



Master of Statistics and Data Science:

Biostatistics, Bioinformatics, Quantitative Epidemiology and Data Science

On campus programme
Distance learning programme

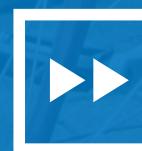
HASSELT UNIVERSITY:

IS LOCATED IN THE **HEART OF THE EU-REGION** NEAR
BRUSSELS (BELGIUM), AACHEN (GERMANY)
& MAASTRICHT (THE NETHERLANDS)

IS THE **47th** BEST UNIVERSITY YOUNGER THAN 50 YEARS (THE-RANKING)

HAS **15%** INTERNATIONAL STUDENTS FROM 75 DIFFERENT COUNTRIES

HAS **670** PHD STUDENTS, OF WHICH **45%** INTERNATIONAL STUDENTS



UHASSELT

KNOWLEDGE IN ACTION

Strengths of the master of statistics and data science

In the past 30 years our master has been the gateway for over a thousand graduates to start a career in (the biopharmaceutical) industry, in academia, and in governmental agencies. The need for well-trained biostatisticians, bioinformaticians, and epidemiological and public-health scientists is ever increasing, enhanced by the scientific revolution in molecular biology and genetics, and its impact on health and the environment.

Statistics is nowadays recognized as a core subject of the emerging field of Data Science, and modern statisticians should therefore also have good knowledge and skills in other aspects of Data Science. Hence, the Master of Statistics has recently been renamed to Master of Statistics and Data Science. All students will therefore get a solid basis of statistics and data science, but you may direct your studies by choosing one of four specializations: Biostatistics, Bioinformatics, Quantitative Epidemiology or Data Science. The former three specializations are more oriented towards statistics, and the latter is a data science study with still a solid statistics ground. In this sense, our Data Science specialization is quite unique in the sense that it offers a data science education with a very sound understanding of important statistical concepts and solutions.

The Master of Statistics and Data Science keeps abreast with modern evolutions. It combines a solid study of fundamental methodology with up-to-date training in topics such as clinical trials, modelling infectious diseases, longitudinal data, survival analysis, genomics, survey methodology...

Key elements of the Master of Statistics and Data Science

- The programme builds upon more than 30 years of research in biostatistics, bioinformatics and quantitative epidemiology
- The programme is organized from within the Data Science Institute of the university. The institute houses more than 20 tenured faculty with internationally recognized expertise in many aspects of statistics and data science.
- The programme strongly emphasizes lifelong learning and employability skills such as communication (writing and presenting), critical attitude, working in team
- The programme has an international and multidisciplinary orientation, as has the teaching faculty
- The programme uses a large diversity of (blended) educational formats and study materials: lectures, web lectures, quizzes, projects, homework assignments, discussion groups, digital learning environment, ...
- The on-campus programme will take a blended form, with on-campus lectures, project work and contact moments when possible, but also with online teaching materials and Q&A sessions when on-campus activities cannot proceed or cannot be attended. We will make sure that all students are in sync.
- The programme is based on student-centered education: small groups, individual guidance and feedback, group work, feedback sessions
- The programme is internationally accredited by the Royal Statistical Society (RSS, UK), allowing graduates to apply for the professional quality label of Graduate Statistician at RSS
- Topics for master thesis and internship are available at top-level research institutes, companies and organizations



4 specializations

1 Biostatistics

Biostatistics focuses on statistical, data scientific, and otherwise quantitative methodology for medicine, agriculture, forestry, environmental sciences, and beyond. Statistics in general and biostatistics in particular rests on solid mathematical and probabilistic foundations. This is why in both the first and second year, foundational courses are offered, in a step-up design, with the lighter version offered during the first year. At the same time, the field's strong focus on the bio-sciences is supported by a broad introduction to medical and molecular biology.

The practicing biostatistician needs to be equipped with important modeling tools, such as linear models (regression, analysis of variance, etc.), generalized linear models (logistic regression, Poisson regression, etc.), multivariate methods, longitudinal data, Bayesian methodology, time-to-event analysis, and so on. Evidently, fluency in the use of statistical software is expected, which is why not only dedicated courses but also assignments and course work throughout a good many courses focus on the computational aspects. Further, specialized courses are offered in clinical trials, omics data, spatial statistics, infectious diseases epidemiology, microbial risk assessment, and so on.

Biostatisticians need to be able to communicate with researchers of various fields, report results, and give effective presentations. Developing such skills is an integral part of the programme.

2 Bioinformatics

Bioinformatics aims at extraction of information from genetic data. Statistical methods used toward this end are the focus of statistical bioinformatics.

Technological developments in molecular biology over the last two decades have improved the knowledge of molecular and cellular processes underlying diseases and treatment effects. "Omics"-oriented approaches (such as genomics, transcriptomics, or proteomics) consider all molecules collectively instead of one molecule at a time, generating a system-wide understanding. Data obtained with the help of "omics" technologies are usually very voluminous (yielding even millions of measurements per single biological sample), highly structured, and complex. Analysis of such data is not trivial and has become a specialty of its own. Of course, good knowledge of "classical" statistical methodology is required and training in this respect is offered in the first year of our programme. Additionally, an introduction to medical and molecular biology is offered, together with an introductory training in programming. The second year focuses on the methods specific for the analysis of genomic, microbiome and proteomic data obtained by using technologies like next-generation sequencing, mass spectrometry, etc. Methods for integrative analyses of different types of data are considered, too.

Bioinformatics is an interdisciplinary science. Statisticians working in this domain need to be able to communicate with researchers of various fields, report results, and give effective presentations. Developing such skills is an integral part of the programme.



3 Quantitative Epidemiology

Being the cornerstone of public, international and global health, epidemiology is the study of the distribution and determinants of health-related outcomes and diseases in populations. Epidemiological information is the basis for planning and evaluating preventive or control strategies; it shapes policy decisions and evidence-based practices in public health.

The design of epidemiological studies and intervention measures, the collection and analysis of epidemiological data require appropriate expertise in statistical methodology in combination with knowledge of other scientific disciplines such as medical biology, computer sciences, social sciences, etc.

Statistical methodology in general and in epidemiology in particular rests on solid mathematical and probabilistic foundations. This is why foundational courses are offered, in a step-up design, during the first year, supported by a broad introduction to medical and molecular biology: linear models (regression, analysis of variance, etc.), generalized linear models (logistic regression, Poisson regression, etc.), multivariate methods, longitudinal data, Bayesian methodology, so on. Further, during the second year, in addition to three foundational courses, specialized courses are offered in spatial epidemiology, digital epidemiology, mathematical modelling of infectious diseases, environmental epidemiology and microbial risk assessment.

Evidently, fluency in the use of statistical software is expected, which is why not only dedicated courses but also assignments and course work throughout the courses focus on the computational aspects.

Statisticians need to be able to communicate with researchers of various fields, report results, and give effective presentations. Developing such skills is an integral part of the programme.

4 Data Science

With the advent of the big data era, several global challenges that were outside of reach can now start to be addressed. In the field of medicine, wearable devices and real-time sensors generate huge amounts of data that can shed light on triggers for disease episodes. Omics and genome sequencing can aid in managing and preventing diseases, especially if they are combined with other data sources as, for example, information from social networks. Integrated analysis of weather data, credit card transactions and air pollution data sheds light on how people change their behaviour due to air pollution. Graph analysis of social network data makes it possible to identify fake accounts and fake news - a growing problem in the current political climate. The list goes on... A data scientist is someone who, apart from technical skills to tackle these issues, has a desire to dig deeper and go beneath the surface of a problem.

The Data Science specialization of the Master of Statistics and Data Science provides a comprehensive education in this field, covering the whole data science cycle from data gathering, cleaning and management, to analysis and visualisation, and finally dissemination. Apart from a very decent knowledge of statistical principles, the topics in the master therefore include (but are not limited to) data and software carpentry, programming in python and R, statistics, algorithms, machine learning (including deep learning), natural language processing and data visualisation. In addition to regular statistics courses, students can integrate their knowledge and skills in several data science projects and a hack week.

Statisticians/data scientists need to be able to communicate with researchers of various fields, report results, and give effective presentations. Developing such skills is an integral part of the programme.

Study tracks

ON-CAMPUS

students participate in lectures (blended education), lab sessions and group projects on campus, also taking exams on campus.

DISTANCE LEARNING

students from all over Europe and the rest of the world can follow weblectures, participate on-line in group projects and quizzes, and take exams on-line.

INTERNATIONAL COURSE PROGRAMME (ICP)*

thanks to VLIR-UOS, 10 excellent students from developing countries worldwide can receive a full scholarship to follow the programme on-campus.

ONE-YEAR TRACK (SHORTENED PROGRAMME)

students already having sound academic knowledge of and/or professional experience with statistics, can apply for a shortened programme (minimal study programme size = 67 ECTS)

WORKING STUDENT

combining (at least half-time) work and (part-time) study is possible by spreading the programme across years, either in on-campus as well as distance learning education.

*This track is not available in the data science specialization for the academic year 2022-23.

Career prospects

- Applied and fundamental research at universities and research centers in scientific, pharmaceutical, biotechnical and medical disciplines (PhD, research associate, scientist, ...)
- Governmental authorities and non governmental organizations focusing on public, international and global health, environment, genetics, agriculture, sustainable development, ...
- Independent statistics consultant
- Education (lecturer, teaching assistant...)
- Tech Manager programming
- Biometrics specialist
- Senior Statistical Programmer
- Data Analyst/Scientist
- ...

Good mix between theory and application, important courses in the core programme and lots of interesting optional courses

statistician and lecturer at a university, Uganda

I received the knowledge and skills which helps to excel in my job and create a significant positive difference with those who did not attend this masters programme, this helped me in defining my career path

now lead operations analyst at NGO, US

The programme is well tailored to equip students with the necessary statistical and research skills to tackle multidisciplinary real world research problems

*now data scientist
at Institute of Agriculture, Nigeria*



The programme is well arranged and covers almost all day to day statistical problems one can face in the real world

now biostatistician at a large company, Belgium

Study programmes



The programme is internationally accredited by the Royal Statistical Society (RSS, UK), allowing graduates to apply for the professional quality label of Graduate Statistician at RSS.

(Statistical) Bioinformatics		Quantitative Epidemiology		Data science																													
COURSES	ECTS	COURSES	ECTS	COURSES	ECTS																												
FIRST YEAR		FIRST YEAR		FIRST YEAR																													
SEMESTER 1 - COMPULSORY																																	
Concepts of Probability and Statistics	5	Concepts of Probability and Statistics	5	Concepts of Probability and Statistics	5																												
Linear Models	5	Linear Models	5	Linear Models	5																												
Project: Learning from Data	5	Project: Learning from Data	5	Project: Learning from Data	5																												
Programming in R	3	Programming in R	3	Programming in R	3																												
Programming in Python	5	Data Management	5	Programming in Python	5																												
Medical and Molecular Biology	6	Medical and Molecular Biology	6	Data Management	5																												
SEMESTER 2 - COMPULSORY																																	
Introduction to Bayesian Inference	4	Introduction to Bayesian Inference	4	Introduction to Bayesian Inference	4																												
Project: Multivariate and Hierarchical Data	8	Project: Multivariate and Hierarchical Data	8	Project: Multivariate and Hierarchical Data	8																												
Generalized Linear Models	6	Generalized Linear Models	6	Generalized Linear Models	3																												
Concepts of Bioinformatics	4	Concepts of Epidemiology	4	Concepts of Data Science	4																												
Advanced Programming in Python	5	Sampling Theory	5	Advanced Programming in Python	5																												
Optional course	4	Optional course	4	Visualisation in Data Science	4																												
SECOND YEAR																																	
SEMESTER 1 - COMPULSORY																																	
Principles of Statistical Inference	3	Principles of Statistical Inference	3	Principles of Statistical Inference	3																												
Longitudinal Data Analysis	6	Longitudinal Data Analysis	6	Longitudinal Data Analysis	6																												
Analysis of Protein Expression	4	Environmental Epidemiology OR Microbial Risk Assessment	3	Optimisation and Numerical Methods	4																												
Machine Learning	5	Spatial Epidemiology	6	Inference for Statistics and Data Science	3																												
Analysis of High Dimensional Omics Data	3	Modeling Infectious Diseases	6	Project: Data Science	5																												
Analysis of Microbiome Data	3	Survival Data Analysis	3	Machine Learning	5																												
Computer Intensive Methods	3	Optional course	3	Optional course	3																												
Optional course	3	SEMESTER 2 - Q3 - COMPULSORY																															
SEMESTER 2 - Q3 - COMPULSORY																																	
Analysis of Sequencing Data	3	Digital Epidemiology	3	SEMESTER 2 - Q3 - COMPULSORY																													
Statistical and Computational Methods for Integrated Analysis	3	Infectious diseases in low-and middle income countries	3	Master Thesis Bioinformatics/ICP	6	Master Thesis Quantitative Epidemiology/ICP	6	Advanced Topics in Data Science	3	SEMESTER 2 - Q4 - COMPULSORY						Master Thesis Bioinformatics/ICP	18	Master Thesis Quantitative Epidemiology/ICP	18	Artificial Neural Networks and Deep Learning	4	SEMESTER 2 - Q4 - COMPULSORY						Master Thesis Data Science	18	Master Thesis Data Science	18	Master Thesis Data Science	18
Master Thesis Bioinformatics/ICP	6	Master Thesis Quantitative Epidemiology/ICP	6	Advanced Topics in Data Science	3																												
SEMESTER 2 - Q4 - COMPULSORY																																	
Master Thesis Bioinformatics/ICP	18	Master Thesis Quantitative Epidemiology/ICP	18	Artificial Neural Networks and Deep Learning	4																												
SEMESTER 2 - Q4 - COMPULSORY																																	
Master Thesis Data Science	18	Master Thesis Data Science	18	Master Thesis Data Science	18																												

Conditions of admission

www.uhasselt.be/admission

Students should hold at least a **university diploma or degree certificate** or a diploma of higher education equivalent to an academic bachelor degree (180 ECTS credit points).

Admission is given directly to holders of an academic bachelor or master, obtained from a Belgian university, in mathematics, statistics or bio/civil engineering. Holders of Belgian academic degrees in the disciplines physics, computer sciences, chemistry, biology, life sciences, business engineering, medicine, sociology, psychology, artificial intelligence and biotechnology can apply for the programme; their applications will be evaluated individually by the Examination Board.

Admission of international degree holders will be evaluated individually by the Examination Board. Holders of an international bachelor or master degree in mathematics, physics, computer sciences, chemistry, biology, life sciences, bio-, business-, civil engineering, medicine, sociology, statistics, psychology, artificial intelligence, biotechnology need a sufficiently strong background in mathematics and statistics.

Holders of an international bachelor or master degree in mathematics and statistics can apply for the programme. Holders of an international bachelor or master degree in physics, computer sciences, chemistry, biology, life sciences, bio-, business-, civil engineering, medicine, sociology, psychology, artificial intelligence, biotechnology can also apply for the programme, but are highly recommended to include recent GMAT/GRE test results with their pre-registration to demonstrate their background in mathematics and statistics.

Candidates who wish to register in an English master programme need to have good English language skills, both written and spoken. Candidates have to demonstrate their English language skills by a recent score on the Test of English as Foreign Language (TOEFL, with an internet-based score of at least 89) or the International English Language Testing System (IELTS, with an overall band score of at least 6.5). The English language test can be waived if your English language proficiency is proven otherwise (if higher education was in English or if English is a national language in your home country).

Registration

Online pre-registration at www.uhasselt.be/admission is compulsory.

- Deadline for pre-registration for on-campus programme: February 1st (non-EEA students) / July 1st (EEA students) / September 15th* (Belgian students).
- Deadline for pre-registration for distance learning programme: June 1st (non-EEA students) / July 1st (EEA students) / September 15th* (Belgian students).

For support in the admission procedure:

admissionformaster@uhasselt.be

The Examination Board will only consider duly completed application files. Applicants will be notified of the Examination Board's decision as soon as possible. The registration becomes active after payment of the tuition fee, augmented with a premium for health insurance for non-EEA students.

Please consult www.uhasselt.be/admission for fees, regulations, and online pre-registration.

*It can not be guaranteed that pre-registrations in September will be processed by the start of the academic year.



Maastricht University

A programme of the transnational University Limburg - a cooperation between Hasselt University (Belgium) and Maastricht University (The Netherlands)

contact info

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www.uhasselt.be/statistics