

BQA NCQF QUALIFICATION TEMPLATE

SECTION A: QUALIFICATION DETAILS																							
QUALIFICATION DEVELOPER (S)			Botswana School of Business Sciences																				
TITLE		Bachelor of Science in Big Data Analytics and Machine Learning								NCQF LEVEL		7											
STRANDS (where applicable)		N/A																					
FIELD		Information and Communication Technology								CREDIT VALUE		480											
SUB FIELD		Information Technology																					
New Qualification		P		Legacy Qualification						Renewal Qualification													
										Registration Code													
SUB-FRAMEWORK		General Education						TVET					Higher Education		✓								
QUALIFICATION TYPE		Certificate		I		II		III			IV			V			Diploma			Bachelor		✓	
		Bachelor Honours				P		Post Graduate Certificate						Post Graduate Diploma									
		Masters										Doctorate/ PhD											
RATIONALE AND PURPOSE OF THE QUALIFICATION																							
PURPOSE: (itemise exit level outcomes) Botswana faces a critical shortage of professionals in machine learning and big data analytics skills identified by the Human Resource Development Council as among the most in-demand for the country's digital economy (HRDC Priority Skills List, 2025). Few graduates currently possess the specialised expertise needed to leverage advanced algorithms and big data for innovation and evidence-based decision-making. This Bachelor of Science in Big Data Analytics and Machine Learning addresses that gap by producing graduates with strong theoretical grounding and practical expertise in data science, machine learning (ML), and big data technologies, directly meeting the needs of both the private and public sectors.																							

The qualification is strategically aligned with Botswana's national development agenda. Vision 2036 (Republic of Botswana, 2016) envisions a high-income, knowledge-based economy that requires deep investment in science, technology, and innovation. The Reset and Reclaim Agenda (Republic of Botswana, 2021) further positions digital transformation as a national priority, calling for a tech-skilled workforce capable of driving public-sector efficiency and Fourth Industrial Revolution (4IR) readiness. This qualification responds directly to both frameworks by equipping graduates to apply data-driven solutions across key sectors including agriculture, mining, finance, healthcare, and governance.

Globally, the demand for these competencies is accelerating. The World Economic Forum Future of Jobs Report (2024) ranks analytical thinking, artificial intelligence, and big data among the top five most in-demand skills worldwide. Across the SADC region, very few undergraduate programmes focus specifically on machine learning or big data analytics, presenting Botswana with a strategic opportunity to lead regional 4IR-ready talent development.

The qualification also addresses Botswana's significant youth unemployment challenge, currently estimated at 40–44% by equipping young Botswana with globally competitive, market-ready digital skills (Edstellar Skills in Demand in Botswana, 2025). Graduates will contribute directly to the country's digital transformation goals, producing a generation of data-driven professionals and ethical innovators capable of advancing a sustainable, knowledge-based economy in line with national aspirations.

The purpose of this qualification is to produce graduates with specialised knowledge, skills and competence to:

1. Innovate across industries: Use machine learning algorithms and big data techniques to solve real-world problems in fields like finance, healthcare, agriculture, mining, and government, which will help Botswana's economy make better decisions and streamline its processes.
2. Harness big data for insights: Create, build, and oversee data pipelines and analytical models that can handle large, complicated datasets. This will turn raw data into useful insights that businesses and policymakers can use to support evidence-based strategies.
3. Integrate advanced technologies securely: Use the latest data science tools (like cloud computing, distributed databases, and AI frameworks) to create analytics solutions that can grow, while also putting in place cybersecurity measures and making sure that sensitive data stays safe and secure throughout the project lifecycle.
4. Communicate and lead Effectively: Use clear, non-technical language to explain data-driven findings to stakeholders like executives, clients, or public officials. Show that you can manage projects and work well with others to lead multidisciplinary data projects from start to finish.
5. Promote ethical and responsible AI: Follow all laws, rules, and ethical guidelines when using AI and data analytics. This means making sure that privacy, fairness, and openness are all protected. This will lead to responsible innovation that benefits everyone in society.
6. Adapt and excel in emerging trends: The graduate will be able to adapt solutions to new technologies (like deep learning, Internet of Things data streams, or advanced predictive modelling) and keep their skills up to date in a field that is always changing by continuing to learn and do research to keep up with the fast-changing global trends in artificial intelligence, machine learning, and big data analytics.

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

(a) Certificate IV, NCQF Level 4 entry or equivalent

(b) Recognition of Prior Learning and CAT will be done in line with individual ETP policies.

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SECTION B QUALIFICATION SPECIFICATION	
GRADUATE PROFILE (LEARNING OUTCOMES)	ASSESSMENT CRITERIA
1. Apply mathematical and statistical principles to analyse, model, and solve complex real-world problems in machine learning and big data analytics.	1.1 Select and apply appropriate mathematical methods (including linear algebra, calculus, probability, and discrete mathematics) to formulate and analyse data-driven problems in professional or research contexts. 1.2 Evaluate the statistical characteristics of organisational datasets to inform sampling strategies, data collection decisions, and analytical approaches for industry or research projects. 1.3 Implement optimisation techniques to tune machine learning model parameters, improving system performance and reliability in operational deployment settings. 1.4 Construct and validate mathematical models that represent complex business or social problems, and communicate modelling choices and limitations clearly to technical and non-technical stakeholders.
2. Design, implement, and evaluate machine learning models for classification, regression, clustering, and sequential data analysis	2.1 Select appropriate ML algorithms for specific problem types and datasets. 2.2 Train, validate, and test models using real-world datasets. 2.3 Apply feature engineering and dimensionality reduction techniques. 2.4 Critically evaluate model performance using suitable evaluation metrics.
3. Build and optimize scalable data architectures for big data acquisition, storage, and processing.	3.1 Design batch and stream processing systems using Apache Spark, Hadoop, or equivalent platforms. 3.2 Implement ETL pipelines for structured and unstructured data. 3.3 Manage distributed storage systems (e.g., HDFS, NoSQL, cloud-based storage)

	3.4 Optimize system performance for fault-tolerance, scalability, and throughput.
4. Extract actionable insights from complex datasets using advanced analytics and visualization techniques.	4.1 Perform exploratory data analysis (EDA) and statistical testing. 4.2 Visualize trends, correlations, and outliers using industry-standard tools. 4.3 Translate data into actionable insights through dashboards and storytelling. 4.4 Use advanced analytics (e.g., time series, anomaly detection, geospatial) for decision support.
5. Integrate machine learning workflows into cloud-based and high-performance computing environments.	5.1 Develop and deploy ML models using MLOps tools (e.g., MLflow, Kubeflow). 5.2 Use Docker and containerized workflows for reproducible model deployment. 5.3 Utilize GPUs and parallel computing frameworks for training large models. 5.4 Demonstrate continuous integration and monitoring of deployed ML systems.
6. Conduct ethical, fair, and transparent AI and big data practices in compliance with legal frameworks.	6.1 Identify and mitigate algorithmic bias and fairness issues in ML systems. 6.2 Ensure compliance with Botswana's DPA and other regulatory frameworks. 6.3 Implement explainable AI (XAI) techniques to promote transparency. 6.4 Evaluate ethical trade-offs in data collection, labelling, and model decisions.
7. Undertake research-led and industry-informed projects demonstrating mastery of machine learning and big data analytics.	7.1 Frame a research question or industry problem with defined objectives. 7.2 Apply the complete data science lifecycle in project execution. 7.3 Defend methodology and justify algorithmic choices in written and oral formats. 7.4 Reflect on project limitations and suggest directions for improvement or further research. 7.5 Propose measures for equitable and responsible system deployment.
8. Exhibit workplace-ready technical, collaborative, and communication skills in multidisciplinary analytics settings.	8.1 Participate in team-based data challenges or cross-functional project groups. 8.2 Communicate technical content clearly to both technical and non-technical audiences. 8.3 Demonstrate professional conduct in workplace simulations or internships.

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	8.4 Apply project management, version control (e.g., Git), and documentation best practices.
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SECTION C	QUALIFICATION STRUCTURE				
COMPONENT	TITLE	Credits Per Relevant NCQF Level			Total Credits
		Level [5]	Level [6]	Level [7]	
FUNDAMENTAL COMPONENT Subjects/ Courses/ Modules/Units	Introduction Programming with Python & R	15			15
	Computational Mathematics 1	20			20
	Linear Algebra	20			20
	Discrete Mathematics	20			20
	Introduction to Databases	15			15
	Computational Mathematics 2		20		20
	Foundations of Data Science	15			15

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	Algorithms & Data Structures		15		15
CORE COMPONENT Subjects/Courses/ Modules/Units	Big Data Analytics		15		15
	Machine Learning I		20		20
	Data Engineering for Big Data		15		15
	Cloud-native Big Data Pipelines		15		15
	Machine Learning II			20	20
	Optimization Methods for Data Science		15		15
	Real Time Analytics		20		20
	Distributed Systems			15	15
	Big Data Analytics		20		20
	Deep Learning and Neural Networks			20	20
	Cloud Computing & MLOps			15	15
	AI Ethics, Law, and Policy			15	15
	Big Data Integration Project			15	15
	Entrepreneurship & Innovation in AI			15	15
	High Performance Computing			15	15

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	Big Data System Design			15	15
	Big Data Governance & Strategy			15	15
	Industry Attachment			60	60
STRANDS/ SPECIALIZATION	Subjects/ Courses/ Modules/Units	Credits Per Relevant NCQF Level			Total Credits
		Level [5]	Level [6]	Level [7]	

BOTSWANA
Qualifications Authority

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL

TOTAL CREDITS PER NCQF LEVEL

NCQF Level	Credit Value
5	105
6	155
7	220
TOTAL CREDITS	480

Rules of Combination:

(Please Indicate combinations for the different constituent components of the qualification)

Fundamentals	Level 5	105 Credits
Fundamentals	Level 6	35 Credits
Fundamentals	Level 7	0 Credits
Core	Level 5	0 Credits
Core	Level 6	120 Credits
Core	Level 7	220 Credits
Total Credits		480 Credits

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ASSESSMENT ARRANGEMENTS

Assessment shall consist of the following:

- Formation assessment (60%)
- Summative assessment (40%)

MODERATION ARRANGEMENTS

There is provision for internal and external moderation on all assessments. And the personnel must be registered with BQA as an Assessor with a master's degree in the same or related field.

RECOGNITION OF PRIOR LEARNING

There is provision to award credits through Recognition of Prior Learning.

CREDIT ACCUMULATION AND TRANSFER

There is provision for award of credits through CAT in line with the ETP policies.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

LEARNING PATHWAYS

Vertical Pathways

- Master of Science in Machine Learning and Big Data Analytics
- Master of Science in Artificial Intelligence
- Master of Science in Data Science and Decision Intelligence
- Postgraduate Diploma in Cloud Computing and Data Infrastructure

Horizontal Pathways

- Bachelor of Science in Computer Science and Artificial Intelligence
- Bachelor of Science in Cybersecurity and Data Governance
- Bachelor of Science in Software Engineering
- Bachelor of Science in Robotics and Intelligent Systems
- Bachelor of Science in Smart Infrastructure and Digital Systems

EMPLOYMENT PATHWAYS

- Machine Learning Engineer
- Big Data Analyst / Data Scientist
- AI Solutions Developer
- Cloud and Data Infrastructure Specialist
- Data Engineer (ETL, Pipelines, Streaming)
- Business Intelligence Analyst
- MLOps Engineer / AI DevOps Specialist
- AI Ethics and Governance Officer
- Predictive Analytics Consultant
- Geospatial and Remote Sensing Data Analyst
- Digital Transformation Officer (GovTech / Smart Cities)
- Data Visualization and Storytelling Specialist
- Research Assistant in AI or Big Data Projects

QUALIFICATION AWARD AND CERTIFICATION

The minimum condition for the award is the successful completion of 480 credits, which includes all core modules and a selection of approved electives. Upon successful completion of the program, learners will be awarded the qualification:

Bachelor of Science in Machine Learning and Big Data Analytics

This qualification is a general-purpose degree and does not require strand (specialization) declaration

All awards under this qualification shall be issued in compliance with:

- The Botswana Qualifications Framework (NCQF Level 7)
- The certification and graduation requirements of the awarding institution
- Relevant academic quality assurance regulations

The final award certificate will state:

- Name of the qualification
- Total credit value (480 credits)
- Institution Name and Accreditation Details
- Date of Award

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

a. Qualification Title

The benchmarked qualifications carry varying designation types reflecting their disciplinary orientation. The University of Edinburgh and the National University of Singapore (NUS) award a BSc (Bachelor of Science), consistent with the science and computing focus of the field. The University of Toronto offers the programme as a Specialist within its honours Bachelor of Science framework. Within the SADC region, Stellenbosch University awards a Bachelor of Data Science (BDatSci) a purpose-built interdisciplinary designation combining mathematics, statistics, and computing while the University of Johannesburg offers a BSc in Information Technology with an AI-focused stream, which remains rooted in general IT rather than dedicated data science or machine learning. The proposed qualification is designated as the Bachelor of Science in Big Data Analytics and Machine Learning, consistent with the BSc designation used by the majority of benchmarked institutions. This designation reflects the applied scientific and computational nature of the programme and clearly distinguishes it from general IT qualifications by positioning machine learning and big data as its primary and sustained areas of focus throughout all four years.

b. Credits

The credit values of the benchmarked qualifications range from 360 to 480 credits. The University of Johannesburg's BSc IT carries 360 credits over three years and does not include a compulsory industry attachment. The University of Edinburgh (480 SCQF Credits), Stellenbosch University (480 Credits), and the proposed qualification all carry 480 credits over four years. The University of Toronto and NUS operate under different national credit frameworks but are structured as four-year honours programmes broadly equivalent in academic volume to 480-credit degrees. The proposed qualification's credit value of 480 credits is therefore consistent with the majority of benchmarked programmes, particularly those that include work-integrated learning or an industry attachment as a graduation requirement.

c. Duration and NQF Level

The duration of the benchmarked qualifications ranges from 3 years to 4 years. Where the duration is 3 years, the programme is typically a general IT qualification that may be extended by a further year to attain honours-level standing, bringing credit volume to 480. All four-year programmes are positioned at the honours or equivalent level FHEQ Level 10 in the UK, an honours-level equivalent in Canada and Singapore, and NQF Level 8 in South Africa. The proposed qualification is registered at NCQF Level 7, which corresponds to an ordinary bachelor's degree under the Botswana national framework. This level is consistent with the entry-level bachelor qualifications across all benchmarked

countries and reflects the same positioning in each national framework. The four-year duration and 480-credit volume are consistent with the majority of benchmarked qualifications.

d. Assessment Type

All five benchmarked qualifications make provision for both formative (coursework) and summative (examination) assessment. Continuous assessment through project work, programming assignments, data science portfolios, and group challenges features prominently at the University of Edinburgh, University of Toronto, and NUS, reflecting the practical, applied nature of the field. South African institutions similarly adopt a blend of coursework and formal examinations. The proposed qualification's arrangement of formative assessment (60%) and summative assessment (40%) is consistent with this global emphasis on applied and project-based learning while retaining formal examination as a summative measure.

e. Modules

The modules across all benchmarked qualifications emphasise a common set of core pillars: mathematics and statistics foundations, programming and algorithms, machine learning and artificial intelligence, data engineering and databases, and applied analytics or capstone projects. All programmes introduce foundational computing and mathematics in the early years before progressing to advanced machine learning, deep learning, and specialised analytics in senior years. Ethical and responsible AI content is increasingly embedded across all programmes. The proposed qualification shares these core pillars and additionally sustains a strong focus on big data infrastructure and engineering throughout the programme an area that several benchmarked qualifications treat only as an elective. Modules such as Data Engineering for Big Data, Cloud-native Big Data Pipelines, Distributed Systems, Real-Time Analytics, and Big Data Governance & Strategy give the proposed qualification a distinctive applied infrastructure competency not consistently present in the benchmarked programmes. The mandatory Industry Attachment module (60 credits) further differentiates this qualification by embedding structured, supervised work-integrated learning as a graduation requirement.

The benchmarked qualifications share a common emphasis on employability through industry links, real-world project work, and professional development pathways. Graduates of comparable programmes internationally target roles including Machine Learning Engineer, Data Scientist, AI Solutions Developer, Cloud and Data Infrastructure Specialist, Business Intelligence Analyst, and MLOps Engineer. Learning pathways in all benchmarked programmes prioritise progression from undergraduate study to either professional certification or postgraduate research, with flexible elective structures enabling specialisation. The proposed qualification is fully consistent with these international trends, equipping graduates for immediate employment in data-driven industries while providing clear vertical pathways to postgraduate study at NCQF Level 8 and beyond.

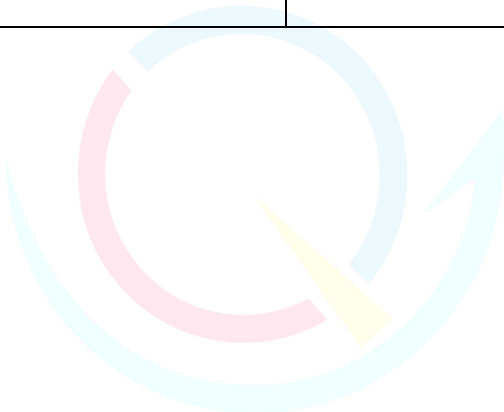
REVIEW PERIOD

The review period is **5 years**.

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For Official Use Only:

CODE (ID)			
REGISTRATION STATUS	BQA DECISION NO.	REGISTRATION START DATE	REGISTRATION END DATE
LAST DATE FOR ENROLMENT		LAST DATE FOR ACHIEVEMENT	



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