf

Several universities have data/business analytics courses in the pipeline for the coming years. NUI Galway is in the process of designing a ME in Computer Science & Information Technology with a specialism in Big Data & Analytics for a 2014 start. NUIG also intend to introduce an MSc in Business Analytics for commencement in September 2015, while UCD are in the process of developing a BSc in Business Analytics for September 2015.

An outline of several of the above dedicated Big Data and Analytics programmes is provided in Appendix 1.

(b) Programmes that provide significant elements in data analytics (Table 2)

There are currently eighteen programmes with 760 students enrolled, which have significant streams or electives in data analytics. These are on both undergraduate and postgraduate degrees in computing, cloud computing and business information systems etc, where students have a choice of modules or electives.

NCI run a BSc in Business Information Systems which aims to attract candidates that are interested in developing practical knowledge and skills in the application of technology to help facilitate business decisions. Graduates of this programme will acquire the fundamentals of mathematics for computing, data structures and algorithms, advanced databases, business data analysis and applied artificial intelligence.[9]

Galway-Mayo IT run a similar Bachelor of Arts (Honours) in Information Systems Management. It is a practical programme, which combines information technology with a range of business subjects, preparing graduates to apply technological solutions to modern, dynamic enterprises. One of the key strengths of the programme is the inclusion of emerging technologies, such as cloud computing and virtualisation.[10]

There is also some overlap with data analytics content in Cloud Computing programmes. At NCI, the MSc in Cloud Computing contains a module in data storage and management, while the MSc in Cork IT gives students the option of taking an elective in data analytics. NUIG designed an MSc in Cloud Computing together with Hewlett-Packard Galway's Cloud Services Innovation Centre. The Master of Science in Cloud Computing Research is a programme of advanced research, designed to develop participants' research skills and to engage participants in a research programme on a relevant business-focused area of cloud computing and services.[11]

DCU have many options for students wishing to pursue a career data analytics. Many of the undergraduate degrees in DCU's school of computing build on a mathematical foundation in first year, which is core and heavily weighted and is a key discipline within analytics. Examples include the BSc in Computer Applications which incorporates modules in probability and statistics, linear algebra and options in operations research, digital image processing, statistical machine translation and informatics. The BSc in Enterprise Computing also includes modules in quantitative analysis for business decisions and additional modules in business database management and business informatics. A new B.Sc. degree in Computational Problem Solving and Software Development commenced its first intake in Sept. 2013 with 25 places available. The programme is unique in targeting those with prior programming experience and also in requiring 'portfolio entry'. Additional

[9] http://www.ncirl.ie/Default.aspx?tabid=258&course=BSc-(Hons)-in-Business-Information-Systems-BSHBIS
[10] http://www.gmit.ie/business/bachelor-arts-honours-information-systems-management
[11] http://www.nuigalway.ie/courses/research-postgraduate-programmes/cloud-computing-research.html

modules thus include problem solving, creativity and design, probability and statistics and Linear Algebra, as well as options in security, digital IP and AI (Artificial Intelligence).

In Dublin Institute of Technology the Masters in Computing (Information and Knowledge Management) provides students with the option of studying programming for big data and advanced databases. DIT also offers a level 8 conversion course in computing through the HEA ICT skills conversion programme. The Higher Diploma in Computing offers a series of data analytics specialisation modules including probability modules and statistical interference, data analytics and advanced databases. It is expected that students will, at a minimum, obtain a work placement or internship with associated industrial partners for a 6 month period.

The MSc in Computer Science through Negotiated Learning at UCD allows students to negotiate a programme of learning that is tailored to their own career goals and requirements. Students can choose modules from a diverse offering by Schools such as the UCD School of Computer Science & Informatics, UCD School of Business, UCD School of Physics, UCD School of Information & Library Studies, and the Nova UCD Innovation and Technology Transfer Centre. The programme is attractive to industrial workers coming from related computer science and IT disciplines, and/or national and international students with relevant computer science undergraduate degree qualifications, who have specific workplace needs or requirements for continuing professional development. Modules available to students on this programme include machine learning; machine learning and network data analysis; enterprise, innovation and entrepreneurship; parallel algorithms design and analysis; data mining techniques and models and numerical algorithms.[12]

Dundalk IT offer a Data Analysis module as part of their BSc in Computing in Applications and Support, BSc in Computing in Networking & Support and the BSc in Computing in Software Development. The module comprises of seven sections including Introduction to Data Analysis; Compilation of Data; Probability; Conditional Probability; Probability Distributions; Sampling Theory and Correlation. The course aims to provide students with skills relating to representing and investigating computing data using summary measures and statistical diagrams, use of established probability distributions including the Poisson, normal and Binomial distributions to represent the random variation in computing related phenomena and apply basic probability and decision theory to the solution of computing problems.[13] The modules also provide knowledge on use of techniques relating to correlation and regression to investigate the relationship between variables with a particular focus on large datasets.

Waterford Institute of Technology run an MSc in Global Financial Information Systems which is delivered over a 16 month period, of which the last six months comprises an internship within an organisation operating in the Financial Services Industry. Students receive practical training in key skills including Data Modelling and analysis; business Intelligence and Data Warehousing; Econometrics; Corporate Financial Interpretation and Project Management.

[12] http://www.csi.ucd.ie/content/module-offerings
[13] http://courses.dkit.ie/index.cfm/page/module/moduleId/47982

(c) Core degrees: Maths, Statistics & Science. (ISCED categories[14] 400, 460, 461, 462) (Table 3) [15]

These more general programmes impart the deep-analytical, problem-solving and quantitative skills needed for data analytics roles. Table three includes relevant courses from the following four categories; combined mathematics and statistics (ISCED 460), general mathematics (ISCED Code 461), statistics programmes (ISCED Code 462), and combined science, maths and computing programmes (ISCED Code 400). Graduates from these general STEM categories would be best placed to up-skill to the data analytics area.

The general Mathematics ISCED category (461) includes degrees in Applicable/Applied Mathematics, Arts degrees majoring in Maths, Research Masters in Maths, Financial Mathematics and Actuarial Science and also Mathematical Modelling. The Combined Mathematics and Statistics category, (ISCED 460), includes programmes in Actuarial Applications, Mathematical Studies, and joint Economics and Mathematical Sciences degrees. The Statistics category (462) mainly covers programmes in Maths and Statistics, Actuarial and Financial Studies, Applied Statistics, Actuarial Mathematics and general Higher Diplomas, Bachelors and Masters Degrees in Statistics. Finally, the Combined Science, Mathematics and Computing category (400) comprises general science bachelors and Master's degrees, some with a specific focus on Financial Maths and Economics, Arts degrees with a focus on Science, Maths and Computing and Mathematical Sciences degrees.

(d) Maths Graduates - ISCED 461 (Table 4)

Table 4 includes 2011 undergraduate and post graduate output from mathematics Programmes – ISCED 461. In total there were 253 mathematics graduates in 2011.

(e) Statistics Graduates - ISCED 462 (Table 5)

Table 5 includes 2011 undergraduate and post graduate output from statistics Programmes – ISCED 462.In total there were 166 statistics graduates in 2011.

(f) Computing Programmes (Table 6)

This Table includes 2011 undergraduate and postgraduate output from ISCED category 481; computer science and ISCED 482; computer use. Several programmes from these categories are also included in Table 3 because they provide significant training in analytics. Graduates from general computing programmes have the core skills and competencies to perform the technology supporting roles required to make use of and maintain big data and analytics software. These personnel are also well placed to up-skill into the data analytics area as they possess core computing, programming and analytical skills which are necessary foundations for data analytics roles.

(g) Engineering Programmes (Table 7)

Table 7 covers Engineering disciplines (ISCED 52) and provides undergraduate and postgraduate output for 2011. ISCED categories include combined engineering and engineering trades; mechanics and metal work; electricity and energy; electronics and automation; chemical and process and;

[14] International Standard Classification of Education (ISCED)
[15] Enrolment and Graduate figures for programmes such as the BSc Common Entry into Science, Bachelor of Science. (Undenominated) and Natural Sciences in ISCED 400 (Combined Science and Mathematics) have not been included.

motor vehicles, ships and aircraft. Graduates with engineering backgrounds have an aptitude for applied problem solving and machine learning which is essential for analytics roles. Therefore, these cohorts of graduates are well suited to upskill or re-train for careers in data analytics. The McKinsey Global Institute identified engineers as one of the occupational categories where 'big data savvy' talent might be found. These are people with a basic knowledge of statistics and/or machine learning that can define key questions data can answer.[16] There were 3,326 engineering graduates in this category in 2011.

(h) Physics Degree Programmes (Table 8)

Physics graduates (ISCED 441) have been identified as a potential supply pool from which analytics talent could be drawn.[17] Physicists possess the quantitative and deep analytical skills necessary for data analytics roles. Table 8 shows the 2011 undergraduate and postgraduate numbers from all Physics programmes. There were 258 physics graduates in 2011.

(i) Data Analytics Programmes Northern Ireland (Table 9)

There is an MSc in Computational Intelligence available at the University of Ulster, Magee which offers modules relevant to the data analytics area. Computational Intelligence (CI) is a domain of artificial intelligence in which the emphasis is placed on heuristic algorithms and evolutionary computation. The course focuses on providing a core foundation in computational intelligence, and, aims to impart students with the high-level skills necessary to develop a career in computing/engineering, or pursue further research in computational intelligence.[18]

(j) Private Data Analytics Courses (Table 10)

There are approximately eleven private training courses which provide training in data analytics, statistics and related skills. These would be suitable for professionals or managers wishing to gain an insight into data analytics and its uses in business. The majority of these courses are under a week in duration with many of them being run by the Analytics Store.

(k) Skillnets short courses planned in the Big Data / Data Analytics Skills area for 2014 (Table 11)

There are five short Skillnets courses in the Big Data/data analytics area planned for 2014 ranging from 3 to 15 day duration. The ICT Skillnet networks are focussed on addressing this need for enterprises. The Summit Finuas Network works within the international financial services sector has also found a demand for programmes in data analytics from its members. The ICT focussed networks are also delivering courses that may be related to this area but not have the exact title of big data. For example the ISA Software Skillnet is delivering programmes in Hadoop which is a programme for the storage and large scale processing of data-sets.

[16] The McKinsey Global Institute, Big Data: The next frontier for innovation, competition and productivity, p. 134.
[17] Accenture, Crunch Time: How to overcome the looming global analytics talent mismatch, Mapping supplies of potential analytics talent, p. 48.
[18] http://study.ulster.ac.uk/prospectus/course/201415/2839

(l) Online Education in Data Analytics (Table 12)

Table twelve provides examples of online courses available through some US universities and from leading online training providers. Stanford University provide free online programmes with training in subject areas relating to data analytics such as machine learning. Stanford Online offers a variety of professional education opportunities in conjunction with Stanford University schools and departments. Classes consist of lecture videos, which are broken into small chunks, usually between eight and fifteen minutes each. Some of these may contain integrated quiz questions. There will also be standalone quizzes, programming assignments, and a final exam. [19]

The Master of Data Science at Berkley is delivered fully online through live, face-to-face classes with online course work. The online learning experience facilitates collaboration, meaningful discussion and lifelong connections with faculty and peers. The program is designed for professionals who want to solve real-world problems using complex and unstructured data with an emphasis on the importance of asking meaningful research and business questions while effectively communicating findings.[20]

The BS in Data Analytics from Southern New Hampshire University combines facets of business, information technology and mathematics with data mining, simulation and optimization. By combining this broad range of knowledge, students learn not only to dissect information, but also to put it in context of the challenges that face the world today. SNHU also offer an online MS in data Analytics. focusing on the advanced uses of data analytics across a broad range of industries, this 36-credit online data analytics master's program prepares students to be a strategic asset to any enterprise, from government, retail, IT and security firms to communications and media, finance, healthcare, manufacturing organisations and any other organisation with big potential for big data. Students will learn how to leverage "big data" for competitiveness, risk-assessment, mission-critical decision-making and organisational effectiveness

Statistics.com offers a range of short online courses on many areas relating to data analytics. Some examples include Data Mining: Unsupervised Techniques; Analysis of Survey Data from Complex Sample Designs; Introduction to Predictive Modeling; Applied Predictive Analytics; Statistical Analysis of Microarray Data with R; Modeling Count Data and; Interactive Data Visualization. Most courses are four weeks long, and are scheduled either once or twice a year. The program is designed for professionals who want to solve real-world problems using complex and unstructured data with an emphasis on the importance of asking meaningful research and business questions while effectively communicating findings.

[19] http://online.stanford.edu/course/algorithms-design-and-analysis-part-2
http://online.stanford.edu/course/machine-learning-fall-2013
[20] http://datascience.berkeley.edu/

Table 1: Dedicated Data Analytics Programmes

Course Title	Provider	NFQ Level	Enrolment Numbers	Graduate Numbers
Certificate in Programming for Data Analytics (Springboard)	Institute of Technology Blanchardstown	Level 6 (part-time, 2 semesters) (20 credits)	35	Not applicable (N/A)
Certificate in Social Media and Web Analytics (Springboard)	Institute of Technology, Tralee	Level 7 (1 year part-time) (30 credits)	Academic Year 2013/14 - 8	Academic Year 2012/13 - 38 (includes two intakes to the programme)
Diploma in Business Analytics (Springboard)	NUI Galway	Level 8 1 year (30 credits)	2013/2014 – 15 (50 applications received)	N/A
Higher Diploma in Science in Data Science & Analytics (NFQ level 8 ICT Conversion programme	Cork IT	Level 8 (60 credits)	2013 - 20	N/A
Higher Diploma in Science in Data Analytics (NFQ Level 8 ICT Conversion Programme)	National College of Ireland	Level 8 (60 credits)	56 (started April 2013)	N/A
Higher Diploma in Science in Data Analytics (Springboard Programme)	National College of Ireland	Level 8 (60 credits)	50 started in Sept 2013. A further 50 places allocated from Jan 2014	N/A
Diploma leading to MSc in Data Business	IMI in conjunction with UCC	Level 8/9	23 – Cork 2012/13	N/A
CPD Diploma in Financial Mathematics & Analytics	DIT	Level 8 (part-time) (45 ECTS)	Starting Sept 2013	N/A
BSc in Business Analytics	UCD	Level 8	Expected start date Sept 2015	N/A

BA in Management Science & Information Systems Studies)	Trinity College Dublin: Relevant modules in statistical analysis and data mining – compulsory for final year students	Level 8	2011/2012: 126	2011 graduates: 21
MSc in Computing (Data Analytics)	DIT	Level 9	15 part-time 15 full-time	N/A
MSc in Computing in Data Analytics	DCU	Level 9	New course for 2013/2014	N/A
Master of Science in Computing (Business Intelligence & Data Mining)	Institute of Technology, Blanchardstown	Level 9	2013: 35	-
Professional Diploma in Data Analytics (online course)	UCD School of Mathematical Sciences	Level 9	2013/14: 53 and 9 students from other programmes	N/A
MSc in Business Analytics (conversion) Full-Time	UCD Michael Smurfit Graduate Business School	Level 9	2011: 19 2012: 23 2013: 31	2011: 23
MSc in Business Analytics (conversion) Part-Time	UCD Michael Smurfit Graduate Business School	Level 9	2011: 19 2012: 18 2013: 18	2011: 12
MSc Data Science & Analytics	UCC	Level 9	September 2013/2014: 9	N/A
ME Computer Science & Information Technology (Specialism in Big Data & Analytics)	NUI Galway	Level 9	Commencing September 2014/2015	N/A
MSc in Business Analytics	NUI Galway	Level 9	In the pipeline for 2015/2016 start.	N/A
Total			**500 enrolments**	

Source: Forfás

Table 2: Programmes which include specialisations/modules in data analytics

Course Title	Provider	NFQ Level	Total Numbers Enrolled (all years)	Recent Graduate Numbers
Bachelor of Science in Computing in Applications and Support	Dundalk Institute of Technology: Relevant modules are Data Analysis for Computing	Level 7	2013: 14	90 Graduates between 2005-2012
Bachelor of Science in Computing in Networking and Support	Dundalk Institute of Technology:Relevant modules are Data Analysis for Computing	Level 7	2013: 15	67 Graduates between 2005-2012
Bachelor of Science in Computing in Software Development	Dundalk Institute of Technology: Relevant modules are: Data Analysis for Computing	Level 7	2013: 20	163 Graduates between 2005-2012
BSc (Hons) in Business Information Systems.	National College of Ireland: Relevant Modules are Data Structures, Algorithms, Business Data Analysis & Artificial Intelligence	Level 8	2011/2012: 83 full-time: 47 part-time: 36	2011 graduates: 6 2012: 14
BSc in Computational Problem-Solving and Software Development	DCU: Relevant modules are Data Structures and Algorithms	Level 8	New course in 2013 with 25 places available	N/A
BSc in Enterprise Computing	DCU	Level 8	2011/2012: 211	-
BSc in Computer Applications	DCU: Relevant modules are advanced algorithms and data structures	Level 8	2011/2012: 149	-
BSc in Computer Science & Information Technology	NUIG:Relevant modules are Modern Information Mgt, Machine Learning & Data Mining	Level 8	2013 : 50 average intake	-
Bachelor of Arts in Information Systems Management	GMIT	Level 8 (4 years)	2013: 25 places	-

Higher Diploma in Computing – Big Data specialisation modules (conversion)	DIT	Level 8	2011/2012: March 2013: 50	-
MSc Cloud Computing -	National College of Ireland: Relevant Modules are Data Storage & Management	Level 9	N/A	N/A
MSc in Cloud Computing – Elective in Data Analytics	Cork IT	Level 9	2011/2012: 62	New Course 11/12
MSc in Computer Science - Negotiated Learning.	UCD: Relevant modules are machine learning; network data analysis; data mining techniques & models; numerical algorithms	Level 9	2011/2012: 24	2011 Graduates: 17
MSc Cloud Computing Research	NUIG	Level 9		
MSc in Computing (Information and Knowledge Management)	DIT: Relevant Modules are Programming for Big Data Relevant	Level 9	2011/2012: 21	2011 Graduates: 0
MSc in Computing (Knowledge Management)	DIT	Level 9	2011/2012: full-time 4 part-time 12	2011: 14
MSc in Computing (Advanced Software Development	DIT: Relevant Modules are Programming for Big Data	Level 9	2011/2012: full-time 2 part-time 21	-
MSC in Global Financial Information Systems-	Waterford Institute of Technology: Relevant modules are Data Modelling & analysis; Business Intelligence and Data Warehousing)	Level 9	-	-
Total			**760 enrolments**	

Source: Forfás

Table 3: Core degrees Maths, Statistics and Science (ISCED CODES 400,460,461,462)

ISCED Category	Provider	NFQ Level	2011/2012 Total Numbers Enrolled (all years)	2011 Graduate Numbers
Combined Maths and Statistics (460) Undergraduate Honours Degree	DCU	Level 8	12	35
Mathematics (461) Undergraduate Honours Degree	DCU	Level 8	36	-
Statistics (462) Undergraduate Honours Degree	DCU	Level 8	123	-
Combined Maths and Statistics (460) Postgraduate Certificate	DCU	Level 8	9	9
Mathematics (461) Masters Taught	DCU	Level 9	-	9
Combined Science, Mathematics and Computing (400) Undergraduate Honours Degree	NUI Galway	Level 8	95	23
Mathematics (461) Undergraduate Honours Degree	NUI Galway	Level 8	26	4
Combined Science, Mathematics and Computing (400) – Masters Research	NUI Galway	Level 9	20	18
Mathematics (461) Masters Taught	NUI Galway	Level 9	4	10
Mathematics (461) Postgraduate Diploma	NUI Galway	Level 9	5	4
Combined Science, Mathematics & Computing (400) Undergraduate Honours Degree	NUI Maynooth	Level 8	78	20
Mathematics (461) Undergraduate Honours Degree	NUI Maynooth	Level 8	85	21
Combined Maths and Statistics (460) Undergraduate Honours Degree	NUI Maynooth	Level 8	-	3
Combined Maths and Statistics (460) Masters Research	NUI Maynooth	Level 9	9	3
Mathematics (461) Masters	NUI Maynooth	Level 9	36	22
Mathematics (461) Postgraduate Certificate	NUI Maynooth	Level 8		16

Mathematics (461) Postgraduate Diploma	NUI Maynooth	Level 9	13	18
Statistics (462) Postgraduate Diploma	NUI Maynooth	Level 9	6	2
Mathematics (461) Undergraduate Honours Degree	TCD	Level 8	106	25
Mathematics (461) Masters Research	TCD	Level 9	4	1
Statistics (462) Masters Research	TCD	Level 9	1	-
Combined Science, Mathematics & Computing (400) – Masters taught	TCD	Level 9	6	1
Statistics (462) Postgraduate Diploma	TCD	Level 9	104 (38 part-time)	83
Combined Science, Maths & Computing (400) Undergraduate Honours Degree	UCC	Level 8	3	-
Combined Maths & Statistics (460) Undergraduate Honours Degree	UCC	Level 8	4	12
Mathematics (461) Undergraduate Honours Degree	UCC	Level 8	134	29
Statistics (462) Masters Research	UCC	Level 9	4	6
Combined Science, Maths & Computing (400) Masters Research	UCC	Level 9	-	1
Combined Maths & Statistics (460) Masters Research	UCC	Level 9	-	2
Mathematics (461) Masters Research	UCC	Level 9	-	1
Mathematics (461) Masters Taught	UCC	Level 9	8	12
Statistics (462) Postgraduate Diploma	UCC	Level 9	1 full-time 1 part-time	4
Combined Science, Mathematics & Computing (400) Undergraduate Honours Degree	UCD	Level 8	43	10
Combined Maths & Science (460) Undergraduate Honours Degree	UCD	Level 8	30	7
Mathematics (461) Undergraduate	UCD	Level 8	35	7

Honours Degree				
Statistics (462) Undergraduate Honours Degree	UCD	Level 8	152	26
Mathematics (461) Masters Taught	UCD	Level 9	4	3
Statistics (462) – Masters Taught	UCD	Level 9	5 Full-Time 2 Part-Time	6
Mathematics (461) Postgraduate Certificate	UCD	Level 8	1	
Mathematics (461) Postgraduate Diploma	UCD	Level 9	12 full-time 1 part-time	12
Statistics (462) Postgraduate Diploma	UCD	Level 9	29 full-time 3 part-time	10
Combined Science, Mathematics & Computing (400) Undergraduate Honours Degree	University of Limerick	Level 8	107 full-time 2 part-time	19
Combined Maths & Statistics (460) Undergraduate Honours Degree	University of Limerick	Level 8	19 full-time 2 part-time	4
Statistics (462) Masters Research	University of Limerick	Level 9	2 part-time	3
Mathematics (461) Masters Taught	University of Limerick	Level 9	4	4
Mathematics (461) Undergraduate Honours Degree	DIT	Level 8	98 full-time 93 part-time	28
Mathematics (461) Undergraduate Ordinary/General Degree	DIT	Level 7	7 part-time	1
Mathematics (461) Masters Research	DIT	Level 9	1 part-time	-
Mathematics (461) Masters Taught	DIT	Level 9	16 part-time	4
Total			**1,601 enrolments**	**538 graduates**

Source: Forfás

Table 4: Maths – Graduates 2011 (ISCED 461) – (included in Table 3 above)

Undergraduate Cert/Diploma	Level 7 (Ordinary Degree)	Level 8	Postgraduate Cert/Diploma	Level 9 Masters Taught/Research	Level 10	Total
3	1	114	50	66	19	253

Source: HEA Key Facts and Figures 2013

Table: 5 Statistics – Graduates 2011 (ISCED 462) – (included in Table 3 above)

Undergraduate Cert/Diploma	Level 7 (Ordinary Degree)	Level 8	Postgraduate Cert/Diploma	Level 9 Masters Taught/Research	Level 10	Total
1	0	36	99	15	15	166

Source: HEA Key Facts and Figures 2013

Table 6: Computing – Graduates 2011 (includes numbers from several courses in Table 3)

ISCED Code	Undergraduate Cert/Diploma	Level 7 (Ordinary Degree)	Level 8	Postgraduate Cert/Diploma	Level 9 Masters Taught/ Research	Level 10	Total
Computer Science - 481	112/52	396	1,054	10/185	668	67	2,544
Computer Use - 482	114	151	146	4/43	6	1	465

Source: HEA Key Facts and Figures 2013

Table 7: Engineering – Graduates 2011 (ISCED 52)

Undergraduate Cert/Diploma	Level 7 (Ordinary Degree)	Level 8	Postgraduate Cert/Diploma	Level 9 Masters Taught/Research	Level 10	Total
311/0	1,159	1,236	6/62	400	152	3,326

Source: HEA Key Facts and Figures 2013

Table 8: Physics – Graduates 2011 (ISCED 441)

Undergraduate Cert/Diploma	Level 7 (Ordinary Degree)	Level 8	Postgraduate Cert/Diploma	Level 9 Masters Taught/Research	Level 10	Total
10	33	121	4	22	68	258

Source: HEA Key Facts and Figures 2013

Table 9: Data Analytics Programmes Northern Ireland

PgDip/MSc in Computational Intelligence	University of Ulster, Magee College	Level 9 Full-time – I year Part-time – 2 years Applicants must have gained a degree in computing or a closely related subject.	In recognition of the current shortage in N.Ireland for graduates with advanced computing skills, this course received 40 fee paid scholarships from the NI Department for Employment and Learning (DEL) in 2013.

Source: Forfás

Table 10: Private sector Data Analytics Courses

Course Title	Provider	Duration
Business Statistics	New Horizons in partnership with The Analytics Store	2 Days
The Art of Building Data Mining Models	New Horizons in partnership with The Analytics Store	3 Days
Understanding Statistics for Managers	New Horizons in partnership with The Analytics Store	1 Day
Putting the Data into Predictive Analytics	New Horizons in partnership with The Analytics Store	3 Days
The Art and Craft of Advanced Analytics	New Horizons in partnership with The Analytics Store	3 Days
Analytics for Marketing	New Horizons in partnership with The Analytics Store	1 Day
Data Visualisation	New Horizons in partnership with The Analytics Store	2 Days
BI Enterprise Data Warehousing	Olas	5 Days
Data Analysis and Design	C2 Cork	2 Days
Analysing Data	The Open University	Level 2
Advanced Data Warehousing	Guru Team	3 Days

Source: Forfás

Table 11: Skillnet short courses planned in the Data analytics Skills area for 2014

Course	Network	Course Length	Certified
Big Data Analytics	ICT Ireland Skillnet	3 days	No
Business Analytics with Big Data	ITAG Skillnet	3 days	No
Data Mining for Business Intelligence	ITAG Skillnet	3 days	No
Implementing Big Data Solutions with Hadoop and MapReduce	ITAG Skillnet	4 days	No
Higher Diploma in Science in Data Analytics	Summit Finuas Network	15 days	NFQ Level 8 certified

Source: Skillnet

Table 12: Online Education in Data Analytics

Online Provider	Course
Stanford University	Machine Learning
Stanford University	Introduction to Databases
Stanford University	Introduction to Artificial Intelligence
Stanford University	Model Thinking
Stanford University	Design and Analysis of Algorithms Part I & 2
Berkley School of Information	Master of Information and Data Science (MIDS)
Southern New Hampshire University	BS/MS in Data Analytics
Statistics.com	Certificate in Data Analytics

Source: Forfás

Appendix 1: Examples of Course Outline for Big Data and Data Analytics Related Programmes (From Table 1)

Title	Certificate in Programming for Data Analytics
Provider	Institute of Technology, Blanchardstown
NFQ Level	6 (20 credits)
Duration	2 semesters, part-time
Annual Enrolment	
Description	This course is a first step in equipping graduates to work in the field of data analytics, and so is applicable to a wide range of industry sectors. The course covers skills required to access, query, present and analyse data. Topics include the fundamentals of database design, SQL, an introduction to statistics for data analysis, and base SAS programming. As part of the course, students are invited to sit the SAS Certified Base Programmer for SAS 9 Credential, a recognised industry certification in data analysis.
Key Modules/ Content	Database Fundamentals Statistics for Data Analysis SAS Programming
Website	http://www.itb.ie/studyatitb/bn762.html

Title	Diploma in Business Analytics
Provider	NUI Galway (Springboard)
NFQ Level	8 (30 credits)
Duration	1 year
Annual Enrolment	15
Description	The Diploma in Business Analytics will provide its students with these skills and graduates of this course will be able to: - carry out effective data analysis utilising descriptive and inferential statistics within a business context using the appropriate software; - solve real business problems using generally accepted practices in the field of business analytics; - communicate effectively the results of data analysis to technical and non-technical audiences; - apply analytical thinking techniques, communication, and interaction skills to support decision making and address business Participants will acquire technical skills in business intelligence software (SAP and advanced MS Excel), statistical analysis software (R), programming (Java), and database management
Key Modules/ Content	Students can choose modules from the following options: **Semester 1** Business Intelligence and Analytics Database Systems Management Information Systems Statistics 1 Database Technologies Business Applications Programming Contemporary Project Management Operations Research **Semester 2** Information Systems Security & Ethics Decision Systems & Business Analytics Communications in Organisations Accounting for Management Decisions Cloud Computing Advanced Applications Programming Statistics 2 Decision Modelling & Analysis
Website	http://www.nuigalway.ie/courses/adult-and-continuing-education-courses/businessanalyticsdiploma/

Title	Higher Diploma in Science in Data Science & Analytics
Provider	Cork Institute of Technology (NFQ Level 8 ICT Conversion Programme)
NFQ Level	8 (60 credits)
Duration	1 Year
Annual Enrolment	20
Description	The programme has been designed to reflect the interdisciplinary nature of Data Science, which draws from areas such as of Statistics, Mathematics, Computer Science, Machine Learning, and Business Intelligence. With this in mind, particular care has been taken to ensure the careful development of each of three strands – Statistics & Mathematics, Computer Science, and Data Science - throughout the programme. Furthermore, the programme will provide the learner with the opportunity to integrate and synthesise the learning acquired in each of these fields, and to apply it to real-life problems in the data analytics sphere.
Key Modules/ Content	**Semester 1** Data Science and Analytics Maths Methods and Modelling Data Management Systems Unstructured Data and Visualisation Analytical and Scientific Programming Applied Stats and Probability **Semester 2** Data Mining and Knowledge Discovery Statistical Methods for Big Data Distributed Data Management Data Science Analytics Project Machine Learning (elective) Times Series and Multivariate Analysis (elective)
Website	http://courses.cit.ie/index.cfm/page/course/courseId/1218

Higher Diploma in Science in Data Science & Analytics- Cork Institute of Technology

Programme Outcomes

On successful completion of this programme the learner will be able to:

- Knowledge - Breadth: Demonstrate detailed knowledge and understanding of areas of Mathematics, Statistics, Computer Science and Business Intelligence relevant to the Data Analyst.
- Knowledge – Kind: Demonstrate understanding of the terminology, concepts and theories underlying the Data Science and Analytics field; demonstrate knowledge of the advanced methods and technologies for acquiring, interpreting and analysing big data, with a critical understanding of the appropriate contexts for their use; relate current issues in Data Science to society; understand current knowledge of the field, including current limits of theoretical and applied knowledge.
- Skill Range: Demonstrate mastery of relevant skills and tools in Statistics, Mathematics, Computer Science and Business Intelligence; use these to solve complex problems involving big data sets; interpret and apply appropriate and referenced literature and other information sources; work independently within defined time and resource boundaries; communicate scientific information in a variety of forms to specialist and non-specialist audiences.
- Skill Selectivity: Formulate and test hypotheses; design experiments; appreciate current limits of knowledge in the Data Science field and respond appropriately; think independently and make effective decisions; contribute fully to the day-to-day operations of the Data Science work setting.
- Competence - Context: Apply data analysis skills and technologies in a range of contexts in order to critically interpret existing knowledge and apply in new situations; make and report appropriate decisions in a responsible and ethical manner.
- Competence - Role: Act effectively under guidance in a peer relationship with qualified practitioners; participate constructively in a complex interdisciplinary team environment; plan for effective project implementation; reflect on own practices.
- Competence - Learning to Learn: Learn to act in variable and unfamiliar learning contexts; identify learning needs and undertake continuous learning in the Data Science field; assimilate and apply new learning.
- Competence – Insight: Demonstrate an understanding of the wider social, political, business and economic contexts of Data Science, including an appreciation of the philosophical and ethical issues involved.

Title	Higher Diploma in Science in Data Analytics
Provider	National College of Ireland (NFQ Level 8 ICT Conversion Programme)
NFQ Level	Level 8 (60 credits)
Duration	1 Year (part-time)
Annual Enrolment	50 of which all are part-time
Description	The aim of this programme is to equip students to enter the world of data analytics through building a foundation of strong statistical knowledge, developing problem-solving skills for business analysis, and helping them understand and use business data to deliver better decision-making. This higher diploma will give students the technical skills in areas like statistics, programming, database management and web mining in addition to business skills such as communications. The programme also includes a career bridge module which will build students job seeking and personal career management skills to enable you to enter this new area of job opportunity.
Key Modules/ Content	Semester 1 Introduction to Data Mining Business Analysis and Problem Solving Techniques Business Data Analysis Programming for Big Data Semester 2 Data and Web Mining Advanced Business Data Analysis Communication Skills – Enhance your personal impact Project Career Bridge
Website	http://www.ncirl.ie/Courses/CourseDetails/tabid/258/course/Higher-Diploma-in-Science-in-Data-Analytics-HDSDA/Default.aspx

Title	MSc in Data Science and Analytics
Provider	University College Cork
NFQ Level	Level 9
Duration	1 Year (Full-time) or 2 Years (Part-time)
Annual Enrolment	9
Description	This programme of the Department of Computer Science and the School of Mathematical Sciences provides an education in the key principles of the rapidly developing area of Data Science and Analytics. In addition to the basic computational underpinnings of this field, a sequence of courses in probability and statistics will develop skills in analysis, summarisation and modelling of data. The programme also allows graduates an opportunity, through development of a research portfolio, to investigate the more applied elements of the discipline. At all times the programme stresses the importance of data science, statistics and probability theory as key tools in the analysis of large-scale heterogeneous data.
Key Modules/ Content	Core Modules: - Advanced Information Storage and Retrieval or Introduction to Relational Databases plus Database Design and Administration - Foundations of Statistical Data Analytics - Generalised Linear Modelling Techniques - Advanced Information Storage and Retrieval or Data Mining Electives from: - Optimisation - Programming in Python or Large-Scale Application Development and Integration - Internet Computing - Operations Research and Stochastic Decision Science - Stochastic Modelling Techniques - Analysis of Networks and Complex Systems - Operations Research and Stochastic Decision Science - Multivariate Methods for Data Analysis Dissertation

Title	Diploma/MSc in Data Business
Provider	Irish Management Institute and University College Cork (Developed in partnership with EMC and SAS)
NFQ Level	Level 8 (Diploma)/Level 9 (MSc)
Duration	1 Year (for Diploma) + 1 Year (for MSc)
Annual Enrolment	20-25
Description	The programme is designed as an executive education programme for professionals who have a role in transforming the existing information supply chain of their business or being a change agent in developing a new data business. It is aimed at professionals who have technical experience and want to develop a more business/holistic view of data strategy and non-technical professionals who need to have a strategic understanding to manage data and collaborate with the data analysts.
Key Modules/ Content Diploma MSc	- Data Business Analysis: To equip participants with an understanding of fundamental techniques in quantitative and statistical analysis and their application to practical business situations. - Business Modelling and Innovation Management: To provide participants with techniques to drive and evaluate innovation initiatives. - Enterprise Data Management: To enable participants to understand the role of data management and governance practices, and business intelligence tools in organisational decision making. The Above + - Advanced techniques and topics in the domain of Data Analysis, Data Management and Organisational Agility; - Data Business Project: To provide participants with the opportunity to apply their theoretical knowledge to a substantial data business problem requiring analytical and/or design and/or experimental effort.

Title	MSc in Computing (Data Analytics)
Provider(s)	Dublin Institute of Technology
NFQ Level	Level 9
Duration	1 Year (Full-time) or 2 Years (Part-time)
Annual Enrolment	30 of which 15 are fulltime and 15 part-time
Description	The programme is run jointly by the Schools of Computing and Mathematical Sciences and is designed to create hybrid technologists to work in the growing and important area of data analytics. Hybrid technologists are graduates equipped with deep technical skills (in data management, data mining, probability and statistics, and machine learning), but also with the softer skills (in communications, research and problem solving) required to work effectively within organisations. The programme is based on modular approach leading to qualifications of Postgraduate Certificate, Postgraduate Diploma or MSc.
Key Modules/ Content	In addition to core MSc subjects, specialist modules include: Probability & Statistical Inference Machine Learning Data & Database Design for Data Analytics Data Management Data Mining Visualisation Other electives including: Geographic Information Systems Ubiquitous Computing App Development & Commercialisation Programming for Big Data Dissertation
Website	http://www.dit.ie/postgrad/programmes/dt228adt228bmscincomputingdataanalytics/

Title	MSc in Computing (Majoring in Data Analytics)
Provider(s)	Dublin City University (in collaboration with IBM)
NFQ Level	9
Duration	1 Year (Full-time) or 2 Years (Part-time)
Annual Enrolment	30 of which 15 full-time and 15 part-time.
Description	The Data Analytics major of the M.Sc. in Computing provides students with a deep understanding of the issues, techniques and tools to examine large amounts of raw data in order to extract meaningful conclusions from the information contained in the raw data. The students get acquainted with the challenges of dealing with large heterogeneous data sources and with scientific methods to extract actionable knowledge from these data sources. The programme builds on the expertise of the School of Computing and its participation in the SFI funded Insight Research Centre for Data Analytics Technologies. The programme has been designed in collaboration with IBM and will help graduate students to develop critical IT skills in areas such as urban analysis, consumer behaviour, social networks, sentiment analysis, healthcare, and cyber and network security.
Key Modules/ Content	**Semester 1** Research/Professional Skills , Cloud Architectures Data Man. & Visualisation, Statistical D.A. **Semester 2** Machine Learning, Data Analytics/DM Mat. Model/Comp.Sci Cloud Tech. Project
Website	http://www.dcu.ie/prospective/deginfo.php?classname=MCM See also http://www.dcu.ie/news/2013/jul/s0713s.shtml

Title	MSc in Computing -Business Intelligence and Data Mining (Online)
Provider(s)	Institute of Technology, Blanchardstown
NFQ Level	Level 9
Duration	2 Years (Part-time)
Annual Enrolment	35 of which 35 are part-time
Description	This course, which is delivered online, focuses on the knowledge and skills to select apply and evaluate business intelligence and data mining techniques which discover knowledge that can add value to a company. Students will gain both an in-depth theoretical understanding and practical hands-on experience, including implementing novel and emerging techniques. This course is designed to produce graduates with the knowledge and skills to: Select, apply and evaluate business intelligence and data mining techniques which are focused on discovering knowledge that can be acted on to add value to a company. Bring both an in-depth theoretical understanding, and the practical hands-on experience, to a data exploration and mining project including implementing novel and emerging techniques. Keep abreast of current research and business intelligence related topics.
Key Modules/ Content	Year 1 Business Intelligence, Data Mining Algorithms Data Pre-processing & Exploration Business Intelligence & Data Mining Applications Year 2 Text Mining & Web Content Mining (Elective) Geographical Information Systems Mining (Elective) Multimedia Mining (Elective) Research Project (which can be industry based)

Title	Professional Diploma in Data Analytics (Online)
Provider(s)	University College Dublin
NFQ Level	Level 9
Duration	1 Year
Annual Enrolment	Approx 50
Description	This online course, delivered by the School of Mathematical Sciences, will help students analyse and understand the large data sets that are regularly being created via the huge growth in freely available online information. Data Analytics is a subject at the crossroads between statistics and computer science, and the Online Professional Diploma contains elements of both. We will give students the tools to apply these advanced skills to maximum effect in any work-related environment.
Key Modules/ Content	Core modules: Introduction to Data Analytics Data Programming with R Multivariate Analysis Data Mining
Website	http://www.ucd.ie/online/courses/course-finder/professionaldiplomaindataanalytics/

Title	MSc in Business Analytics
Provider	UCD Michael Smurfit Graduate Business School
NFQ Level	Level 9
Duration	1 Year (Full-time) or 2 Years (Part-time)
Annual Enrolment	50 of which 30 full-time and 20 part-time.
Description	The programme is aimed at graduates from a wide variety of disciplines including Business Studies, Engineering, Computer Science and Maths who would like to use their aptitude for mathematics/computerised problem solving to address business problems. It is a technically focused programme directed at management applications, not a general course about management. This programme is comparable to a Masters degree (typically MSc) in Operational Research (UK) or Operations Research (USA). Students will learn how to use advanced mathematics and quantitative techniques to make effective business decisions that will help enhance companies' performance in an increasingly competitive business environment.
Key Modules/ Content	4 Core Modules: Quantitative Methods Numerical Analytics and Software Project Management and Decision Analytics Applied Probability and Statistics 4 Electives from: Simulation Modelling and Analysis Analytical Business Modelling Network Software Modelling Decision Support and Business Intelligence Data Mining Techniques & Models Dissertation

Appendix 1: Members of the Steering Group for the Forfás / EGFSN Study: Assessing the Demand for Big Data and Analytics Skills in Ireland

Margaret Cox (Chairperson)	Member EGFSN
Vincent Mc Key	IBM
Edel Lynch	Accenture
Paul Forde	Glanbia
Peter Cosgrove	CPL
Conor Murphy	Datahug
Maurice Lynch	Nathean Technologies
Richard Southern	Deloitte
Gerard Lande	Enterprise Ireland
Aidan McCauley	IDA Ireland
Donal Flavin	IDA Ireland
Duncan Cleary	Revenue Commissioners
Grainne Morrisey	Department of Education and Skills
Tim Conlon	Higher Education Authority
Kevin Magee	Vidiro Analytics
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