BI Data Science for Business Course Descriptions

Contents

Bachelor

1 EBA 3400: Programming, Data Extraction and Visualisation

Learning Outcomes

Knowledge

Throughout the course, students will:

- Learn how to translate real-world problems into Python code and explore the possibilities of using programming to complete data science tasks.
- Learn basic data analytics and develop an understanding of the exploratory phase in empirical investigations.

Skills

After completed course students will be able to:

- Perform basic data exploration and visualization tasks.
- Automate analyses that would otherwise be impossible to perform manually. Importantly, the course gives basic skills in Python programming.
- Communicate the result of an empirical investigation based on the tools introduced in the course.

General Competence

This course develops logical thinking by converting ideas into computer programs. Students also gain experience working with datasets and answering practical questions using data. Overall, the course strengthens information literacy by building a technical understanding of how information is processed and used.

2 EXC 3460: Organizational Behavior and Leadership

Learning Outcomes

Knowledge

Learning outcomes - Knowledge

Based on this course, students should:

- Learn about the major concepts, theories, and perspectives of organizational behaviour and leadership
- Identify the implications of different types of leadership styles on organizational performance
- Define the role of organizational culture and its effects on organizational life
- Learn how to effectively motivate and manage employees

- Describe the implications of diversity and its effects on organizational performance and creativity

Skills

Based on this course, students should be able to:

- Link organizational theories and organizational behaviour concepts to desired organizational outcomes (e.g. positive change or performance).
- List effective communication and problem-solving strategies for addressing organizational behaviour issues.
- Recognize the different types of leadership styles, and identify their strengths and weaknesses.
- Indicate the implications of diversity in the workplace and recognize how diversity affects organizational behaviour.
- Indicate how organizational culture influences organizational performance.

General Competence

After completing this course, students should grasp that organizational behaviour provides fundamental knowledge for interpreting the dynamics and performance of organizations. Students should understand that psychological traits, group dynamics, the influence of leaders, and organizational factors (such as organizational culture) have a substantial impact on organizational performance. Students should also be able to comprehend the significance of sustainable human resource management.

3 EXC 3430: Fundamentals of Accounting and Finance

Learning Outcomes

Knowledge

After having completed the course, students will be capable of explaining general accounting concepts and basic tools used for analyzing accounting specific problems.

- Examples of concepts: accrual accounting, income vs. cash flow, fixed and variable costs vs. direct and indirect costs, sunk costs, opportunity costs, discounting, ...
- Examples from the toolbox: balance sheet, income statement, and cashflow statement, contribution margin, gross margin, break-even analysis, net present value, internal rate of return, residual income...

Skills

After having completed the course, students will be able (a) to apply acquired knowledge (concepts and tools) when analyzing and discussing accounting problems, (b) to distinguish between relevant and irrelevant information and (c) to answer accounting specific questions in an understandable way. Examples:

- Students will be able to apply the respective accounting tools correctly.

- For basic descriptions of economic situations, students will be able to choose the correct tool for analyzing these situations and apply it correctly.
- For more complex situation descriptions, students will be able to search for relevant information, link it to the correct tool and apply the tool correctly.

Since the toolbox is of a general nature, the learning outcomes also apply in international settings.

General Competence

After completing the course, students will be able to ask critical questions and reflect on crucial assumptions and theories within the field of accounting. They will thus be able to contribute to profitable and sustainable business activity.

4 EXC 3420: Economics I

Learning Outcomes

Knowledge

After completing the course, the candidate will have acquired knowledge of the central themes and problems, empirical patterns, and theories within the field of economics. The candidate will

- Be able to explain the key features of historical and global economic characteristics, such as income, inequality, and environmental challenges.
- Be able to describe how firms operate as economic agent, with a particular focus on internal conflicts of interest and their adaptation to market conditions.

Skills

The candidate should be able to:

- Define and explain key economic terms, quantities, and concepts within the course topics.
- Apply economic models to explain and evaluate important economic phenomena such as technological development, price determination, wage determination, unemployment, and how scarcity affects individual choices

General Competence

The candidate:

- Demonstrates the ability to critically assess and discuss economic data and theoretical concepts and insights.
- Has the ability to independently extract information and produce and communicate basic economic analyses and evaluations from both Norwegian and international sources.

5 EBA 1180: Mathematics for Data Science

Learning Outcomes

Knowledge

After completing the course, the student will have;

- Acquired a broad understanding of concepts, methods and theories in mathematics.
- A broad knowledge of algebra, functions in one or several variables, financial mathematics, derivation and integration, and linear algebra.
- Specialized knowledge of how mathematical models and methods can be used in economics and finance.

Skills

After completing the course, the student will be able to:

- Analyze quantitative problems using mathematical concepts, and be able to use mathematical methods to solve these problems.
- Assess solution strategies, and be able to carry out the necessary computations correctly and precisely.
- Give mathematical arguments to justify his conclusions, and be able to give written answers that explains the method used and the obtained results to the reader.
- See connections between mathematics and other subjects, especially economics and finance.
- Be able to translate mathematical problems into algorithms and Python code

General Competence

After completing the course, the student will be able to reflect upon central assumptions for the models and theories used. The student will be able to reflect upon the results obtained, and critically assess if they are reasonable.

6 EBA 3520: AI and Data Ethics

Learning Outcomes

Knowledge

During the course students shall learn:

- What are the foundational paradigms of information ethics, and how do they relate to different ways of framing and resolving ethical issues in a number of disciplinary ways
- What are ethical implications of Data, AI and Algorithms as either tools or agents in modern work and living environments

- Which trajectory will Data Collection and Usage, AI and Algorithmic development take? Which are the best-case and which are the worst-case scenarios
- How can we ethically manage Data, AI and Algorithms in the context of business analytics? How may these challenges be managed in light of key legislations such as the EU General Data Protection Regulation (GDRP) and the Artificial Intelligence (AI) Act
- Which trajectory will Data Collection and Usage, AI and Algorithmic development take? Which are the best-case and which are the worst-case scenarios

Skills

After completing the course students should have the ability to:

- Identify and assess the ethical impacts of a given course of action in data-driven organizations
- Describe techniques for protecting privacy, sharing data ethically and legally, minimizing both collective and individual harm associated with data-driven organizational processes.
- Explain the impact of key legislations such as the GDPR and AI Act on data analytics and the use of AI
- Practice performing an ethical audit of data-driven processes in a given organizational context.

General Competence

- Critical Reflection on ethical, legal and policy issues, and to perceive the various facets and viewpoints surrounding complex data ethics questions.
- Reflection of the ethical, legal and social implications that the application of advanced data analytics may bring to business and society, and the impact biased or incomplete data sets may have on stakeholders.
- Be able to apply your understanding to problematize specific technologies, analyze and reflect critically on their impacts, think through various interventions and argue for how to develop technologies in more thoughtful ways.

7 EBA 2904: Statistics with Programming

Learning Outcomes

Knowledge

After completed course students shall:

- Understand the relevance of statistical analysis in economics and marketing
- Acquire knowledge of basic concepts and overview of statistics
- Understand the difference between a population and a sample
- Understand what a random variable and a statistical model is
- Understand that statistical methods are based on assumptions that must be checked
- Understand what estimation and hypothesis testing is about
- Be acquainted with the statistical and mathematical notations used in statistics

Skills

After completed course students will be able to:

- Discern randomness from real underlying effects
- Use statistical software and interpret computer displays from such software
- Produce statistical graphics
- Compute probabilities and confidence intervals
- Conduct the most basic types of hypothesis testing and estimation
- Reflect on the role of randomness

General Competence

Students will understand that in many situations a statistical analysis will help making better decisions, but also be aware that statistical methods can be wrongly applied and lead to false conclusions.

8 EBA 3420: Databases

Learning Outcomes

Knowledge

During the course, the students will:

- Gain a solid understanding of the relational database model and key database modeling techniques.
- Develop proficiency in SQL syntax and semantics for effective database management.
- Understand concurrency control mechanisms and the challenges of multi-user database access.
- Explore how databases can be leveraged for data analysis using Python.

Skills

After completed course the students will be able to:

- use SQL to create, modify and query relational databases.
- use ER modelling to conceptualize given problem specifications.
- translate an ER-model to a relational database model.
- apply normalization techniques to reduce data redundancy and improve data integrity.
- set up indexes to improve the performance of databases.
- create computer programs which store, modify and query data in databases.
- use Python programming to present and analyze data from databases.

General Competence

The course will strengthen the analytical abilities of the students and improve their technical skills and general information literacy. The students will improve their understanding of how the modern data-driven society functions from a technical perspective, and how databases are essential to many industries. The students will gain experience in working in teams on technical problems, and will understand the possibilities and risks associated with digitally stored information as they will gain understanding on how easy it is now to process, extract and present individual-level details from big datasets.

9 EBA 3501: Foundations of Data Science

Learning Outcomes

Knowledge

Upon completion of this course, students will be able to:

- Understand the basic concepts of machine learning and exploratory data analysis.
- Know the most popular machine learning methods' definition, interpretation, and properties.
- Appreciate the reasoning behind basic workflows in data science.

Skills

Upon completion of this course, students will be able to:

- Apply Python libraries for loading, cleaning, and exploration of data.
- Fit a variety of important machine learning models in Python and interpret the results.
- Present data analyses professionally using Quarto and Jupyter notebooks.

General Competence

Upon completion of the course, students will have stronger competence in:

- Work on difficult problems, independently and in teams.
- Read and understand technical documentation.
- Present analyses professionally.

10 EBA 3610: Decision Modelling Using Spreadsheet

Learning Outcomes

Knowledge

During the course, students should have acquired:

- Basic knowledge in Spreadsheet Modeling to be able to formulate a model based on a decision problem
- Identify and apply the right method
- Interpret and analyze the results
- Basic knowledge of Optimization with Linear, as well as Mixed-Integer Optimization Programming Models with a goal of finding an optimal solution that mimimizes the costs, emissions, distance or maximizes the profit or other objectives.

Skills

After completing the course, students shall be able to:

- Build models in spreadsheet and analyse the results
- Identify and apply modelling approach to solve decision problems
- Use spreadsheets for various business applications
- Model and solve linear and Mixed-Integer Optimization problems and perform sensitivity analysis
- Model decisions under uncertainty.

General Competence

The students will learn how to build a model, analyze a decision problem, evaluate the data and how to select a modelling and solution approach.

11 EXC 3500: Economics II

Learning Outcomes

Knowledge

Upon completion of the course, students should have knowledge of:

- The difference between absolute and comparative advantage and why free trade between individuals and nations is profitable.
- Strategic behavior and simple game theoretical models.
- The difference between efficiency and distribution.
- Consumer surplus, producer surplus, and economic surplus.
- Various market models such as perfect competition and monopoly.
- Different types of market failures, such as lack of competition, externalities, and public goods.
- How various instruments can be used to correct market failures.
- Macroeconomic indicators containing information about the current economic situation.
- Key objectives and instruments in economic policy and the background for the economic policies pursued by the Government and Norges Bank.
- The effect of economic policy in a small open economy with a flexible exchange rate.

- Causes and problems with inflation.
- The relationship between inflation and unemployment.
- The effect of demand and supply shocks on inflation.
- Exchange rate fluctuations and exchange rate regimes.
- Inflation targeting.

Skills

After completing the course, students should be able to:

- Explain the conditions for profitable trade and discuss the effects of different trade policy measures.
- Understand and analyze various types of games, such as the prisoner's dilemma. Show how the equilibrium in a game can be altered.
- Analyze how different markets work and demonstrate how various instruments can alter the equilibrium.
- Discuss different types of market failures and how these can be corrected.
- Analyze how economic policy can be used to stabilize output.
- Explain the effect of monetary policy under different exchange rate regimes.
- Determine which economic theory is most relevant to discuss an issue in a specific situation.
- Collect updated economic data and indicators and use them, for example, to assess a country's current economic situation.
- Discuss fundamental economic relationships and have developed a critical sense to distinguish between correct and incorrect statements about economic policy and use of policy instruments.
- Conduct discussions on possible effects of changes in economic policy and policy instruments using both mathematical and graphical reasoning.

General Competence

Students should be ethically aware of the fundamental conflicts between interest and goals associated with economic policy. They should be aware of the importance of sustainable resource use. They should be able to assess an economic issue from different perspectives with respect to the economic interests of different groups. Students should further develop a critical sense for possible deviations between declared political goals and ambitions and the actual effects of economic policy. Students should develop the ability to independently extract information and produce and communicate simple economic analyses and assessments.

12 EBA 3630: Data Driven Management Accounting

Learning Outcomes

Knowledge

During the course, students should have learned/acquired knowledge of:

- The importance of external and internal data sources to solve management accounting problems
- Relevant management accounting tools
- How to translate management accounting problems into Python Code and/or other relevant programming languages
- How to use data for management decision making

Skills

After completing the course, students shall be able to:

- Identify relevant data
- Scope a management accounting problem
- Apply the correct management accounting tool
- Translate management accounting problems into Python Code and/or other relevant programming language
- Conduct financial accounting forensic analysis
- Communicate and interpret the results of using management accounting tools
- Derive recommendations for actions based on their analysis

General Competence

- Evaluate the meaningfulness of certain types of data to the problem being analyzed
- Understand the benefits and limitations of certain management accounting tools

13 EXC 2110: Basic Financial Management

Learning Outcomes

Knowledge

During the course, students shall master the following skills:

- Understand the importance of cash flows for the analysis of investment projects
- Understand that cash flows received at different times have different (present) values (discounting), and the importance of this concept for the valuation of investment projects.
- Understand what is the relevant risk, and how it affects the cost of capital for investments.
- Understand different financial securities, especially shares and bonds, and how their prices are formed in markets.

Skills

After completing the course, students should be able to:

- Perform capital budgeting analysis and basic company valuation.

- Understand the various discounting rules and be proficient in project valuation and in the valuation of stocks and bonds. The theoretical understanding of these issues will be paired with a working knowledge of Excel applications.
- Understand and assess risk and the cost of capital

General Competence

After taking the course, the students shall be able to ask critical questions and reflect on crucial assumptions and theories within the business economics field. The students will understand that cash flows received at different times have different (present) values (discounting), and will fully acknowledge the importance of this concept for the valuation of investment projects.

14 EXC 3580: Marketing Management and Strategy

Learning Outcomes

Knowledge

- Students shall acquire sufficient theoretical and practical knowledge needed to understand how companies develop profitable and sustainable strategies in competitive and dynamic markets.
- The content of a strategic marketing plan and the key activities in the planning process.
- Students will learn what companies do to:
- Attract, keep, and develop valuable customers.
- Develop attractive and profitable products and services.
- Develop and leverage attractive brands.
- Students will learn how digitalization of the economy is affecting customer interaction and competitive dynamics.

Skills

- Be able to develop a strategic marketing plan that specifies what actions a company will do to obtain strategic goals, how the actions are expected to affect revenues and costs, the key performance indicators used to monitor the implementation of the strategy, and how the strategy will relate to roles and responsibilities in the organization.
- Be able to conduct and interpret analysis of markets, competitors, customers, and effectiveness of market related activities.

15 EBA 3640: Marketing Analytics

Learning Outcomes

Knowledge

After completed course students shall:

- Understand how different analytical approaches can inform specific marketing decisions.
- Know which type of data are needed for each method and understand how to structure such data.
- Understand the key intuition behind different analytical methods.
- Understand how to find, interpret, reconcile, and assess key numbers from statistical output.

Skills

After completed course students shall be able to:

- Select the appropriate analytical approach to answer specific managerial questions
- Structure and clean data required
- Run data analysis using statistical software
- Validate, assess, interpret, and present the results
- Articulate an analysis' limitations and strengths
- Formulate strategy recommendations

General Competence

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16 EBA 3530: Machine Learning

Learning Outcomes

Knowledge

In this course, the student will:

- Get a thorough introduction to supervised and unsupervised learning techniques.
- Understand different learning paradigms in machine learning.
- Learn key statistical and machine learning methods used for prediction, classification, clustering, and generating data.

Skills

After finishing this course, the student will be able to:

- Work with different machine learning and pattern recognition models and applications.
- Apply and choose among different clustering, regression, classification and generative models.
- Code different machine learning and pattern recognition models in modern Python libraries.

General Competence

The students should be able to think critically about, and apply, statistical or machine learning techniques for forecasting, classification, clustering, or to generate data. A successful candidate will be in a good position to conduct applied data science work, or expand his/her knowledge in more advanced courses on the topic.

17 EBA 3650: Quantitative Economics

Learning Outcomes

Knowledge

After taking this course the student:

- Knows how to apply microeconomic modeling to firm decision making
- Knows how to turn a simple economic model into a mathematic model that can be solved numerically
- Knows a handful of useful mathematical techniques for numerical optimization and equation solving

Skills

After taking this course the student:

- Can practically apply simple general numerical tools for optimization and equation solving,
- Can numerically solve various constrained optimization problems, such as finding the optimal price a firm can specify for a product, given a known demand function.
- Can numerically solve for equilibrium solutions resulting from several agents' optimizing decisions, such as finding a market price in a market with known supply and demand functions - and to study how factors that affect demand or supply affects the market price.
- Can numerically solve for optimal decisions and equilibrium solutions in game-theoretic models with strategic interaction, such as models of oligopoly.
- Can numerically quantify the welfare loss resulting from pricing decisions that exploits market power.

General Competence

After taking this course the student:

- Has gained an understanding of how one can practically apply numerical techniques to quantity the welfare loss caused by the exercise of market power
- Has understood how one can improve the understanding of economic models and problems by specifying models numerically, experimenting with different specifications and studying the properties of the models graphically and numerically

18 STR 3610: Doing Sustainable Business

Learning Outcomes

Knowledge

During the course students shall acquire knowledge of:

- how to develop sustainable strategies for solving complex business problems in multidisciplinary teams,
- how to analytically approach complex business problems by applying established theoretical models, strategy frameworks and tools,
- how to develop documented and clear recommendations that companies and organizations can act upon (make decisions about).

Skills

After completed course students shall be able to:

- defining and scoping complex business problems, breaking them down into manageable parts, and analyzing and using data to support arguments,
- evaluating and developing a firm's value creation and business model, as well as its strategic positioning, including balancing exploration and exploitation,
- making clear, and convincing oral and written presentations of complex business problems and outlining productive solutions,
- working in multidisciplinary teams in an effective and efficient manner.

General Competence

Ability to

- reflect on the role of leadership, sustainability, and ethics in business,
- collaborate in multidisciplinary teams, including facilitating productive collaborative processes and solving conflicts that might arise in such collaborations,
- reflect on how strategies for solving complex problems may produce indirect effects and include important trade-offs both internal and external to the company.

Bachelor Electives

19 ELE 3781: Mathematics - Elective

Learning Outcomes

Knowledge

After completing the course, the student will have advanced knowledge of mathematical concepts, models, theories, and methods. The student will have an advanced understanding of linear algebra and matrix methods, complex numbers, optimisation in several real variables, differential and difference equations and optimal control theory, and specialized understanding of how these mathematical models and methods can be used in business, economics and finance.

Skills

After completing the course, the student will be able to analyse quantitative problems using the mathematical language, and be able to use mathematical models and methods to solve these problems. The student will be able to assess solution strategies, be able to carry out necessary computations correctly and precisely. The student will be able to give mathematical arguments for his conclusions, and be able to formulate written answers that explain the methods used and interpret the solutions obtained.

General Competence

After completing the course, the student will be able to reflect upon central assumptions for the models and theories used, and critically assess if they are met in applications. The student will be capable of critical thinking. The student will be able to reflect upon the results obtained, and critically assess if they are reasonable.

20 ELE 3917: Stochastic Processes for Finance and Economics

Learning Outcomes

Knowledge

The students will be introduced to various discrete and continuous time stochastic processes, which frequently appear in financial and economic modeling. They will learn how these stochastic processes are applied in practical problems, and will understand how basic tools from statistics and mathematics can be used to analyse them. Through elementary examples relating to gambling and finance, the students will see how stochastic processes can be used to understand and solve real problems.

Skills

After completion of the course, the student will:

- Have a good understanding of discrete and continuous random variables, expectation and conditional expectation, as well as moments of random variables.

- Be familiar with Poisson processes and discrete random walks
- Understand the relation between a discrete random walk and the continuous Brownian motion.
- Be able to provide an elementary analysis of the sample paths of stochastic processes.
- Have developed a mathematical toolbox for the analysis of stochastic processes.
- Be able to simulate elementary stochastic processes using Python (simple introduction given).
- Be aware of how these models are applied in economics, insurance and finance.
- Be able to create simple models for gambling and insurance by using Monte Carlo simulations.

General Competence

Students will work throughout the semester with various written assignments, which in the end will be evaluated and part of the final grade. Students are allowed to collaborate on the assignments, and half way through the semester get the chance to give an oral presentation of their results and receive feedback.

Oral presentations of mathematical computations and ideas is an important skill valued by employers in the industry and will prove useful for further studies.

21 EXC 3506: Research Methods and Econometrics

Learning Outcomes

Knowledge

After the course, the students will have knowledge about:

- Important research methodological concepts
- The main principles of scientific thinking and formulation of hypothesis
- Knowledge of the main approaches (both qualitative and quantitative with the focus on the latter) to the collection, processing and analysis of data
- Basic econometrics
- Possibilities and limitations of econometric tools for business uses (research, quality control, forecasting, logistic analysis and control, etc.)
- Limitations in the case where statistical assumptions are violated
- The plurality of interpretation and uncertainty associated with econometric analysis

Skills

After the course the students will be able to:

- Understand and assess research based on scientific principles
- Evaluate which approaches that best suit the nature of a research question
- Collect, process and analyse data on the basis of scientific research methods
- Conduct econometric analysis by means of modern software

- Conduct and interpret the results of multiple econometric hypothesis testing, also in the cases where the classical assumptions are not fulfilled
- Undertake model selection

General Competence

- The students should acquire a conscious and critical attitude towards data, towards econometric analysis, and towards the assessment and interpretation of results from applied research

22 FIN 3621: Options and Futures

Learning Outcomes

Knowledge

The students will acquire a good understanding of the derivatives markets and the derivatives securities available for trading. More specifically the students will develop their understanding with respect to the following topics:

- The derivatives markets, their participants, their basic functioning and the idiosyncrasies of each
- The structure and specifics of the basic derivative securities, futures, forwards, and options
- The principles behind the pricing of derivative securities, namely no-arbitrage and risk-neutral pricing
- Understand the applicability and limitations of the standard pricing techniques
- Understand relevant risk measures of options

Skills

During the acquisition of the above mentioned knowledge the students will acquire the following skills:

- Represent the payoff/profit of a derivative contract both diagrammatically and mathematically
- Construct and evaluate various derivative strategies
- Price derivatives such as options, forwards, and futures using the Black-Scholes model, the binomial model, and no-arbitrage principle
- Conduct hedging using derivative contracts
- Calculate option risk measures (Greeks) and conduct delta hedge
- Implementing Binomial pricing models using Excel or R

General Competence

The acquired theoretical and practical knowledge provided by the course should enable the student to understand and apply the basic principle behind the pricing and hedging of derivative instruments such as replication and arbitrage. In addition, the student would acquire the ability to appreciate the financial and economic opportunities that derivative instruments offer while also being able

to critically assess their role and practical value in light of how these products are being used in practice

Master

23 TEM 0050: Mathematics and Statistics for Data Science

Learning Outcomes

Knowledge

After completing the course, the student will have an advanced understanding of

- Linear algebra
- Calculus in several variables
- Optimization
- Probability
- Statistical inference

Skills

After completing the course, the student will be able to

- Use mathematical and statistical methods to analyse and solve problems arising in business, economics and finance
- Assess solution strategies and carry out computations accurately
- Give mathematical arguments for their conclusion, including formulation of written justifications detailing how the solution was obtained
- See the connections between mathematics, statistics, computer science and other subjects

General Competence

After completing the course, the student will be able to

- Reflect upon central assumptions for the models and theories used and critically assess if they are met in applications
- Assess obtained results and critically assess if they are reasonable from a mathematical and statistical viewpoint

24 TEM 0051: Machine Learning Operations

Learning Outcomes

Knowledge

Add a sentence in the beginning of each learning outcome, like "the student can:" (See here: : https://www.nokut.no/en/norwegian-education/the-norwegian-qualifications-framework-for-lifelong-learning/beskrivelser-av-laringsutbytte-for-nivaene-i-nkr/)

- Define and explain the fundamentals of object-oriented programming
- Understand the concepts of classes, objects, methods, constructors, or inheritance
- Describe what version control tools do, and how they contribute towards increased productivity in programming
- Can identify and describe the important components of an efficient automated machine learning pipeline.
- Can compare various data preparation/cleaning procedures and know how these might affect estimation output at a later stage.
- Demonstrates a good understanding of different database infrastructures, such as relational and non-relational databases, and can adequately contrast and compare how they fit in different situations.

Skills

- Use Python to design programs using object-oriented programming
- Use version control tools to track, share, and cooperate while coding a program
- Handle large data sets with Python
- Can effectively use Python libraries for data science applications such as NumPy, Pandas, Matplotlib, SciPy, and Scikit-learn.
- Can build, deploy, and manage machine learning pipelines in an efficient manner, including cleaning, transforming, merging and reshaping data.
- Can apply a number of data curation techniques to handle, e.g., missing numbers and outliers in the data.
- Can read/write data from/to a database

General Competence

- The student will be able to design computational and data intensive applications using object-oriented programming.
- A successful student can work efficiently individually, or in teams, using version control tools.
- Understands the end-to-end process of building a data science project and knows how to build efficient workflows.
- By replicating real-world situations, students can understand what challenges they will face as data scientists and how to solve them.

25 TEM 0641: Numerical Methods for Pythons with Applications

Learning Outcomes

Knowledge

- After taking the course students should have a basic understanding of numerical methods and how to apply them to solve economic models. The emphasis of the course is applying the

methods to a range of topics of interest in business economics and finance such as: climate change, portfolio choice, planning/inventory problems, etc.

- Students should be able to use the Python language to solve models that arise in business economics.

Skills

- Students will learn basic numerical techniques in Python. They will also know how to apply several scientific packages normally used in applied work.
- Students will learn how to solve and analyse economics models and produce quantitative answers to a variety of practical problems.
- Students will also learn practical techniques in numerical methods in Python. The course is hands-on and they will learn by doing several scientific packages that are often used in practical applications in business economics.

General Competence

- Students will reflect on the importance of economic reasoning in approaching practical questions of economic importance by the practice of solving and analysing economic models. The course offers an opportunity to reflect on how effective a programming language can be to produce quantitative answers to many economic problems.

26 TEM 0052: Predictive Modelling with Machine Learning

Learning Outcomes

Knowledge

By the end of the course students can

- explain statistical principles behind predictive modelling including bias/variance trade-off, over-fitting, and regularisation;
- describe and compare standard ML algorithms for regression, classification, clustering, ensembles, and feed-forward neural networks;
- identify assumptions, strengths, and limitations of each method with respect to accuracy, interpretability, and computational cost.

Skills

Students will be able to

- design, implement, and validate predictive models in Python (NumPy, scikit-learn, PyTorch)
- apply cross-validation, hyper-parameter tuning, and model-selection strategies in reproducible ML pipelines;
- extend linear regression to penalised models (ridge, lasso, elastic-net) and to GLMs (logistic, Poisson, etc.);

- critically evaluate model performance and communicate findings in professional reports and presentations.

General Competence

Students will

- translate business or societal problems into data-driven questions;
- collaborate effectively in interdisciplinary teams, balancing statistical rigour with pragmatic data-science practice;
- reflect on ethical, legal, and sustainability aspects of predictive analytics (bias, privacy, transparency).

27 TEM 0053: Time Series Analysis and Sequential Data Networks

Learning Outcomes

Knowledge

After completing the course, the student

- Has a solid understanding of how NLP and time series methods can be strategically integrated into business processes, leading to improved efficiencies and competitive advantages.
- Will be able to discuss and differentiate between different NLP and time series methodologies and identify their strengths and weaknesses in relation to specific business cases.

Skills

After completing the course, the student

- Will be proficient in selecting and applying relevant sequence data tools and algorithms.
- Has the ability to create empirical models using sequence data and apply them strategically to drive business growth, foster innovation, and gain a competitive edge in the digital era.

General Competence

After completing the course, the student

- Can describe and apply fundamental sequence data tools, and extrapolate the knowledge and skills obtained in this course to other relevant fields.
- Has a broader understanding of how different data modalities can be used to create business value, including considering the sustainability aspect of modeling high-dimensional sequence data.

28 TEM 0058: Causal Inference

Learning Outcomes

Knowledge

- Students will develop a solid understanding of the potential outcome framework and clearly distinguish between various types of treatment effects.
- Students will understand and articulate the differences between causal inference models and predictive modeling approaches.
- Students will become well-versed in the design, implementation, and analysis of experimental and quasi-experimental methods for causal inference, including an understanding of their strengths and limitations.

Skills

- Students will learn how to apply microeconometric methods effectively to answer counterfactual ("what if") questions relevant to business and policy decisions.
- Students will gain hands-on experience in causal inference through replicating and extending empirical analyses from published research papers.

General Competence

- Students will develop the ability to critically evaluate and discuss empirical research, paying close attention to methodological assumptions and empirical implementations.
- Students will cultivate a mindset oriented toward rigorous, data-driven decision-making, emphasizing both analytical clarity and practical applicability.

29 TEM 0644: Quantitative Risk and Asset Management

Learning Outcomes

Knowledge

By the end of the course, students are expected to know:

- Common measures of risk.
- Properties of univariate and multivariate time series.
- Tools for univariate and multivariate modelling of skewness and fat tails.
- The Kelly optimal growth criterion.
- Models of time-varying volatility.
- Factor models.
- Mean-variance optimization in practice (non-normality, estimation error, model error).
- Some popular portfolio management strategies and their connection to mean-variance optimization.

Skills

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General Competence

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30 TEM 0054: Deep Learning and Explainable AI

Learning Outcomes

Knowledge

By the end of the course, the students will be able to

- describe the fundamental concepts of deep learning and neural networks.
- explain the differences between the various deep learning architectures and their learning algorithms.
- describe key principles and techniques of Explainable AI for model interpretability.

Skills

By the end of the course, the students will be able to

- choose appropriate methodology for a given learning problem and given data set.
- implement, train, and evaluate deep learning models using TensorFlow.
- use generative models to deal with limited amount of data.
- use XAI methods to interpret and explain deep learning models and their predictions.

General Competence

By the end of the course, the students will be able to:

- critically assess the strengths and limitations of deep learning models.
- work effectively individually and in teams to develop and analyze deep learning models.
- communicate technical findings and insights to both technical and non-technical audiences.
- apply ethical considerations in AI, particularly regarding model transparency and bias.
- follow the advancements in deep learning and XAI through academic literature and industry trends.

31 TEM 0061: Data Protection and Ethics

Learning Outcomes

Knowledge

This course will provide a comprehensive understanding of the legal and regulatory frameworks governing data protection and privacy. Students will learn about the essential requirements of data protection law in the European Economic Area (EEA) and the European Union (EU), as well as the ethical implications and competitive advantages of using personal information in doing business.

Throughout the course, students will:

- Learn about key terminology related to data protection and privacy
- Develop a fundamental understanding of the rules and principles for protecting privacy and personal data, particularly as laid down in EU and other international instruments.
- Gain detailed knowledge of the EU General Data Protection Regulation (GDPR)
- Understand the rules concerning the transfer of personal data to other countries
- Gain solid understanding of the main data protection concerns associated with big data analytics and AI, and mechanisms for addressing these challenges
- Learn about the ethical challenges in modern business arising from the use of personal information and big data, such as monitoring, surveillance of individual behavior, and offering personalized services and products
- Explore the big data paradoxes of transparency, identity, and power.

Skills

At the end of the course, the students will:

- Be able to differentiate between legitimate and problematic business behavior in light of data protection rules
- Can design and advise on appropriate solutions to address privacy concerns associated with the use of AI, algorithms, and big data
- Be able to see the potential for technological development and discuss it based on regulations in privacy protection
- Be able to engage in informed debate on the necessary balance between the need of privacy and control over data in business settings and markets at large
- Be able to recognize the ethical and regulatory challenges of big data analytics and data sharing

General Competence

At the end of the course, the students will:

- Develop heightened ethical consciousness when assessing data protection challenges
- Recognize and navigate ambiguities beyond clearly defined regulatory boundaries
- Be able to place data protection rules within the broader context of ethical business conduct and responsible use of technology

Master Electives

32 TEM 0400: Business Economics

Learning Outcomes

Knowledge

This course aims to provide students with an understanding of: (i) the economics of competition, monopoly, and oligopoly; (ii) contracts such as product pricing; (iii) basic game and contract theory; (iv) vertical relations between firms; (v) economic organization (vi) market dynamics. Overall, students learn an economic approach to assessing firm decisions and organization of economic activities.

Skills

- Students should be able to design price schedules or structure products that maximize firm profits under the constraints posed by market structure and available information and evaluate how these solutions affect social surplus.
- Students should be able to analyze strategic interaction among firms, and thereby develop skills to predict market outcomes such as prices, competition intensity and ultimately firm profitability and social surplus.
- Students should develop skills to design contracts that can be used between and within firms to solve coordination problems and create value to firms and society. As part of this skill, students should be able to assess how the content of contracts is likely to shape decisions made by the contractual parties and the distribution of surplus between them.

General Competence

Through this course, students should develop basic understanding of how outcomes such as firms' price setting, social surplus and organizational efficiency are shaped by individual incentives and constraints. The course aims to develop an understanding of strategic interaction. Namely, to evaluate the consequences of a possible decision by one firm or employee, it is necessary to internalize how that decision affects the behavior of other firms and workers. Students should also learn the basic economic challenges that are associated with organizing economic activities when many agents are involved, as in a firm. Throughout the course, students will learn how to design contracts wisely, and some of the main solutions that economics proposes to overcome coordination problems and to promote surplus at the higher level of the firm or society at large.

33 TEM 0420: Strategic Risk Analysis

Learning Outcomes

Knowledge

After finishing this course, the student should have knowledge about:

- Differing types of risk that organizations face, as well as possible responses to these risks.

- Tools and processes required for strategy implementation.
- Corporate governance and its associated risks.
- The internal auditing process.
- Financial risks that organizations face.
- Alternative tools to manage financial risks.

Skills

After finishing the course, the student should be able to:

- Identify, evaluate, and respond to the different types of risk facing an organization.
- Evaluate the tools and processes required for sustainable strategy implementation.
- Understand the importance of good corporate governance in order to manage risk.
- Develop, evaluate, and apply internal control systems managing risks.
- Evaluate risk management strategies and internal control.
- Identify and evaluate different types of financial and operational risks.
- Evaluate alternative risk management tools.
- Understand the potential risks that come with particular risk management tools and how to avoid them.

General Competence

Upon completion of the course, the student should understand the risks companies face; and the ethical, social, and environmental issues arising from risk management. They should also know how risks are identified and evaluated, and how they are addressed to avoid affecting future cash flows and misstatements in financial reporting.