PhD School - Politecnico di Milano

Regulations of the Ph.D. Programme in:

Data Analytics and Decision Sciences

Cycle XXXIV

1. General Information

PhD School - Politecnico di Milano

PhD Programme: Data Analytics and Decision Sciences

Course start: November 2018

Location of the PhD Programme: Milano Leonardo and Milano Bovisa

Promoter Department:
- Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB)
- Dipartimento di Ingegneria Gestionale (DIG)
- Dipartimento di Matematica (MATE)

Scientific Disciplinary Sectors
- ING-INF/05: Information processing systems
- SECS-S/01: Statistics
- SECS-P/08: Management
- MAT/05: Mathematical Analysis
- ING-IND/35: Business and Management Engineering
- ING-IND/17: Industrial Mechanical Systems Engineering
- ING-INF/06: Electronic and Informatics Bioengineering
- ING-INF/04: Systems and control engineering
- ING-INF/03: Telecommunications

Areas
- Information Technology
- Management
- Statistics

PhD School website: http://www.polimi.it/phd
Ph.D. programme website: https://phd-dads.polimi.it

2. General presentation

The PhD program in Data Analytics and Decision Sciences (DADS) aims at training highly qualified senior data analysts and data managers capable of carrying out research at universities, international institutions, tech and financial companies, regulatory authorities, and other public bodies.

The program stems from the cooperation between three departments - Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB), Dipartimento di Ingegneria Gestionale (DIG), Dipartimento di Matematica (MATE) and the Center for Analysis, Decisions and Society (CADS) at Human Technopole. It gives the enrolled students the opportunity to work in a highly interdisciplinary environment with strong connections to international research centers and private companies. The program provides successful candidates with the opportunity to acquire a high degree of professional expertise in specific scientific and technological fields.

The program lasts three years: upon its successful completion and final exam, candidates will be awarded the title of PhD in Data Analytics and Decision Sciences. The first year is devoted to the courses that build the broad competence and the strong interdisciplinary set of skills required by data analytics. The next two years focus on the development of the Doctoral thesis. Students are required to spend at least one semester in a research institution abroad, taking advantage of the network of international collaborations of the three departments involved in the program.

3. Objectives

The program aims at breeding the next generation of data scientists who will tackle the challenges and the opportunities created by the increasing availability of massive amount of data. These data scientists will be able to capture the relevant aspects of phenomena at play, develop adequate models, supervise the development of analytic pipelines, critically analyze the results, and support the technological transfer.

4. Professional opportunities and job market

Data Analytics and Decision Sciences graduates are equipped with distinctive skills and advanced knowledge that open up career opportunities at universities, international research centers and institutions, R&D departments, regulatory authorities, financial institutions, tech companies, and other public bodies.

5. Enrolment

5.1 Admission requirements

Italian and International citizens can apply. They are requested to have graduated in accordance with the pre-existing laws D.M. 3.11.1999 n. 509, or to have a Master of Science degree in accordance with D.M. 3.11.1999 n. 509, or a Master of Science in accordance with D.M. 22.10.2004 n. 270, or similar academic title obtained abroad, equivalent for duration and content to the Italian title, with an overall duration of university studies of at least five years. The certified knowledge of the English language is a requirement for admission. Please refer to the PhD School website for details. The admission to the programmes will be established according to the evaluation of the candidates' curricula, motivation letters, and an illustrative report about the development of a possible PhD research, which candidates will send contextually with their application to the admission announcement.

5.2 Admission deadlines and number of vacancies

The number of positions is indicated in the Call for admission to the 34th PhD cycle Programmes at http://www.polimi.it/phd

Scholarships both on general and on specific themes are available, in accordance with what is specified in the call for admission. Each year full scholarships are available both for elective (self-selected) research topics and for oriented research topics. Financial support for oriented topics is provided by private companies and research institutions like the Center for Analysis, Decisions and Society (CADS) at Human Technopole. Limited support is also available for research periods abroad and to attend conferences.

6. Contents

6.1 Requirements for the PhD title achievement

The achievement of the PhD title in Data Analytics and Decision Sciences requires a study and research activity of at least three years equivalent of full time study, research and development of PhD thesis.
PhD candidates in Data Analytics and Decision Sciences must earn a minimum of 30 course credits (see paragraph 6.3 below), and to continuously conduct studies and research.

At the beginning of the course, the Faculty Board assigns two tutors to each PhD candidate to supervise and assist him/her in the overall training programme. The tutors shall be professors belonging to the Faculty Board. The tutors assist the candidates in the choice of courses to be included in the study plan, which is eventually submitted for approval to the Coordinator of the PhD Programme (see also section 6.4 below). The Faculty Board may assign extra course credits to one or more candidates, in case they need to complete their preparation in specific topics, relevant for their research projects.

6.2 Research development

The main aim of all Politecnico di Milano PhD programmes is the development in the candidates of a research-oriented mind-set, with expertise and skills in a specific research topic.   To this end, candidates develop a problem-solving capability in complex contexts, including the capacity of performing deep problem analysis, identifying original solutions, and evaluating their applicability in practical contexts. These skills provide the PhD candidates with major opportunities of development in their research both in the academic field, and in public and private organisations. PhD candidates are requested to develop an original research contribution. The PhD thesis must thus contribute to increase the knowledge in the candidate's research field. Besides, it has to be coherent with the research topics developed in the Department where the PhD Programme is carried out. The original research results are collected in the PhD thesis, where the candidate's contribution is put in perspective with respect to the research state of the art in the specific research field. The PhD research is developed under the guidance of a supervisor, who supports the candidate in the setting-out and in the everyday activities related to the thesis development. The supervisor is not necessarily a member of the Faculty Board, and may also belong to an institution different from Politecnico di Milano. The supervisor can be supported by one or more co-supervisors. Further activities intended to develop the candidate's personal skills and research expertise are encouraged during the PhD path. Candidates must acquire the capability to present and discuss their work in their research community. Consequently, both the participation to international conferences and the publication of the research results in peer-reviewed journals are encouraged. The PhD programme favors the candidates' research interactions with other groups in their research field, preferably abroad. Research visits of at least three months are strongly encouraged, as through them the candidates may acquire further skills to develop their research work and thesis. The duration of the program is normally three years, which could be extended under specific conditions.

6.3 Objectives and general framework of the teaching activities

The PhD Programmes and the PhD School activate teaching forms of different kind and credit value, including courses, seminars, project workshops, laboratories. Teaching activities both cover the basic research issues (problems, theories, methods), which represent the founding element of the PhD Programme and identify clearly its cultural position and deepening in a specialist way some research issues connected with the problems developed in the theses. Lessons are usually held in English, except when indicated otherwise. Structured teaching activities allow to earn ECTS credits. Other activities, typically specialized and for which it is difficult to evaluate the learning and its quantification, fall within the scientific activities of which the Faculty Board takes into account in the overall evaluation, but they do not allow to earn ECTS.

Candidates must earn in the first two years a minimum of 30 ECTS credits from courses coherent with their PhD activities. At least 10 credits must be obtained from PhD School Courses on soft and transferable skills proposed by the PhD School. At least 15 credits must be obtained from PhD courses characterizing the PhD program in Data Analytics and Decision Sciences. 5 credits or less may be taken either with PhD courses from other PhD programs or with specialized Summer Schools.
All the mentioned courses should provide an evaluation of the student's performance to assign the corresponding credits. Other activities like attendance to seminars, PhD courses without evaluation, workshops, conferences, and similar, contribute to create the curriculum of the PhD student but do not contribute to the acquisition of ECTS credits. Courses from the Master Degree may also be

inserted in the curriculum of the student, in agreement with the Supervisor and the Tutors, but do not contribute to the acquisition of credits. The Faculty Board may assign extra course credits to candidates, in case they need to complete their preparation in specific topics, relevant for their research projects. The PhD School of Politecnico di Milano proposes a set of courses aiming to train the PhD candidates in soft and transferable skills. The skills and abilities provided by these courses are expected to help candidates across different areas of their careers in order to respond to the rapidly evolving needs of the global economy and society at large. The PhD School courses activated for the 2018-2019 Academic Year are summarized in the following table.

PhD School Courses	Professor
Ethics in Research	Andrea Aliverti
Advanced Interaction Skills for Academic Professional	Michela Arnaboldi
Scientific Communication in English	Paolo Biscari
Complementary doctoral skills	Paolo Biscari
Industrial Skills	Paolo Biscari
Empowering Imagination	Viola Schiaffonati – Simona Chiodo
Issue Mapping	Paolo Ciuccarelli
Resource Planning and Management with Sustainable Development	Emanuela Colombo
Technology and Society	Stefano Crabu
Design thinking	Alessandro Deserti
Professional Communication	Nicoletta Di Blas
Strategic Decision Making	Gianni Ferretti
Project Management Basics	Alfonso Fuggetta
Project Management PMI-CAPM Certification Preparation	Alfonso Fuggetta
Sustain Metrics, Life Cycl Assessment and Environmental Footprint	Monica Lavagna
Innovative Teaching Skills	Giulio Magli
Project Management (in Action)	Mauro Mancini
Ethical Aspetcs of Research on Dual-Use Products	Pierangelo Masarati
Sulla Responsabilità della Tecnica	Paolo Maria Ossi
Science, Technology, Society, and Wikipedia	Guido Raos
Research Skills	Donatella Sciuto
Scientific Models: Conceptual Foundations and Philosophical Issue	Giovanni Valente
The process of research	Paolo Volontè
La diffusione della Ricerca	Anna Maria Paganoni
The ageing society: a challenge for technological and social innovation	Ranci Costanzo Stefania Sabatinelli

At least 10 of the 30 course credits that each candidate is required to earn shall be obtained through soft and transferable skills courses organized by the PhD School.

The tables below summarize the candidate's path (as regards coursework activities). At the same time, the programme foresees that the candidates are devoted to research activity in a continuous way, following the lead of their supervisors, and of the Faculty Board.

First/Second Year (proposal structure to be tailored)

Courses	Details or Reference	Number of credits (min-max)	Note
PhD School Courses	See table and School website	10	
Courses characterizing the PhD Programme		15-20	
Other PhD courses	Summer/Winter Schools Reading Courses Elective Ph.D. courses	0-5	To be agreed in advance with the tutor

Third year
The third year should be devoted entirely to the research and to the development of the PhD thesis.

PhD Course List

A. The PhD Programme in Data Analytics and Decision Sciences organizes the **Characterising Courses** listed in Table A. For the admission to the final exam the acquisition of at least 15 credits in this list is **mandatory**.
B. The PhD School of Politecnico di Milano proposes a set of courses aiming to train the PhD candidates in soft and transferable skills. The skills and abilities provided by these courses are expected to support candidates across different areas of their careers in order to respond to the rapidly evolving needs of the global economy and society at large. The acquisition of **at least 10 credits** from these courses is **mandatory** within the first two years. The PhD School courses activated for the 2018-2019 Academic Year are listed in the following table, and on the web site: http://www.dottorato.polimi.it/en/during-your-phd/phd-school-courses
C. A maximum of 5 ECTS can be obtained by choosing among courses provided by other PhD programmes at Politecnico di Milano and/or external Institutions. These courses must be agreed in advance with the tutor. A listed of pre-approved courses is listed in Table B.

PREPARATORY COURSES
If the supervisor and the tutor find it useful or necessary, that the candidate attends preparatory courses (chosen among the activated courses at the Politecnico di Milano) the Faculty Board of the PhD programme may assign some extra-credits to be acquired to complete the training path. The credits acquired in this way will be considered as additional, in relation to the mandatory credits to be acquired with the PhD courses.

SPECIALISTIC COURSES, LONG-TRAINING SEMINARS
The attendance of Specialist Courses, Workshops, Schools, Seminars cycles is strongly encouraged and (if these seminars, workshops are certified and evaluated) may permit to acquire credits according the modalities established by the Faculty Board and previous approval of the study plan submitted by the candidate. These courses and workshops can be inserted in the study plan, even if they are not evaluated (and therefore not qualified as credits), as optional "additional teaching".

The scheduled course planning for the academic year 2018-2019 follows. Other courses may be activated during the year. In this case the candidates will be promptly informed and will be allowed to insert these new courses in their study plan.

Table A: PHD COURSES CHARACTERISING THE PHD PROGRAMME

SSD	Name of the Course	**Professor**	A.A./Semester	Language	Credits
INF-INF/05	Data and Results Visualization	Daniele Loiacono	May 2019	English	5
ING-INF/05	Data Management for Large-scale Analytics	Marco Brambilla	January 2019	English	5
SECS-P/08	Interdependencies and Aggregation in Socio Economic Systems	Fabio Pammolli	February-April 2019	English	5
SECS-S/01	Statistical Inference for the Information Age	Piercesare Secchi	January-March 2019	English	5

Table B SUGGESTED CROSS –SECTORAL COURSES

SSD	Name of the Course	Professor	Language	Credits
ING-INF/05	Advances in Deep Learning with Applications in Text and Image Processing	Matteo Matteucci, Giacomo Boracchi, Alessandro Giusti	English	5
ING-INF/05	Complex Network	Danilo Ardagna, Ana Paula Couto da Silva	English	5
ING-INF/05	Stream and Complex Event Processing in the Big Data Era	Alessandro Margara, Gianpaolo Cugola, Emanuele Della Valle	English	5
MAT/08	Python per il calcolo scientifico	Miglio	English	5
SEC-S/06	Machine learning in finance	Marazzina, Restelli	English	5
SECS-S/01	Statistical methods in healthcare research - tailored techniques for the analysis of complex and massive data in healthcare	Ieva	English	5
SECS-P/05	Advanced topics in Econometrics	Mosconi	English	5
ING-IND/17	Modelling and analysis of complex systems	Macchi	English	5
ING-IND/35	Survey and Experimental research methodologies	Cagliano	English	5

6.4 Presentation of the study plan

PhD candidates must submit a study plan, which may be revised periodically (approximately every three months), in order to adequate them to possible changes in the course list, or to needs motivated by the development of their PhD career. The study plans must be approved by the PhD programme Coordinator, according to the modalities established by the Faculty Board of the PhD Programme itself.

6.5 Yearly evaluations

Candidates present their work to the Faculty Board at least once a year. In particular, the candidates must pass an annual evaluation in order to be admitted to the following PhD year. The third year evaluation establishes the candidate's admission to the final PhD defense. As a result of each successful annual evaluation, the candidates receive an evaluation (A/B/C/D). Candidates who do not pass the exam will be qualified as "Repeating candidate" (Er) or "not able to carry on with the PhD (Ei)". After the final year, candidates who have achieved sufficient results but need more time to draw up their theses, may obtain a prorogation of up to 12 months.

6.6 PhD thesis preparation

The main objective of the PhD career is the development of an original research contribute. The PhD thesis is expected to contribute to the advance of the knowledge in the candidate's research field. The PhD study and research work is carried out, full time, during the three years of the PhD course. Stages or study periods in (Italian or International) companies or external Institutions may complete the candidate's preparation. The resulting theses need to be coherent with the research issues developed in the Department where the PhD programme is developed. The candidate must present an original thesis, discuss its contribution to the state of the art in the research field in the research community. The PhD research is developed following the lead of two supervisors, who support the candidate in the setting out and in the everyday activities regarding the thesis development. At the conclusion of the PhD studies, the Faculty Board evaluates the candidates. Candidates who receive a positive evaluation submit their theses to two external reviewers for refereeing. If the evaluation provided by the reviewers is positive (o after the revisions required by the external reviewers), the candidates defend their thesis in a final exam, in front of a Committee composed of three members (at least two of which must be external experts).

7. PhD Secretary Services

The secretary service of the PhD programme can be reached by at phd-dads@polimi.it

8. Internationalization and inter-sectoriality

Carrying out study and research activities at external laboratories is strongly recommended. Politecnico di Milano supports joint PhD paths with International Institutions, as well as Joint and Double PhD programmes. Further information is available on the PhD School website and on the PhD programme website.

More specifically, the PhD programme in Data Analytics and Decision Sciences collaborates with the Center for Analysis Decisions and Society (CADS) an international research center dedicated to the elaboration and analysis of the analyzing high-throughput data provided by the Human Technopole. Interaction with and exposure to non-academic sectors provides significant benefits to doctoral candidates as well as to research and innovation intensive employment sectors. Direct exposure to the challenges and opportunities in non-academic sectors of the economy and society at large is fostered by networking, connectivity, inter-sectoral mobility and wide access to knowledge.

Attachment A1 – PhD Programme Coordinator

Pier Luca Lanzi is full professor at Politecnico di Milano, Dipartimento di Elettronica, Informazione e Bioingegneria, School of Industrial Engineering and Information. He has been working in the area of Data Mining since 1995 when he did an internship in the Data Mining group of CSELT laboratories. He received his PhD in 1999 with a thesis on Genetics-Based Machine Learning. His research interests include data mining, machine learning, and data-driven game design. He published several papers on international journals and conferences. He has been the editor in chief of ACM SIGEvolution from 2006 to 2014. He is associate editor of Applied Soft Computing (Elsevier) and of the Evolutionary Computation Journal (MIT Press). He was in the board of Evolutionary Intelligence (Springer) and associate editor per la IEEE Transactions on Computational Intelligence and AI in Games from 2008 to 2017. He participated to several national and international projects and served as general chair of the 2009 IEEE Symposium on Computational Intelligence and Games (IEEE CIG- 2009) and the 2011 ACM Genetic and Evolutionary Computation (ACM GECCO-2011).

Attachment A2 – PhD Faculty Board

Description of the composition of the Faculty Board

Name	Affiliation	Scientific Disciplinary Sector
Lanzi Pier Luca (coordinator)	DEIB	ING-INF/05
Azzone Giovanni	DIG	*ING-IND/35*
Caiani Enrico Gianluca	DEIB	ING-INF/06
Ceri Stefano	DEIB	ING-INF/05
Guerini Massimiliano	DIG	ING-IND/35
Ieva Francesca	MATE	SECS-S/01
Mangiaracina Riccardo	DIG	ING-IND/17
Matteucci Matteo	DEIB	ING-INF/05
Pammolli Fabio	DIG	SECS-P/08
Punzo Fabio	MATE	MAT/05
Roveri Manuel	DEIB	ING-INF/05
Secchi Piercesare	MATE	SECS-S/01
Spagnolini Umberto	DEIB	ING-INF/03
Tubaro Stefano	DEIB	ING-INF/03
Vantini Simone	MATE	SECS-S/01
Tanelli Mara	DEIB	ING-INF/04