GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2024-2025

Predictive and Prescriptive Analytics (F000801)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)	English	Gent	lecture
			group work
			seminar

Lecturers in academic year 2024-2025

Bogaert, Matthias	EB23	lecturer-in-charge
Janssens, Bram	EB23	co-lecturer

Offered in the following programmes in 2024-2025	**crdts**	**offering**
Master of Science in Business Engineering(main subject Data Analytics)	6	A
Master of Science in Business Engineering (Double Degree)(main subject Data Analytics)	6	A
Master of Science in Business Engineering (Double Degree)(main subject Operations Management)	6	A
Master of Science in Business Engineering(main subject Operations Management)	6	A
Exchange programme in Economics and Business Administration	6	A

Teaching languages

English

Keywords

Advanced predictive models, advanced optimization and simulation methods, data science, machine learning, deep learning, reinforcement learning, ensembles, forecasting, Python

Position of the course

This course builds on the content of techniques seen in 'Machine Learning', 'Analytics Customer Relationship Management' and 'Social Media and Web Analytics'. Specific emphasis will be put on business applications of analytics. The course will not only cover more advanced methods in predictive analytics, but also prescriptive analytics. All examples and exercises will be performed in Python.

Contents

The techniques covered in 'Machine Learning', 'Analytics Customer Relationship Management' and 'Social Media and Web Analytics' are considered as basic knowledge in this course.The **first part** of the course will primarily focus on the theory about the advanced predictive analytics, prescriptive analytics, the combination of predictive and prescriptive analytics and reinforcement learning. In prescriptive analytics several mathematical optimization methods will be discussed, with the focus business application. The main goal will be to use these optimization techniques to make better business decisions. Finally, the course will cover reinforcement learning, focusing on the trade-off between exploration and exploitation. The techniques covered in reinforcement learning will focus on business application (e.g., markdown management) and not on computer vision (e.g., self-driving cars).

- Introduction to predictive and prescriptive analytics
- Advanced predictive analytics
  - Feature selection
  - Ensemble methods (e.g., XGBoost, lightGBM, and catboost)

- Heterogeneous ensemble
- Prescriptive analytics with exact optimization
- Linear and integer programming
- Prescriptive analytics with meta-heuristics
  - Genetic algorithms
  - Particle swarm optimization
  - Simulated annealing
  - Gradient descent
  - Multi-objective optimization
- Forecasting
  - Statistical forecasting
  - Machine learning forecasting
  - Forecasting with deep learning
- Reinforcement learning
  - Exploration vs exploitation
  - Multi-armed bandit problem
  - Markov decision process
  - Q-learning

The **second part** of the course will be devoted to several business applications. The business application will be discussed with a focus on identifying and solving data-related problems. Depending on the application, new analytical methods can be introduced. The emphasis will always be put on the application and how data analytics can add value.

- Topics:
  - HR analytics
  - Fraud analytics
  - Data science and ethics (including explainable artificial intelligence)
  - Value-driven analytics
  - Advanced NLP for business

Initial competences

The students should have profound knowledge of the algorithms discussed in 'Machine Learning', 'Analytical Customer Relationship Management' and 'Social Media and Web Analytics'. The student should have knowledge of Python.

Final competences

1 Understanding predictive, prescriptive and reinforcement learning methods.
2 Using Python to apply these methods
3 Correctly interpreting, reporting, and presenting the discussed methods.
4 Recognizing and solving a specific data-driven business-related problem from start to finish.
5 Have insight into the several business applications and know the data-related problems in these specific applications.
6 Knowing and understanding when to use and when not to use a specific method in a certain context.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, Seminar, Lecture

Extra information on the teaching methods

Ex cathedra sessions as well as active class discussions of the different techniques and models with interactive exercises in the PC room.

Study material

Type: Slides

Name: Slides theory
Indicative price: Free or paid by faculty
Optional: no
Language : English
Available on Ufora : Yes

Online Available : Yes
Available in the Library : No
Available through Student Association : No

Type: Software

Name: Code files in Python
Indicative price: Free or paid by faculty
Optional: no
Available on Athena : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No
Usability and Lifetime within the Course Unit : regularly
Usability and Lifetime within the Study Programme : regularly
Usability and Lifetime after the Study Programme : regularly

References

Géron, A. (2022). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow. " O'Reilly Media, Inc.".
Baesens, B., Van Vlasselaer, V., & Verbeke, W. (2015). Fraud analytics using descriptive, predictive, and social network techniques: a guide to data science for fraud detection. John Wiley & Sons.
Verbeke, W., Baesens, B., & Bravo, C. (2017). Profit driven business analytics: A practitioner's guide to transforming big data into added value. John Wiley & Sons.
Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction. MIT press.

Course content-related study coaching

For the course content-related the students will receive coaching the lecturer and the teaching assistant. During the practical exercises students will be coached by the lecturer and the teaching assistant. There will be several feedback moments (during lectures, group and individual meetings).

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment

Presentation, Peer and/or self assessment, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

Periodic: written exam with open and multiple choice questions (closed book)
Permanent: project work in group with written report, presentation corrected with peer assessment.

Calculation of the examination mark

Periodic: 50%
Permanent: 50%
When the student obtains less than 10/20 for the periodic evaluation, he/she can no longer pass the course unit as a whole. If the total score does turn out to be a mark of 10 or more out of 20, this is reduced to the highest fail mark (9/20).