UCLouvain

DATS2M

2024 - 2025

Master [120] in Data Science : Statistic

DATS2M - Introduction

Introduction

Introduction

The digitalization is at the origin of the considerable increase of available data. From then on, most of the actors of the society rely on an analysis of these data to objectify their decision-making and develop their disciplinary axes. From these specific needs, we attend to the emergence of new jobs oriented to "data".

The Master's degree in Data Science proposes a training in scientific methods and technological tools to answer societal or scientific questions by processing data that are often massive ("Big Data"). This discipline requires associating a model structured by the problem of interest, with computer sciences, statistics and mathematics to bring a rigorous, quantitative and operational solution to the asked question. An IT infrastructure and algorithms of complex calculations also complement these scientific methods to allow the data structuring and processing.

The fields of application of data sciences are extremely varied: the political and security decision taking, the real time on-line advertising, the e-commerce, the data processing of network, the processing of financial data or industrial production, the biomedical research based on o-mics data or of imaging.

Your profile

You hold an undergraduate diploma or a Master's degree and you have acquired solid skills and the taste for the three pillars of the sciences of the data: the mathematics, the statistics and the computing as well as a curiosity for the fields of application of these disciplines.

You master technical English and are capable of attending class, reading scientific documents, to draft reports and to express you orally in this language. You have general skills and necessary personal qualities to approach a diploma of scientific Master's degree such as of the autonomy, a critical mind, the rigor, a capacity of auto-apprenticeship and to look for or to deal with the information.

A block of additional courses (of maximum 60 credits) is proposed to students having no all these skills.

Your future job

Your diploma of Master's degree in Data Science, statistical orientation, prepares you for positions of "data scientist", "data analyst", "data and analytics manager" or simply "statistician" and prepares to set of responsibility in these domains.

Your programme

The Master's degree in Data Science, declined in two orientations, leans on the following four common pillars:

- Statistical inference and modelling.
- Learning theory, Data mining and visualization of large-dimension data.
- The industrial aspects and the business of data sciences and data analytics.

The "Statistical" orientation offered by the LSBA (Louvain School in statistics, biostatistics and actuarial sciences) proposes, in complement to these four common pillars, a training more specialized in useful statistical methods for data sciences and a strong opening towards the implementation of tools in various fields of application, in management, finance and human sciences.

The Louvain School of Engineering (EPL) offers a second orientation, which complements the four common pillars with a specialization in "Information technology" via two options in "Computer systems" and "Digital methods and optimization".

Your parcours

You will develop firstly interdisciplinary fundamental skills, solid and deepened to be capable of approaching a wide spectrum of problems in data science. You will also be able to bring to a successful conclusion projects or of to develop research in the domain.

Your program will offer you opportunities to discover, via projects, internships or applied courses, extremely varied scopes of data sciences: political and security decision-making, the real time online advertising, the e-commerce, the data processing of network, the data processing financiers or of industrial production, the biomedical research based on –omics data or of imaging...

DATS2M - Teaching profile

Learning outcomes

Acquire robust methodological bases in analysis and data processing and apply them in varied domains such as human sciences, engineering, marketing, finance, insurance, or scientific research.

After completing the training, the student will master the fundamental concepts in statistics, algorithmic, data mining, and machine learning that are necessary for the job of «data scientist». He will develop skills in communication and will be capable of analyzing a complex problem, of collaborating in a research project. According to the objectives aimed by the student, several elective modules are proposed: applied data, dated sciences in linguistics, algorithmic and computing, statistics and sampling, dated sciences applied to management.

On successful completion of this programme, each student is able to :

1.

Demonstrate the control of a robust corpus of knowledge in data sciences, allowing him(her) to solve the problems which are a matter of his(her) discipline

1.1

The structures of data and algorithms for the analysis of data.

1.2

The theories of the learning, the data mining and the visualization of large-dimension data.

1.3

The statistical inference, the modelling and statistical computing. The student in the orientation information technologies specializes via compulsory or electives courses.

1.4

The industrial and entrepreneurial aspects of data sciences.

1.5

The computer systems, including parallel computing, the networks and the safety(security).

1.6

Numerical methods and optimization, constrained optimization included, operational research, identification and applied mathematics.

2.

Organize and to lead to its term an initiative of development of a data operating system, fulfilling to complex needs of a customer.

2.1

Analyze the problem or solving the functional needs and to formulate the corresponding specifications.

2.2

Formalize and model the problem and design one or several original technical solutions answering these specifications.

2.3

Estimate, justify and classify the solutions with regard to all the criteria appearing in technical specifications: efficiency, feasibility, quality, relevance and security.

2.4

Implement, test and validate the selected solution and interpret the results.

2.5

Formulate recommendations to improve the operational features of the solution.

3.

Organize and lead to his term a research work to comprehend an unsolved problem bound to the exploitation of data according to a new methodology or in a new environment.

3.1

Document and summarize the state of the current knowledge in the considered domain.

3.2

Propose a modelling and/or an experimental plan allowing to simulate and to test hypotheses relative to the studied problem.

3.3

Shape a summary report to describe the methodology with rigor and clarify the theoretical and\or technical potentialities of innovation resulting from this research work.

4.

To contribute in team to the conduct of a project of data exploitation and to lead it to its term by taking into account objectives, assigned resources and constraints that characterize it.

4.1

To center and clarify the objectives of a project (by associating it performance indicators) considering the stakes and the constraints that characterize the environment of the project.

4.2

To be collectively committed on a work plan, a schedule and roles.

4.3

To the program of 120 credits, a module of additional teachings can be added for the student not possessing all the prerequisites of the Master's degree. This module is selected with the advisor of the program.

DATS2M Programme

Detailed programme by subject

CORE COURSES

- Mandatory
- Optional
- Not offered in 2024-2025
- Not offered in 2024-2025 but offered the following year
- Offered in 2024-2025 but not the following year
- Not offered in 2024-2025 or the following year
- Activity with requisites
- Open to incoming exchange students
- Not open to incoming exchange students

PROFESSIONAL FOCUS [30.0]

Mandatory
Optional
Not offered in 2024-2025
Not offered in 2024-2025 but offered the following year
Offered in 2024-2025 but not the following year
Not offered in 2024-2025 or the following year
Activity with requisites
Open to incoming exchange students
Not open to incoming exchange students
[FR] Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

Content:

				Year 1	Year 2
LDATS2840	Master thesis in data analytics		[FR] [q1 or q2] [] [20 Credits]		x
LDATS2350	Data Mining	Robin Van Oirbeek	[EN] [q2] [15h+15h] [5 Credits]	x	

Optionnal course

Choose 1 course among the 2 following.

LDATA2010	Information visualisation	John Lee	[EN] [q1] [30h+30h] [5 Credits] *> French-friendly*		x
LINFO2364	Mining Patterns in Data	Siegfried Nijssen	[EN] [q2] [30h+15h] [5 Credits] *> French-friendly*		x

OPTIONS

The student completes his program with elective courses reported in the list below. With the agreement of the restricted jury, the student can also complete his program by other courses that he would consider relevant and taught at the UCLouvain. The student may include a maximum of 5 language course credits in his or her program, provided that the level is appropriate and consistent with the student's and the program's profile.

> Data in action *[en-prog-2024-dats2m-ldats210o]*
> Data sciences en linguistique et Text Mining *[en-prog-2024-dats2m-ldats211o]*
> Algorithme, informatique, optimisation, recherche opérationnelle *[en-prog-2024-dats2m-ldats220o]*
> Stage *[en-prog-2024-dats2m-ldats240o]*
> Data Sciences appliquées à la gestion *[en-prog-2024-dats2m-ldats250o]*
> Optional courses *[en-prog-2024-dats2m-lsc100o]*

OPTIONS

DATA IN AA1 cm -1 0 0 -1 0 0 cm 0 0 m 3NF.50 0.5 m ptimisation, recherche opérationnelle

Year
1 2

Content:

Cours au choix

Maximum one course among the two courses (As they are bachelor course, the amount of credits is reduced to 5)

LINFO1113	Numerical algorithmic	Sébastien Jodogne Estelle Massart	[FR] [q2] [30h+30h] [6 Credits]	x	
LINFO1114	Discrete Mathematics	Marco Saerens	[FR] [q1] [30h+15h] [5 Credits]	x	
LINFO1252	Informatic Systems	Etienne Riviere	[FR] [q1] [30h+30h] [5 Credits]	x	x
LINFO2266	Advanced Algorithms for Optimization	Pierre Schaus	[EN] [q1] [30h+15h] [5 Credits] > *French-friendly*	x	x
LINFO2145	Cloud Computing	Etienne Riviere	[EN] [q1] [30h+15h] [5 Credits] > *French-friendly*		x

STAGE

- Mandatory
- Optional
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- Offered in 2024-2025 but not the following year
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- Activity with requisites
- Open to incoming exchange students
- Not open to incoming exchange students
- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

1 internship maximum, chosen among the two following (optional):

Year
1 2

Content:

LDATS2940	Stage en science des données		[FR] [q1 or q2] [] [10 Credits]		x
LDATS2945	Stage en science des données en lien avec le mémoire		[FR] [q1 or q2] [] [5 Credits]		x

DATA SCIENCES APPLIQUÉES À LA GESTION

- Mandatory
- Optional
- Not offered in 2024-2025
- Not offered in 2024-2025 but offered the following year
- Offered in 2024-2025 but not the following year
- Not offered in 2024-2025 or the following year
- Activity with requisites
- Open to incoming exchange students
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- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

Click on the course title to see detailed informations (objectives, methods, evaluation...)

The following courses are taught on two-month periods and the first three ones are taught on the Campus of UCL Mons. Thus, we ask to students to check that this choice is compatible with their schedule, before inscription.

Year
1 2

Content:

MLSMM2152	New Technologies & Emerging Practices	Bart Jourquin	FR [q1] [30h] [5 Credits]	x	x

The student is invited to meet the program advisor to decide which courses should be followed. The restricted jury must next approve his program.

- Mandatory
- Optional
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- Not offered in 2024-2025 or the following year
- Activity with requisites
- Open to incoming exchange students
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- [FR] Teaching language (FR, EN, ES, NL, DE, ...)

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Mathématique - Analyse et algèbre linéaire

Each of the following three modules allows acquiring similar skills:

Module 1

LINFO1111	Analysis	Pierre-Antoine Absil François Glineur	FR [q1] [45h+37.5h] [7 Credits]
LINFO1112	Algebra	Christophe Craeye Enrico Vitale	FR [q2] [30h+30h] [5 Credits]

Module 2

LINGE1114	Mathematics I: analysis	Heiner Olbermann	FR [q1] [30h+30h] [5 Credits]
LINGE1121	Mathematics II: algebra and matrix calculus	Cécile Coyette (compensates Tom Claeys)	FR [q2] [30h+30h] [5 Credits]

Module 3

LMAT1101	Mathematics 1	Pedro Dos Santos Santana Forte Vaz	FR [q1] [30h+20h] [4 Credits]
LMAT1102	Mathematics 2	Augusto Ponce	FR [q2] [30h+30h] [4 Credits]

Probabilités et Statistique

Each of the following four modules allows acquiring similar skills:

Module 1

LSTAT2014	Elements of probabilityh W n 1 gprob a[E statistics	Eugen Pira[Eabelu	FR [q1] [22.5h+22.5h] [5 Credits]

Module 2

LBIR1212	Probabilities and statistics (I)	Patrick Bogaert	FR [q1] [30h+15h] [4 Credits]
LBIR1315	Probability and statistics II	Patrick Bogaert	FR [q1] [22.5h+22.5h] [3 Credits]

Module 3

LINGE1113	Probability	Johan Segers	FR [q2] [30h+15h] [4 Credits]
LINGE1214	Further Statistics	Christian Hafner	FR [q1] [30h+15h] [4 Credits]

Module 4

LMAT1271	Calculation of probabilityh W nstatisticalh Walysis	Rainer von Sachs	FR [q2] [30h+30h] [6 Credits] *> English-friendly*

Programmation et informatique

Thenstudent must acquire the skills related to these three courses:

LINFO1101	Introduction to programming	Kim Mens Siegfried Nijssen Charles Pecheur	FR [q1] [30h+30h] [5 Credits]
LEPL1402	Informatics 2	Sébastien Jodogne Ramin Sadre Pierre Schaus	EN [q1] [30h+30h] [5 Credits]
LINGE1322	Computer science: AWalysish W nDesign of Information Systems	Jean V W erdonckt	FR [q2] [30h+15h] [5 Credits]

Course prerequisites

The **table** below lists the activities (course units, or CUs) for which there are one or more prerequisites within the programme, i.e. the programme CU for which the learning outcomes must be certified and the corresponding credits awarded by the jury before registering for that CU.

These activities are also identified **in the detailed programme**: their title is followed by a yellow square.

Prerequisites and student's annual programme

As the prerequisite is for CU registration puposes only, there are no prerequisites within a programme year. Prerequisites are defined between CUs of different years and therefore influence the order in which the student will be able to register for the programme's CUs.

In addition, when the jury validates a student's individual programme at the beginning of the year, it ensures its coherence, meaning that it may:

- require the student to combine registration in two separate CUs which it considers necessary from a pedagogical point of view.
- transform a prerequisite into a corequisite if the student is in the final year of a degree course.

For more information, please consult the Academic Regulations and Procedures.

 # Prerequisities list

LDATS2940 "Stage en science des données" has prerequisite(s) LSTAT2020 ET LSTAT2110 ET LSTAT2120

- LSTAT2020 - Statistical softwares and basic statistical programming
- LSTAT2110 - Data Analysis
- LSTAT2120 - Linear models

The programme's courses and learning outcomes

For each UCLouvain training programme, a reference framework of learning outcomes specifies the the skills expected of every graduate on completion of the programme. Course unit descriptions specify targeted learning outcomes, as well as the unit's contribution to reference framework of learning outcomes.

			authorisation from the faculty/ school.
Bachelor in Economics and Management Bachelor in Bioengineering Bachelor in Management		Access with additional training	Straight access, but the program is completed with an additional training of maximum 10C
Other Bachelor	if no minor in computer sciences / statistics and data sciences	Access based on application	
Others Bachelors of the French speaking Community of Belgium			
Engineer in management Engineering, orientation « civil engineer » Computer sciences Mathematical sciences Physical sciences		Direct access	
Bachelor in economics or management Engineering orientation bio-engineering		Access with additional training	Straight access, but the program is completed with an additional training of maximum 10C
Other Bachelor		Access based on application	
Bachelors of the Dutch speaking Community of Belgium			
Bachelor in de ingenieurswetenschappen Bachelor in de informatica Bachelor in de wiskunde Bachelor in de fysica Bachelor in de economische wetenschappen Bachelor in de bio-ingenieurswetenschappen		Access based on application	
Foreign Bachelors			
All degree		Access based on application	

Non university Bachelors

> Find out more about links to the university

Diploma	Access	Remarks
BA en informatique de gestion - crédits supplémentaires entre 30 et 60 BA en informatique et systèmes, orientation informatique industrielle - crédits supplémentaires entre 30 et 60 BA en informatique et systèmes, orientation réseaux et télécommunications - crédits supplémentaires entre 30 et 60 BA en informatique et systèmes, orientation sécurité des systèmes - crédits supplémentaires entre 30 et 60 BA en informatique et systèmes, orientation technologie de l'informatique - crédits supplémentaires entre 30 et 60 BA en informatique, orientation développement d'applications - crédits supplémentaires entre 30 et 60 BA en informatique, orientation informatique industrielle - crédits supplémentaires entre 30 et 60 BA en informatique, orientation réseaux et télécommunications - crédits supplémentaires entre 30 et 60 BA en informatique, orientation sécurité des systèmes - crédits supplémentaires entre 30 et 60 BA en informatique, orientation technologies de l'informatique - crédits supplémentaires entre 30 et 60		

Masters

Master degree from the French community of Belgium:
Civil engineer
Computer sciences

Teaching method

By its professional vocation, the teaching is completed by numerous practical class having for objective the implementation of methods of analysis on real data. On the other hand, the student also has the possibility of including in his program, a company internship to develop the methodological aspects of the report there. Certain projects will also require working in multidisciplinary teams, what contributes to the development of a stimulating and friendly spirit of collaboration among the students of the program.

The majority of the courses distributed by the teachers are accompanied by an intranet site on the platform "moodle". These sites propose tools of e-learning and serve as forum to the students.

Certain specialized modules are taught by professors coming from the industry.

Finally, the program includes compulsory courses in English and in French. Thus, the student must be capable of attending class in both languages. The report can be made in English and the student can also individual ask to take his examinations in English. The choice of English aims at favoring international attraction of this training and at perfecting the skills of our own local students. Opportunities will be offered to students who do not know French and wish for a complete cycle in English.

Evaluation

The evaluation methods comply with the regulations concerning studies and exams. More detailed explanation of the modalities specific to each learning unit are available on their description sheets under the heading "Learning outcomes evaluation method".

Assessment methods are in accordance with the regulation of studies and examinations. More information about the modalities appropriate to every credit is available in their descriptive index card, in the column "Assessment mode of learning outcomes of students".

Every EU of the program contains an oral examination or a written examination often completed by a project completed by a report, taken into account in the assessment. The (optional) internship and the master thesis each involve the writing of a document being the object of an oral defense in front of a jury.

The total mark is an average of marks for each course, weighted by their respective credits.

If a student registered to an examination in January was not able to attend for duly justified reasons of force majeure, he can ask to the foreman of jury for the authorization to present the examination in June. The foreman of jury judges the relevance of the request and, if the professor of the course agrees, the student can retake the examination in June.

Mobility and/or Internationalisation outlook

The program of Master's degree in Data Science (statistical orientation) being new, no program of systematic exchange with foreign universities is set up.

The students who wish to gain an experience abroad within a company or an outside body during their program can:

- Do an internship in a private company (in Belgium or abroad).
- Prepare a master thesis in collaboration with a company (in Belgium or abroad).
- Participate to a program with a university that has a partnership with UCLouvain, for bilateral exchange of students.

The students wishing to participate in a program of international exchange are invited to get in touch with the person responsible for these within the Faculty of Science or with the person of contact within the School of statistics, biostatistics and actuarial sciences (LSBA).

Detailed Information on: https://uclouvain.be/fr/facultes/sc/programmes-d-echange-d-etudiants.html.

Possible trainings at the end of the programme

After having obtained the Master's degree in data sciences (statistical orientation) a student who has chosen adequate elective