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MSc Data Science and Business Analytics
University of Amsterdam

Assessment of conditions

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Project code P2204

Contents

Summary

The initial accreditation of the MSc Data Science and Business Analytics in December 2021 was conditionally positive, stating two conditions regarding the business analytics content and the admission requirements. Firstly, the programme was to adapt the curriculum to include advanced level business analytics. Secondly, the programme was to update the admission requirements to safeguard a sufficient level of business analytics, including Operations Research (OR) and optimization, and data science/programming skills.

The panel appreciates the work done and the improvements made regarding the two conditions set in the previous assessment. It concludes that both conditions have been met.

- *Condition 1: Business analytics content of the curriculum*. The programme chose to increase the amount of advanced business analytics content in the curriculum, and implemented this in a satisfactory way. The panel considers the curriculum to be sufficiently challenging for BSc graduates from both data science and business analytics. For the latter, the panel recommends careful monitoring of the first cohort of students coming from the UvA BSc Business Analytics. The programme management is currently streamlining the curriculum through the development of learning lines, in order to enhance the integration of both business analytics and data science content.

- *Condition 2: Admission requirements:* The admission requirements of the programme have been sufficiently adapted regarding the level of business analytics and data science. The content of the courses as well as the experiences of staff and students demonstrate that this starting level of students allows the courses to successfully build up towards a master's level in both business analytics and data science.

In general, the panel encourages the programme to keep working on developing a clear identity shared by all stakeholders. The programme should further develop the curriculum based on this identity, relying less on the content offered by other master's programmes in the faculty. Furthermore, the programme should work on formalizing and structuring its quality assurance and management to become future proof in view of the expected increase in the number of students. According to the panel, the dedicated teaching staff of the programme puts the programme in a good position to realize these aims.

Score table

The panel assesses the programme as follows:

MSc Data Science and Business Analytics	
Standard 1: Intended learning outcomes	meets the standard
Standard 2: Teaching-learning environment	**meets the standard**
Standard 3: Student assessment	meets the standard
General conclusion	**positive**

Prof.dr.ir. K.I. (Karen) Aardal (chair)
Date: 14 April 2023

Peter Hildering MSc (secretary)

Introduction

Procedure

Assessment

On 14 March 2023, the MSc programme Data Science and Business Analytics of the Faculty of Economics and Business of the University of Amsterdam was assessed by an independent panel to determine whether the programme had fulfilled the conditions imposed by the initial assessment panel on 7 December 2021. The assessment followed the procedure and standards of the NVAO Assessment Framework for the Higher Education Accreditation System of the Netherlands (September 2018). Quality assurance agency Academion coordinated the assessment upon request of the University of Amsterdam.

Panel

In consultation with the programme, Academion approached the members of the initial accreditation panel that participated in the site visit in 2021. The NVAO confirmed the composition of the panel on 7 December 2022.

The panel assessing the MSc Data Science and Business Analytics at the University of Amsterdam consisted of the following members:

- Prof. dr. ir. Karen Aardal (TU Delft) - chair
- Prof .dr. ir. Jan Fransoo (Tilburg University)
- Dr. Lieven Quintens (Maastricht University)
- Ruward Karper MSc – (alumnus MSc Data Science TiU/TUe) - student member

Peter Hildering MSc of Academion acted as coordinator and secretary of the assessment. He has been certified and registered by the NVAO.

Preparation and site visit

The programme prepared a status report in the form of a self-evaluation of the implemented recovery plan, which was made available to the panel members and secretary in preparation of the online visit. Prior to the visit, the panel studied this report as well as a number of supporting documents (see appendix 4). The panel members circulated their preliminary findings on the self-evaluation report and other materials, sharing these with the panel secretary.

The University of Amsterdam composed a site visit schedule in consultation with Academion (see appendix 3), and provided the panel with the opportunity to speak to the programme management, students and teaching staff about the conditions imposed on the MSc during the initial accreditation, in a site visit on 14 March 2023.

Report

The secretary wrote a draft report based on the panel's findings and submitted it to a colleague at Academion for peer assessment. Subsequently, the secretary sent the report to the panel for feedback. After processing this feedback, the secretary sent the draft report to the programme in order to have it checked for factual irregularities. The secretary discussed the ensuing comments with the panel chair and changes were implemented accordingly. The panel then finalised the report, and the secretary sent it to the Faculty of Economics and Business of the University of Amsterdam.

Information on the programme

Name of the institution:	University of Amsterdam
Status of the institution:	Publicly funded institution
Result institutional quality assurance assessment:	Positive

Programme name:	Data Science and Business Analytics
CROHO number:	60984
Level:	master
Orientation:	academic
Number of credits:	60 EC
Specialisations or tracks:	-
Location:	Amsterdam
Mode(s) of study:	Fulltime
Language of instruction:	English
Submission date NVAO (conditions):	08-03-2024

Description of the assessment

Introduction

The MSc Data Science and Business Analytics was assessed by an external panel on 7 December 2021 seeking initial accreditation. In its report, the panel advised the NVAO to accredit the programme under two conditions regarding standard 2 of the assessment framework (Teaching-learning environment):

1. The curriculum should be improved with regard to the business analytics content. The programme should include advanced level business analytics content to serve graduates from the BSc Business Analytics, or abandon the position that the programme is a direct follow-up of this BSc, and communicate this clearly to prospective students.
2. The programme should update its admission requirements, in particular with regard to the level of business analytics, including Operations Research (OR) and optimization, and data science/programming skills. The requirements should be adjusted to ensure that an advanced level in both business analytics and data science can be achieved for all students during the curriculum.

The assessment panel made six additional recommendations for improvement.

I. The programme management and teaching staff should engage in further discussion to ensure that their vision on the programme becomes fully aligned; the excellent views of the teaching staff are a good starting point for these discussions.
II. Improve the mapping of the courses to the intended learning outcomes (ILOs) by being more selective in which courses cover what learning outcome. Formulating learning lines through the courses and the associated assessment might be useful to achieve this. To this end, it may be useful to split ILO 1 into three more specific elements regarding analytics, business, and computer/data science, such that the overall matrix becomes more sparse.
III. Expand the learning outcome describing the knowledge obtained by students, describing the particular knowledge that students should obtain in analytics, business, and computer science (ABC) respectively.
IV. Rephrase the learning outcome on research skills to better reflect the master level of the programme.
V. Drop the Quantum Computing elective from the curriculum until quantum computing has matured more. For a course such as quantum computing it will be essential to ensure that the students have sufficient background knowledge.
VI. Monitor the workload of thesis supervisors during the summer with regard to thesis deadlines in mid-summer.

The Board of the NVAO adopted these conditions and recommendations, and granted the MSc Business Analytics conditional accreditation on 8 March 2022. Based on the issues signaled by the panel, the programme formulated a Recovery Plan, and implemented this in the regulations and curriculum for the first cohort of students per 2022-2023. This report uses this Recovery Plan and the implementation thereof as the basis for an assessment of the two conditions imposed by the previous assessment panel.

Standard 2. Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Findings

Recommendation 1: Business analytics content

Programme vision and curriculum adaptations
In 2021, the panel concluded that the proposed teaching-learning environment of the MSc was generally of a high quality, yet lacked advanced level business analytics content. As the MSc programme aimed to serve graduates from BSc programmes in both Data Science and Business Analytics (and most prominently the UvA BSc Business Analytics), the panel concluded that it should either add advanced business analytics content to the curriculum to provide graduates from a BSc Business Analytics with sufficient challenge, or abandon the position that the MSc Data Science & Business Analytics is an advanced Business Analytics programme for graduates from a BSc in this field.

In response to the observations of the panel, the programme management and teaching staff reflected on their vision on MSc (in line with recommendation I). It was concluded that the panel was correct in observing that the programme is essentially a data science programme in a business context, rather than an advanced business analytics programme. The connection to a BSc Business Analytics is that it allows students to combine advanced data science and business analytics techniques to solve business-related problems.

The programme translated this vision into an adapted curriculum. This new curriculum takes existing business analytics knowledge and skills as a starting point (see also Admission requirements below). The courses add advanced data science as well as advanced business analytics content to this existing knowledge, and teach student to connect the two elements. The advanced business analytics content has been added by changing the mandatory *Machine Learning* course into the course *Machine Learning and Optimisation*, which teaches students advanced optimization methods and connects these to machine learning. Furthermore, the *Data Science Methods* course has been adapted to cover more advanced topics such as Bayesian learning and density forecast evaluation. In order to give students the opportunity to further develop advanced business analytics skills, the programme added *Supply Chain Analytics* and *Machine Learning in Finance* as constrained-choice electives in the second semester. The latter replaces the *Quantum Computing* course, which was dropped from the curriculum following the advice of the panel (recommendation V). This new curriculum (see appendix 2) was implemented in 2022-2023 for the first cohort of students.

The panel studied the new curriculum and the content of the new and adapted courses, and discussed them with management, students and teaching staff. It observes that the programme has reflected on its vision on the programme, and has adapted the curriculum of the programme accordingly. The panel respects the programme's choice to further improve the advanced business analytics content of the curriculum, and concludes that this has been done in a satisfactory way. The panel expects, also based on the discussion with students coming from the BSc Econometrics, that graduates from a BSc Business Analytics will have sufficient opportunities to study advanced business analytics content. The first cohort of students for which this is the case can be expected in 2024-2025, when the first graduates of the UvA BSc Business Analytics can

enrol in the MSc. The panel thinks it would be helpful to careful monitor this future cohort of graduates of the BSc Business Analytics, and using the feedback of these students to further fine-tune the curriculum.

From the discussions with management and teaching staff, the panel notes with appreciation that the programme management and the teaching staff further aligned their vision. It has developed into a shared aim of teaching students how to use data science methodologies on business challenges. However, the panel observed that there are still slight differences in perception. While the teaching staff in particular mentions that the programme aims to integrate data science and business analytics methodologies, the programme management is more inclined to mention the application of data science methodologies on business challenges. The panel advises the programme to elaborate on the role of business analytics in the vision on the MSc, and to what extent this is the same as working on business challenges. According to the panel, formulating a shared mission and story is important for a new programme, especially when it has emerged from building blocks of various existing programmes. The panel thinks that the programme would benefit from further developing its identity in the coming years. The programme has been established and can reasonably expect a higher number of students in the coming years. This provides the opportunity to further develop the programme based on its own mission and vision, with less reliance on courses already available within other master's programmes.

Learning lines and future development
Besides the curriculum content, the programme also adapted the intended learning outcomes and learning lines of the programme in line with the programme vision and the panel recommendations. The programme formulated three programme-wide learning lines (recommendation II): academic skills, professional skills and content/knowledge. It introduced regular meeting series, where the programme director and teaching staff discuss these learning lines and the alignment between courses. To further ensure the alignment with the BSc Business Analytics, the programme director of this BSc also attends the meetings. For the content/knowledge learning lines, there are separate meetings between course coordinators to align courses with specific content, such as machine learning and statistics. The programme is currently working on more extensive learning lines and associated ILOs that describe the knowledge and skills students obtain in analytics, business and computer science (recommendation II and III), as well as the integration of these three elements. The programme has requested the assistance of the university's Teaching and Learning Centre, and expects these changes to become effective from the academic year 2024-2025 onward.

The panel approves of the further streamlining of the curriculum, and thinks that this development of the ILOs and learning lines helps to ensure that all students encounter sufficient data science and business analytics content within the programme. The involvement of the programme director of the BSc Business Analytics in these discussions promotes alignment between the BSc and MSc programmes. In the discussions during the site visit, the panel understood that the programme is considering letting the knowledge and skills learning lines evolve into two tracks for the programme, allowing students to further specialize in either Data Science or Business Analytics after following shared core courses. The panel understands these considerations, but also underlines that the combination of data science and business analytics is one of the core strengths of the programme. It recommends ensuring that this identity remains present in the programme for all students by keeping a sufficiently strong core of business analytics and data science for all students.

<u>Recommendation 2: Admission requirements</u>

In order to realize the vision of the programme described above, the curriculum should build upon pre-existing knowledge of business analytics. The programme has adapted its admission requirements to

safeguard this, and implemented the changed requirements for the 2022-2023 cohort. Students of the BSc Business Analytics are directly admitted; students from the related UvA BSc programmes Econometrics and Actuarial Sciences are admitted on the condition that they completed the Optimization elective. Other UvA BSc students are required to have completed the UvA minor or pre-master Econometrics, as well as the Optimization elective.

For non-UvA students, an Admission Board decides whether the student has knowledge and skills at the level of the BSc Business Analytics on the following content: (1) probability and mathematical statistics, (2) linear algebra, calculus and analysis, (3) data science and programming skills, (4) operations research and optimization, and (5) econometrics. The programme website helps prospective students self-assess whether they qualify prior to applying.

The panel studied the new admission requirements of the programme and discussed them with teaching staff and students. It concludes that the admission requirements have been sufficiently adapted regarding the level of business analytics and data science. Furthermore, it understood from students and staff, as well as from the course materials, that the courses successfully build up to a master's level in business analytics and data science. The teaching staff is aware of the variation in background and entry level in various courses between students, and anticipates this in lectures. As a result, graduates from bachelor's programmes in both fields feel sufficiently challenged by the courses. The panel compliments the programme with this, and concludes that the programme has convincingly fulfilled the recommendation concerning the admission requirements.

Other recommendations

The panel's recommendations on the phrasing of the ILO on research skills (recommendation IV) was addressed by adapting ILO 5 (see appendix 1) from 'conduct independent research at a post-graduate level' to 'conduct independent research'. The panel thinks that this is more fitting for a master's programme, although it considers the phrasing still to be quite broad. It trusts the programme to further operationalize this ILO in the programme assessment, for instance in the rubric of the master's thesis. Regarding the workload of thesis supervisors in the summer (recommendation VI), the programme has decided to shift the thesis deadlines to 15 July, and only allowing extension to 15 August for delays outside the span of control of the students.

The panel appreciates the follow-up of the additional recommendations made during the initial accreditation. Regarding the workload for thesis supervision, the panel noted that the teaching staff is aware of the potential risks of supervision workload during the summer, and is committed to using the option for extension only in exceptional cases. Regarding the expected growth of the programme, the panel suggests facilitating both students and thesis supervisors with more extensive guidelines for the thesis to promote timely completion, for instance in the shape of a thesis guide for teaching staff and students.

Final remarks

As a final remark for further development, the panel encourages the programme to proactively scale up its system of quality assurance to prepare for the expected rise in student numbers. The panel noted during the site visit that the current quality assurance and management culture of the programme has the characteristics of those of a small-scale programme, with several separate initiatives to collect feedback and align the course content. This works well at the moment, but considering the expected growth in student numbers, the panel thinks that further formalization and professionalization would be beneficial. Examples

are a more structured system for collecting student feedback rather than informal talks with students, and the integration of the learning lines into the assessment plan of the programme rather than alignment between individual course coordinators. The planned cooperation with the university's Teaching and Learning Centre is a good first step in this direction; the panel encourages the programme to continue down this path. Furthermore, the programme should prioritize filling the vacancy for a student member of the MSc Business Analytics & Data Science in the programme committee, since structured student feedback is crucial for the professionalization of quality assurance. The panel noted during the site visit that the MSc has an excellent teaching staff that already has a frequent informal contact to align the programme content, so it has full confidence that the programme has the potential to realize this.

Considerations

The panel appreciates the work done and the improvements made regarding the two conditions set in the previous assessment. It concludes that both conditions have been met.

- *Condition 1: Business analytics content of the curriculum*. The programme chose to increase the amount of advanced business analytics content in the curriculum, and implemented this in a satisfactory way. The panel considers the curriculum to be sufficiently challenging for BSc graduates from both data science and business analytics. For the latter, the panel recommends careful monitoring of the first cohort of students coming from the UvA BSc Business Analytics. The programme management is currently streamlining the curriculum through the development of learning lines, in order to enhance the integration of both business analytics and data science content.

- *Condition 2: Admission requirements:* The admission requirements of the programme have been sufficiently adapted regarding the level of business analytics and data science. The content of the courses as well as the experiences of staff and students demonstrate that this starting level of students allows the courses to successfully build up towards a master's level in both business analytics and data science.

In general, the panel encourages the programme to keep working on developing a clear identity shared by all stakeholders. The programme should further develop the curriculum based on this identity, relying less on the content offered by other master's programmes in the faculty. Furthermore, the programme should work on formalizing and structuring its quality assurance and management to become future proof in view of the expected increase in the number of students. According to the panel, the dedicated teaching staff of the programme puts the programme in a good position to realize these aims.

Conclusion

The panel concludes that the programme meets standard 2.

General conclusion

The panel's assessment of the MSc Data Science and Business Analytics is positive.

Appendix 1. Intended learning outcomes

Dublin Descriptors	Intended learning outcomes of the MSc Data Science and Business Analytics
Knowledge and understanding	1. advanced knowledge of data science and econometric methods in business analytics, covering a balanced mix of Analytics (A), Business (B) and Computer Science (C) subjects; 2. thorough understanding of the role of data driven processes in organisations, enabling the shift towards data-driven decision making in businesses; 3. thorough understanding of the scope and limits of data science and econometric methods in business analytics;
Application of knowledge and understanding	4. awareness of the ethical, legal and societal implications of data science and algorithmic design and the ability to incorporate these implications in decision making for businesses and their stakeholders; 5. the ability to conduct independent research, which includes being able to design or re-design methodology, apply it and report on the findings in view of the adequate suitability of the methodology and the data; 6. the ability to write a cohesive scientific paper with regard to a subject of the Master's programme and to present the paper to a professional audience;
Making judgements	7. based on a multidisciplinary attitude, the skills to translate a problem from practice into a problem definition that can be analysed by methods from the fields of data science and econometrics, and the ability to translate the results of these analyses back to the practical setting;
Communication	8. the ability both to function independently and to cooperate constructively within a team based on a professional and multidisciplinary attitude; 9. the ability to effectively interact with an international team in the chosen professional field and to manage challenges from diverse perspectives; 10. the ability to clearly communicate and professionally present (orally and in writing) information for an expert or nonexpert audience;
(Lifelong) Learning skills	11. acquired academic and professional skills that enables the student to think critically and to analyse situations in their chosen professional field through the application of analytical thinking skills. The knowledge, skills and pro-active learning attitude to grow towards a leadership position in the profession.

Appendix 2. Programme curriculum

2022-2023 curriculum of the MSc Data Science and Business Analytics. Courses that were adapted in response to the accreditation are highlighted in red.

<table>
<tr><th>Period 1</th><th>Period 2</th><th>Period 3</th><th>Period 4</th><th>Period 5</th><th>Period 6</th></tr>
<tr><td>Advanced Analytics for a Better World (5 ECTS)</td><td>Privacy & AI, Law & Ethics (5 ECTS)</td><td rowspan="3">Applied AI Research Seminar (5 ECTS)</td><td rowspan="2">Choose 2 courses from:
Supply Chain Analytics (5 ECTS)

FinTech (5 ECTS)

Advanced People Analytics (5 ECTS)

Economic and Financial Network Analysis (5 ECTS)

Machine Learning in Finance (5 ECTS)</td><td rowspan="2">Master's thesis (15 ECTS)</td><td rowspan="3"></td></tr>
<tr><td>Data Science Methods (5 ECTS)</td><td>Advanced Econometrics for DSBA (5 ECTS)</td></tr>
<tr><td colspan="2">Machine Learning and Optimisation (5 ECTS)</td><td colspan="2">Advanced Marketing Analytics (5 ECTS)</td></tr>
</table>

Appendix 3. Site visit schedule

14 March 2023
Faculty of Economics and Business, University of Amsterdam

11:00 – 12:30	Deliberation panel (incl. lunch)
12:30 – 13:15	Interview representatives from management
13:15 - 13:30	Break
13:30 - 14:00	Interview students
14:00 - 14:15	Break
14:15 - 14:45	Interview lecturer team
14:45 - 16:00	Panel meeting (confidential)
16:00 - 16:30	Feedback session

Appendix 4. Materials

The panel considered the following additional materials:

- Teaching and Examination Regulations 2022-2023 (OER) of the MSc Data Science and Business Analytics
- Excerpt from the webpage for students with an international BSc degree
- Curriculum of the MSc Data Science and Business Analytics 2023-2024
- Newly hired faculty in the domain of Business Analytics and Data Science since 7 December 2021
- Course descriptions and content of the courses of the MSc Data Science and Business Analytics, 2022-2023