



UNIVERSITA' DEGLI STUDI DI MILANO
PROGRAMME DESCRIPTION - ACADEMIC YEAR 2024/25
MASTER DEGREE
DATA SCIENCE FOR ECONOMICS (Classe LM-data)
Enrolled from 2022/23 academic year

HEADING

Degree classification - Denomination and code:	LM Data
Degree title:	Dottore Magistrale
Length of course:	2 years
Credits required for admission:	180
Total number of credits required to complete programme:	120
Years of course currently available:	1st , 2nd
Access procedures:	Open, subject to entry requirements
Course code:	B79

PERSONS/ROLES

Head of Interdepartmental Study Programme

Prof. Stefano Montanelli

Tutors - Faculty

Prof. Alfio Ferrara (Academic guidance tutor)
Prof. Luca Rossini (Academic guidance tutor)
Prof. Dario Malchiodi (Erasmus and international mobility tutor)
Prof. Domenico Massaro (Erasmus and international mobility tutor)
Prof. Matteo Zignani (Internship tutor)

Degree Course website

<https://dse.cdl.unimi.it/en>

Didactic Secretariat

18, Via G. Celoria, Milan <https://informastudenti.unimi.it/saw/ess?AUTH=SAML>

Disability Referee

Prof.ssa Silvia Salini

Student Registrar

Via Santa Sofia 9 Phone +39 02 5032 5032 <https://www.unimi.it/en/study/student-services/welcome-desk-informastudenti>

CHARACTERISTICS OF DEGREE PROGRAMME

General and specific learning objectives

The master degree course in Data Science for Economics (DSE), entirely delivered in English, aims to provide advanced education on methodological methods and tools in computer science, statistics, and mathematics designed to interpret and analyze complex phenomena in the fields of economics. The course of study offers advanced skills through the study of emerging information technologies about data management and scalability of analysis systems in cloud environments, advanced statistical and mathematical techniques, as well as machine learning techniques for information extraction and classification. Furthermore, the course addresses topics about economic theory, decision theory under conditions of uncertainty, econometrics, and time-series analysis. The graduates of the DSE MSc program will receive advanced education on methodologies and tools in computer science, quantitative and methodological notions to interpret and analyze economic phenomena using approaches that integrate business, market and social media data. Among these, the MSc program focuses on the analysis of the effects of economic policies as well as the evaluation of actions and any other activity related to the sectors of economy, marketing and business.

The DSE course bolsters the construction of solid methodological bases by addressing topics of the economic theory, decision theory under uncertainty conditions, micro-econometric techniques and time-series analysis. It also fosters the study of emerging data management technologies and scalability of analysis systems in cloud environments, as well as machine learning techniques for the extraction and classification of information.

In addition to these compulsory activities, the DSE course allows students to autonomously customize/specialize the study plan according to their own inclinations, by choosing elective courses up to 18 ECTS in total between two different educational paths, namely the "Data Science" path and the "Economic Data Analysis" path. A first kind of specialization focus is about the aspects of methodological and technological innovation, advanced statistical methods, techniques of social media analysis and textual analysis as well as their impact on the data-driven business. A further kind of specialization offers useful tools for economic applications in the area of policy or investment assessment, the study of production processes, and the evolution of social phenomena.

These specialization activities are geared, together with the external training activities, to the preparation of the dissertation and to the final exam. Therefore, the dissertation is considered as the fulfilment of the course of study and the learning process began with the choice of the educational path.

The courses of DSE, both compulsory and elective, include lectures and laboratory classes as well as autonomous project activities and individual activities to guarantee an adequate preparation also from a practical point of view, in close contact with case studies and real data.

The in-depth studies in mathematics, statistics, computer science and economics highly qualify the educational project of Data Science for Economics and they also pave the way to students interested in PhD and research programs in the areas of Data Science, Computer Science, and Economics.

Expected learning outcomes

- Knowledge and comprehension skills

Data Science for Economics master's degree course aims to train specialists capable of using mathematical statistical-computer techniques in the economic field, by pursuing the following educational objectives: understanding the mathematical tools relevant to tackle data science problems; understanding the theory and the methodological-operational aspects of statistics and probability; understanding the theory, the methodological aspects, and the tools of the computer science discipline; understanding the methodological-operational aspects of the economic theory (at micro and macro-economic level) and of the statistical-econometric methods; understanding the aspects relative to business, management and company organization; understanding the essential elements of data protection legislation and privacy risks stemming from release/disclosure of public and semi-public data.

- Application of knowledge and comprehension skills

Knowledge and comprehension skills are provided mainly through lectures, along with seminars, practice drills/exercises and focus groups, as well as through autonomous and guided individual study. The achievement of the learning results are assessed through oral and/or written exams, as well as by evaluating written reports drafted individually or in team. Data Science for Economics Master's Degree aims to provide practical capabilities in order to identify, analyse, and spot issues pertaining data and their analysis; tackle and solve problems linked to data management and storage; process data by using complex software tools; be able to define autonomously algorithms and data processing programs; devise mathematic models, both deterministic and stochastic ones, as well as develop original calculus codes for data analysis; master a full awareness of economic data nature; be able to interpret economic data analysis outcome with expertise and ability to understand its effects. Practice exercises, as supplement to all the lectures, play a crucial role in terms of achievement and validation of the ability to put in practice the knowledge and comprehension acquired. Students are expected to broaden and deepen knowledge thus acquired through participation in: laboratories and workshops, many of which offered by companies and organizations; seminars chaired by external experts; internships or curricular internships; by consulting bibliographic material and carrying out their thesis work.

- Making judgments

DSE graduates will also develop the following skills: i) ability to read and critically evaluate data analysis results, technical and scientific reports and articles containing data; ii) problem analysis (both theoretical and practical) and focus on key points to develop the solution; iii) ability to solve economic problems through effective data mining/acquisition, and/or data processing, and/or data modeling procedures, in light of the most advanced technologies, knowledge and methodologies; iv) work in group abilities in research groups or in interdisciplinary contexts. Data Science for Economics Master's Course aims to foster students' autonomy by focusing on autonomous judgment and critical thinking skills both during the evaluation of the problems considered, and during the elaboration of the results. To that end, student will have to face theoretical and practical problems, aimed to involve skills related to key points detection, solutions modelling, choice of suitable tools and techniques for the resolution of these problems, and the analysis of the results. The achievement of all these skills are put to test throughout economics and corporate classes, through presentation and discussion of case studies.

Lastly, students will also participate in group works, and will be involved in interdisciplinary research activities to develop proactive and collaborative mindset/attitude.

- Communication skills

DSE graduates will be capable of: i) presenting, discuss and effectively communicate in a clear form (written or oral) their work results (e.g. projects, reporting, document analysis) within the company or institutions they take part in, along with their positions/opinions based on evidences supported by data; ii) setting up cooperative and collaborative relations within work groups, and adopting new communication tools. In particular, graduates will develop the following skills: i) ability to present a problem pertaining data and its resolution procedure by using suitable language and terms; ii) ability to effectively report data analysis/his job results to personnel and potential stakeholders unfamiliar with data; iv) ability to report data, as well as its management and the results of their analysis by use of the new communication, information, and education

technologies.

Communication skills in working contexts is firstly achieved throughout the presentation and discussion of case studies. The application of quantitative methods and computer/IT techniques within economic courses enable the ability of students to employ information and empirical patency/facts in support of its estimations within working contexts. Moreover, DSE courses include drafting reports, projects or short papers activities; these, along with the thesis draft, allow students to enhance their written communication skills.

Active participation in exercises and professional laboratories, as well as carrying out internships in companies, represent opportunities to develop relational competencies. Communication skills are put to test throughout work groups and exams, as embedded in the total/overall score, specifically within courses in which communication is considered among the educational goals. Even thesis drafting and dissertation provide further elements of evaluation.

- Learning Skills

DSE graduates will learn to consult scientific publications, databases and other online sources. Methodological skills enhanced throughout the Master's course will facilitate the learning skills, useful both for undertaking a professional path individually, and to cover management role in research institution, as well as for pursuing the studies through 2nd level Postgraduate Specialization or in PhD programs. Specifically, graduates will develop the following skills: i) ability to conduct bibliographic researches to analyse the progress status of the research basing on data tools and models; ii) ability to detect an open problem related to data and suggest a strategy to solve it; iii) ability to constantly update skills and competencies, in order to adopt it in multiple contexts, also different from work; iv) ability to evaluate the effectiveness of the approaches learned or even different ones to new areas of interest.

The multidisciplinary of DSE Master's Course fosters learning abilities, providing students opportunities to relate methodological approaches to different disciplines. The significant quantity of economics and computer science courses, which provide methodological skills and formal analysis techniques, facilitate the learning of a scientific approach oriented to the problem solving.

Furthermore, students will be delivered activities consisting in reading and evaluating technical-scientific reports and articles to assess learning skills in relation to the most recent scientific literature. Such skills will be assessed through open question in exams, and in some cases through the evaluation of small projects or written papers.

Professional profile and employment opportunities

The MSc program in Data Science for Economics aims to train the following professional figures:

Profile: Data Scientist

Functions: its main functions are i) to analyze and elaborate forecasts on large data flows, ii) to identify and apply the most suitable software tools and statistical techniques for their processing, iii) to create complex models for predictive data-based analysis. The Data Scientist knows the different contexts in which data emerge and she/he knows how to interact with experts from various disciplines.

Skills: statistical analysis, programming, knowledge of software tools.

Outlets: large companies, small and medium-sized enterprises, startups and Public Administration. They can work in manufacturing, telco and media, services, banking-insurance, utilities sectors.

Profile: Data Analyst

Functions: its main functions are the identification and supervision of operational decision-making processes in direct coordination with the company executive management. They can work in marketing, business, management innovation, and finance.

Skills: baggage of theoretical knowledge about economics, statistics and computer science to support both organizational and development decisions of economic institutions and companies.

Outlets: large companies, small and medium-sized enterprises and consulting firms operating in various sectors such as manufacturing, telco and media, services, banking-insurance, utilities.

Profile: Data Driven Economist

Functions: its main functions are to frame problems of economic analysis in the context of data science by identifying data and technologies capable of providing new keys to interpret or to evaluate economic and social phenomena.

Skills: economic theory, statistical, econometric and computer science techniques.

Outlets: large companies, Public Administration and international organizations.

Profile: Data-Driven Decision Maker

Functions: the professions included in this category perform managerial functions of high responsibility in private and public companies with an international vocation and a strong technological component, using data analysis to guide strategic and operational decisions.

Skills: wealth of theoretical knowledge about economics, statistics and computer science to support organizational and development decisions of economic institutions and companies.

Outlets: small and medium enterprises, large companies, Public Administration.

Profile: Analyst of development projects or economic policies

Functions: the professions included in this category contribute to the formulation, monitoring and analysis of development

projects or economic policies.

Skills: baggage of theoretical and operational notions in the field of economics, business management strategy, and the economic policies that govern them.

Outlets: they work in private or public companies in industry, commerce, business services, personal services, and companies of similar kind as well as international and/or governmental institutions.

Initial knowledge required

1. Curricular requirements

Candidates for admission to the master's degree course may come from various bachelor's, but must have earned at least 30 ECTS in computer science and mathematics (scientific disciplinary sectors: from MAT-01 to MAT-09, INF-01, ING-INF/05) and/or in the area of economic sciences and statistics (scientific disciplinary sectors: SECS-S/01, SECS-S/02, SECS-S/03, SECS-S/06, SECS-P/05, SECS-P/01, SECS-P/02, SECS-P/03, SECS-P/07, SECS-P/08, SECS-P/10).

Curricular requirements must be met by the date of effective submission of the application for admission.

2. Proficiency in English

Proficiency in English at a B2 level or higher per the Common European Framework of Reference for Languages (CEFR) is required for admission.

The B2-level requirement will be ascertained by the University Language Centre (SLAM) upon admission as follows:

- Language certificate of B2 or higher level issued no more than three years before the date of admission application. You will find the list of language certificates recognized by the University at: <https://www.unimi.it/en/node/39322>. The certificate must be uploaded when submitting the online application;

- English level achieved during a University of Milan degree programme and certified by the University Language Centre (SLAM) no more than four years before the date of admission application, including levels based on language certificates submitted by the applicant during their Bachelor's degree at the University of Milan. In this case the process is automatic, the applicant does not have to attach any certificates to the application;

- Placement test administrated by the University Language Centre (SLAM) according to the calendar published on the website: (<https://www.unimi.it/en/node/39267/>)

All those who fail to submit a valid certificate or do not meet the required proficiency level will be instructed during the admission procedure to take the placement test.

Applicants who do not take or pass the placement test will be required to obtain a language proficiency certificate recognized by the University (see <https://www.unimi.it/en/node/39322>) and deliver it to the SLAM via the InformaStudenti service by the deadline fixed for the master's programme (<https://www.unimi.it/en/node/39267/>).

Applicants who do not meet the requirement by said deadline will not be admitted to the master's degree programme and may not sit any further tests.

3. Personal competencies and skills: assessment criteria

Minimum curricular requirements cannot be considered as a verification of personal competencies and skills, which is mandatory. Admission is conditional and it depends on the assessment of the personal competencies and skills of the student provided by the Admission Board, whose members are appointed by the Faculty Board-Collegio Didattico.

Assessment of personal competencies and skills will be ascertained through a written online admission test, held in English language. A more detailed description of the test content and how the test will be structured and organised will be made available on the degree course website close to the opening of admissions. Candidates who do not sit or reach the minimum level required from the Admission Board in the admission test will not be admitted to the master's degree programme and cannot sit further tests.

For candidates who both meet the curricular requirements and reach the minimum level in the admission test, assessment of personal competencies and skills is based on the academic curriculum (quality of the previous degree as well as the average grade obtained in the bachelor program; grades obtained in mathematics, statistics, computer science and economics courses are part of the evaluation) and choice coherence (coherence between the academic curriculum and/or the activities previously carried out by the student and the learning objectives of the MSc in Data Science for Economics).

The Admission Board also reserves the possibility to request the applicant an oral interview (i.e., via Teams, Skype, Zoom or other platforms). The oral interview aims to verify the individual knowledge and skills required by DSE. A complete, detailed list of topics that can be asked during the interview is published on the DSE website. Students with a foreign qualification are also required to ascertain the basic requirements equivalent to the minimum requirements for students with an Italian qualification.

The DSE program also reserves the right to evaluate the possible definition of a planned maximum number of students, determined each year by the competent academic bodies, on the basis of structural, instrumental, and personnel resources available for the functioning of the degree course.

To obtain the degree, those who do not hold an Italian high school diploma or bachelor's degree must demonstrate proficiency in Italian at the A2 or higher level per the Common European Framework of Reference for Languages (CEFR). This level must be demonstrated prior to completing the course programme in one of the following ways:

by submitting a certificate of A2 or higher level issued no more than three years prior to the date of submission. You will

find the list of language certificates recognized by the University at: <https://www.unimi.it/en/node/349/>). The language certificate must be submitted to the University Language Centre (SLAM) via the Language Test category of the InformaStudenti service: <https://informastudenti.unimi.it/saw/ess?AUTH=SAML>; via an entry-level test administrated by SLAM that can be taken only once and is compulsory for all students who do not have a valid language certificate. Those who fail to reach A2 level will have to attend one or more than one 60-hour Italian course(s) geared to their level. Those who do not take the entry-level test or fail to pass the end-of-course test after six attempts will have to obtain language certification privately in order to earn the 3 credits of Additional language skills: Italian.

Compulsory attendance

No obligation, strongly recommended.

Internship criteria

There are 3 compulsory ECTS addressed for a training internship or external internship.

Degree programme final exams

Having earned at least 105 credits for the learning activities expected by her/his study plan and a minimum of 3 credits for internship, a student can be admitted to undertake the final exam leading to the award of the Master's degree. The final exam consists in a public discussion in front of a committee of a master's dissertation. The master's dissertation is an original piece of work, written by the candidate under the guidance of a supervisor. A total of 12 credits is reserved to the design, preparation and writing up of the master's dissertation. The formal assignment of these credits is possible only when the dissertation is completed and the final exam is passed.

EXPERIENCE OF STUDY ABROAD AS PART OF THE TRAINING PROGRAM

The University of Milan supports international mobility by providing its students with the opportunity to spend study and internship periods abroad. It is a unique chance to enrich your educational path in a new exciting environment.

The agreements entered into by the University with over 300 universities from the 27 EU member countries under the European Erasmus+ programme allow regularly enrolled students to carry out part of their studies at one of the partner universities or to undertake internships at companies, training and research centres and other organizations.

Similar international mobility opportunities are provided outside Europe, through agreements with a number of prestigious institutions.

Study and internships abroad

One of the most effective policies adopted by European Union in the last years has been the internationalization of higher education. The various Erasmus programmes that have been implemented since the nineties have greatly increased the mobility of European students. Being a brand-new programme with an internationally oriented educational core strategy, DSE promotes a wide internationalization of their students, and therefore strongly encourages them to spend part of their studies abroad in Erasmus+ Programmes. Erasmus+ provides opportunities to study, train, gain work experience and skills in different locations such as Germany, Denmark, French and many others. Students can go abroad from 3 up to 12 months (including a complementary traineeship period, if planned), and may receive additional grants for studying or training. At the end of their foreign stay, students get full recognition of completed activities in terms of credits for their degree. Student mobility is carried out in the framework of prior "inter-institutional agreements" between the sending and receiving institutions. Students can also join the traineeship programme (Placement), by going abroad from 2 up to 12 months, starting their traineeship from the first year of study. For a traineeship which is an integral part of the curriculum, the sending institution must give full academic recognition for the period spent abroad. For a traineeship that is not part of the curriculum of the student, the sending institution shall at least provide recognition by recording this period in the Diploma Supplement or, in the case of recent graduates, by providing a traineeship certificate. Traineeship may also be established with private and public companies, educational or research centers other than the hosting institution, especially in the field of finance.

Students can apply to the double-degree program with the "Data Science and Business Analytics - (120 ECTS)", a master-program jointly organized by the Faculty of Economic Sciences, University of Warsaw. Detailed information on the agreement, how to apply, and joint curricula can be found at <https://dse.cdl.unimi.it/en>

How to participate in Erasmus mobility programs

The students of the University of Milan can participate in mobility programmes, through a public selection procedure. Ad hoc commissions will evaluate:

- Academic career
- the candidate's proposed study programme abroad
- his/her foreign language proficiency
- the reasons behind his/her application

Call for applications and informative meetings

The public selection for Erasmus+ mobility for study generally begins around February each year with the publication of a call for applications specifying destinations and requirements. Regarding the Erasmus+ Mobility for Traineeship, the

University of Milan usually publishes two calls a year enabling students to choose a destination defined by an inter-institutional agreement or to find a traineeship position on their own.

The University organizes informative meetings to illustrate mobility opportunities and rules for participation.

Erasmus+ scholarship

The European Union grants the winners of the Erasmus+ programme selection a scholarship to contribute to their mobility costs, which may be supplemented by the University funding for disadvantaged students.

Language courses

Students who pass the selections for mobility programmes can benefit from intensive foreign language courses offered each year by the University Language Centre (SLAM).

<https://www.unimi.it/en/node/8/>

Learn more at <https://www.unimi.it/en/node/274/>

For assistance, please contact:

International Mobility Office Via Santa Sofia 9 (second floor)

Tel. 02 503 13501-12589-13495-13502

Contacts: InformaStudenti

Student Desk booking through InformaStudenti

1st COURSE YEAR Core/compulsory courses/activities common		
Learning activity	Ects	Sector
Coding for Data Science and Data Management	12	(6) SECS-S/01, (6) INF/01
Data-Driven Economic Analysis	12	(6) SECS-P/05, (6) SECS-P/02, (6) SECS-P/01
Dynamic Economic Modeling	9	SECS-P/01
Machine Learning and Statistical Learning	12	(6) SECS-S/01, (6) INF/01
Statistical Theory and Mathematics	12	(6) SECS-S/01, (6) MAT/08
Total compulsory credits		57
2nd COURSE YEAR Core/compulsory courses/activities common		
Learning activity	Ects	Sector
Cybersecurity and Protection of Personal Data: Legal and Policies Issues	6	IUS/09, IUS/20
Privacy, Data Protection and Massive Data Analysis in Emerging Scenarios	12	INF/01
Total compulsory credits		18
Elective courses		
3 activities among the selected path		
Total 18 credits/ects		
DATA SCIENCE PATH		
(3 courses chosen from the following, no more than 1 among those indicated with the symbol *)		
Advanced Multivariate Statistics	6	SECS-S/01
Bayesian Analysis	6	SECS-S/01
Functional and Topological Data Analysis	6	MAT/06
Marketing Analytics*	6	SECS-P/08
Network Science	6	INF/01
Project Management and Innovation*	6	SECS-P/10
Reinforcement Learning	6	INF/01
Text Mining and Sentiment Analysis	6	INF/01
Time Series and Forecasting**	6	SECS-P/05
ECONOMIC DATA ANALYSIS PATH		
(3 courses chosen from the following, at least 2 of those indicated with the symbol **)		
Advanced Multivariate Statistics	6	SECS-S/01
Bayesian Analysis	6	SECS-S/01
Causal Inference and Policy Evaluation**	6	SECS-P/01
Experimental Methods and Behavioural Economics**	6	SECS-P/01
Text Mining and Sentiment Analysis	6	INF/01
Time Series and Forecasting**	6	SECS-P/05
Further elective courses		
Students must earn 9 credits for elective activities (courses/laboratories).		
Students with Italian qualification must earn 3 credits as Transversal Skills (please check		

https://www.unimi.it/en/study/bachelor-and-master-study/following-your-programme-study/soft-skills). As alternative, students can select a laboratory ascribed as Transversal Skill as well (please check https://dse.cdl.unimi.it/en/courses/laboratories). Students with a foreign qualification must earn 3 credits as Additional Language skills: Italian (please check https://dse.cdl.unimi.it/en/courses/italian-language-foreigners-tests-and-courses), instead of Transversal Skills.		
Additional Language Skills: Italian (3 ECTS)	3	ND
Students must earn 3 credits by selecting one of the following alternatives: - Internship or stage in companies, public or private bodies, professional orders; - Training and orientation internship.		
<i>End of course requirements</i>		
Final Exam	12	NA
Total compulsory credits	12	

COURSE PROGRESSION REQUIREMENTS

none