![Botswana Qualifications Authority logo]	**BQA NCQF QUALIFICATION TEMPLATE**	Document No.	DNCQF.QIDD.GD02
		Issue No.	01
		Effective Date	04/02/2020

SECTION A:	QUALIFICATION DETAILS						

QUALIFICATION DEVELOPER (S)	University of Botswana						

TITLE	Bachelor of Science in Mathematics and Statistics				**NCQF LEVEL**		7
FIELD	Natural, Mathematical and Life Sciences	**SUB-FIELD**	Mathematics and Statistics		**CREDIT VALUE**		482

New Qualification					✓	*Review of Existing Qualification*		

SUB-FRAMEWORK	*General Education*			*TVET*		*Higher Education*	✓

QUALIFICATION TYPE	*Certificate*	*I*	*II*	*III*	*IV*	*V*	*Diploma*	*Bachelor*	✓
	Bachelor Honours			*Post Graduate Certificate*			*Post Graduate Diploma*	
	Masters					*Doctorate/ PhD*		

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RATIONALE AND PURPOSE OF THE QUALIFICATION

RATIONALE: The current report (2019) on the Human Resource Development Council (HRDC) of Botswana's Priority Skills and Employment Trends' job rankings put data analysts and/or scientists, machine learning and big data specialists high on the list of the future jobs as suggested by the World Economic Forum. All these are specialised jobs that are directly related to the study of mathematics and statistics as a science of decision-making. Furthermore, statistical, mathematical, and related associate professionals have been listed amongst the top occupations in demand in the Research, Innovation, Science and Technology (RIST) sector. These top occupations are informed by national priorities as outlined in the VISION 2036, National Development Plan (NDP 11) and long-term strategies of the different sectors of the economy.

The Bachelor of Science in Mathematics and Statistics qualification offers an opportunity to provide Botswana with a cadre of mathematical statisticians who will be highly equipped with great analytic skills and market-ready to provide technical support required by the different sectors of the economy. Mathematics is a major tool in developing science and supporting modern technology through its diverse applications. Mathematical modelling plays a crucial role in communication technologies, engineering, financial systems, biological systems, and other branches of mathematical sciences. On the other hand, the knowledge of statistics provides the learners with the necessary analytical tools and quantitative reasoning to extract useful information from both the small and big data sets.

PURPOSE:

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

- Apply a wide range of mathematical and statistical techniques in problem-solving, project work, computation, and presentation.

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- Demonstrate critical thinking, generic skills such as written and oral communication, computer-literacy and great interpersonal skills infused through assessments and multicultural environment.
- Show initiative, responsibility, and accountability in the work environment.
- Perform duties in a professional and ethical manner and be able to provide intellectual leadership.

ENTRY REQUIREMENTS (including access and inclusion)

Minimum entry into a Bachelor of Science in Mathematics and Statistics program requires an applicant to have:

I.   Certificate IV, NCQF level 4 (TVET/GE) or equivalent

II.   Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) shall be applicable for admission into the qualification in accordance with institutional and national policies on RPL and CAT.

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SECTION B	QUALIFICATION SPECIFICATION

GRADUATE PROFILE (LEARNING OUTCOMES)	ASSESSMENT CRITERIA
1. Solve complex problems in a range of mathematical and statistical applications using calculus	1.1. Integrate knowledge and ideas of different mathematical techniques and use appropriate techniques to solve and establish results in probability and statistics which can arise in the field of work. 1.2. Apply differentiation to optimization problems arising from theory of estimation and related applications in business, social and life sciences. 1.3. Examine and apply various techniques of integration to establish different measures of probability distributions that are used for modelling natural phenomena. 1.4. Demonstrate specialised knowledge and theory of functions of complex numbers in proving some of the fundamental results in Mathematics.
2. Apply knowledge, understanding and skills to analyze and evaluate mathematical problems using appropriate differential equations.	2.1. Solve problems involving exponential growth and decay, including in population models and mechanics problems. 2.2. Apply advanced techniques such as variation of parameters, and Laplace transform, to solve systems of linear differential equations

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	used to model different problems in economics and natural sciences.
3. Apply appropriate, specialised techniques from linear algebra to solve mathematical, statistical, and real-life applications.	3.1. Formulate logistics, operations, or project management problem as a linear programming problem. 3.2. Compute and apply a (generalized) inverse of a matrix to solve systems of linear systems arising from differential equations, logistics, operations, or project management problems. 3.3. Represent multivariate data arising in business, social and life sciences in a compact matrix form and apply appropriate techniques of linear algebra to transform and/or analyse data.
4. Demonstrate specialised knowledge and critical understanding of well-established principles within mathematical analysis	4.1. Use theory of sequences and series, continuity, differentiation, and integration competently in real life applications. 4.3. Apply the concepts and principles in mathematical analysis in well-defined contexts, showing the ability to evaluate critically the appropriateness of different tools and techniques. 4.4. Effectively write mathematical solutions or proofs in a clear, logical and concise manner for others to be able to understand and follow your work.

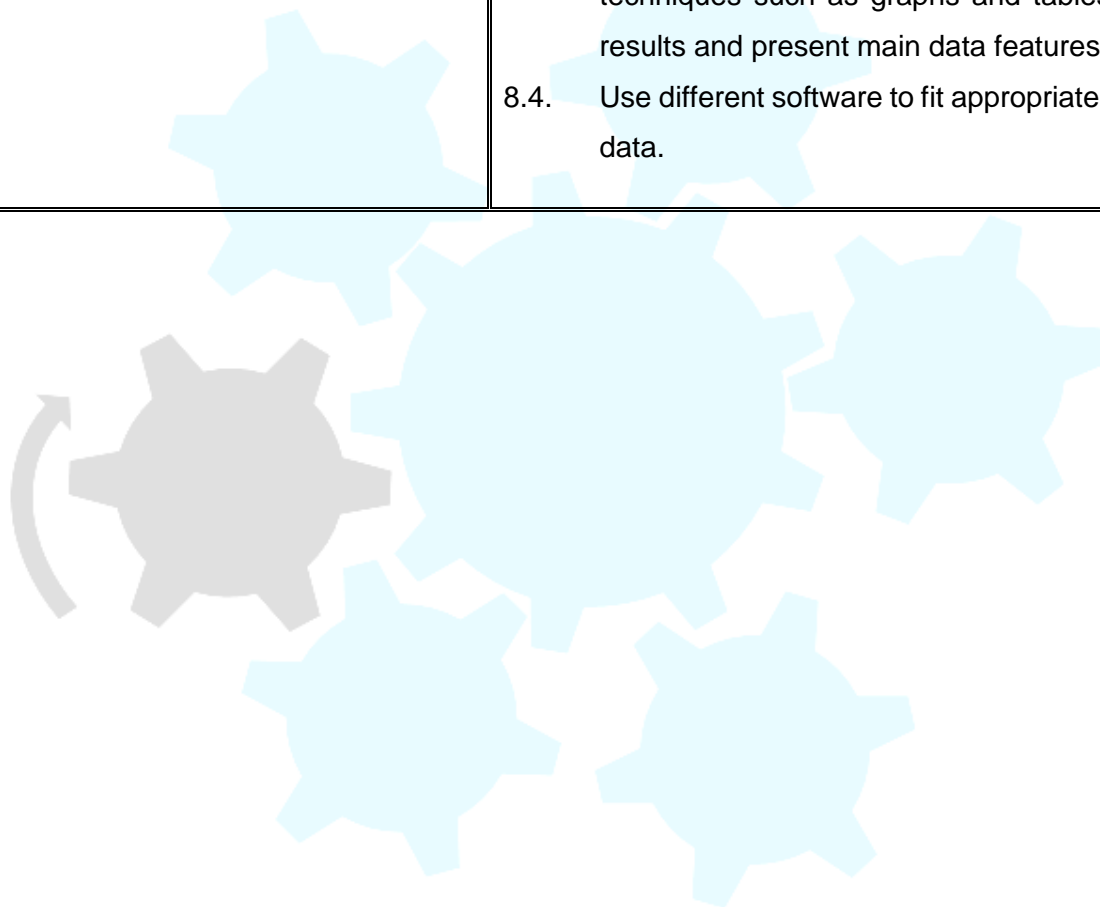*Building a seamless Education and Training System*

5. Apply specialised knowledge of probability and mathematical statistics to real life applications.	5.1. Identify a random variable(s) and their probability distribution(s) for a given real life problem to be able to select the most appropriate model for the problem.
	5.2. Use an appropriate probability distribution to compute probabilities of some well-defined event for a given real life problem.
	5.3. Demonstrate specialised Bayesian statistics knowledge and understanding on how one can incorporate prior knowledge of a problem under study to improve the results of the fitted model.
	5.4. Derive mathematical expectations, generating functions, marginal and conditional distributions, and convolutions of standard statistical distributions and apply them in different research problems.
6. Integrate and apply statistical methods, theory of estimation and hypothesis testing to solve real life problems	6.1. Compute and discuss desirable properties of a given estimator to establish its appropriateness for a given research problem.
	6.2. Apply linear models to real-world problems related to either scientific inquiry, management or decision making.
	6.3. Apply estimation techniques such as maximum likelihood, least squares method and method of moments to compute point and interval estimators for a given research problem.

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	6.4.	Conduct appropriate parametric and non-parametric statistical test for various hypotheses that can arise from different research problems.
	6.5.	Interpret the statistical test results and conclude on the statistical significance of the results.
7. Develop and apply an appropriate study design for a given research problem independently	7.1.	Develop a basic or specialised study design using either a sample survey or an experiment for research problems in agriculture, business, health, social and life sciences.
	7.2.	Implement the study design and monitor the experiment or field survey to ensure professional integrity during both data collection and analysis stages.
	7.3.	Analyse critically survey or experimental data and interpret the results to inform decision-making and policy formulation.
	7.4.	Organise and effectively disseminate experimental or survey results to other stakeholders through either workshops, seminars or publications.
8. Use statistical software to extract, transform, explore, and analyse data	8.1.	Capture and store data into an appropriate format for data analysis.
	8.2.	Import, clean and transform data from data management software to ensure high quality of the data sets before analysis.

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	8.3. Carry out exploratory data analysis using different statistical techniques such as graphs and tables to aid interpretation of the results and present main data features.
	8.4. Use different software to fit appropriate statistical model to the given data.

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SECTION C	QUALIFICATION STRUCTURE				
COMPONENT	**TITLE**	**Credits Per Relevant NCQF Level**			**Total (Per** Subject/ Course/ Module/ Units)
		Level [6]	**Level [7]**	**Level [8]**	
FUNDAMENTAL COMPONENT Subjects/ Courses/ Modules/Units	Information and Communication Technology	20			20
	Communication and Writing Skills	20			20
CORE COMPONENT Subjects/Courses/ Modules/Units	Calculus	28	24	12	64
	Real Analysis		12		12
	Algebra		36		36
	Differential Equations		12		12
	Probability	14	24		38
	Statistical Methods	14	24		38

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	Statistical Distributions		36		36
	Statistical Inference		12	12	24
	Sampling Theory and Experimental Design		24		24
	Statistical Computing		12		*12*
ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses/ Modules/Units*	**STATISTICS OPTIONS**				
	Econometrics		36		
	Statistical Quality Control		12		
	Operations Research		12	12	
	Health Statistics		24		
	Stochastics Processes		12	12	48
	Generalised Linear Models			12	
	Agricultural Statistics		12		
	Multivariate Data Analysis		12		
	Advanced Experimental Design			12	

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	Research Project		24		
	MATHEMATICS OPTIONS				
	General Mathematics		24		
	Algebra		12	36	36
	Mathematical Analysis		24	48	
	Numerical Analysis		48		
	Mathematical Modelling		12		
	Topology			12	
	GENERAL EDUCATION MODULES				
	General Education Courses (GEC)	24	100		62

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SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	

NCQF Level	Credit Value
Level 6	124
Level 7	334
Level 8	24
TOTAL CREDITS	**482**

Rules of Combination:

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

For learners to graduate with a Bachelor of Science in Statistics degree, they must have acquired the following credits:

- Fundamentals: 40
- Core courses: 296
- Optional Courses:
  - A minimum of 48 credits from Statistics options
  - A minimum of 36 credits from Mathematics options
  - A minimum of 62 credits from any other Level 6 or Level 7 modules offered by the ETP

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ASSESSMENT ARRANGEMENTS

All the assessments, formative and summative, leading to the award of credits or a qualification should be based on learning outcomes.

5.1 Formative assessment

The contribution of formative assessment to the final grade is **40 - 50 %.**

5.2 Summative assessment

Learners may undergo assessment including written and practical examination, simulated and practical projects. Summative assessment contributes **50 - 60 %** towards the qualification.

All assessment processes shall be conducted by assessors who are registered and accredited by Botswana Qualifications Authority.

MODERATION ARRANGEMENTS

There shall be internal and external moderation which will be conducted by BQA registered and accredited moderators. The moderation processes shall be consistent with ETP and national policies on moderation.

RECOGNITION OF PRIOR LEARNING

Candidates may submit evidence of prior learning and current competence and/or undergo appropriate forms of Recognition of Prior Learning assessment for the award of credits towards the qualification in accordance with ETP and national   policies on RPL and legislative framework.

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Implementation of RPL shall also be consistent with requirements, if any, prescribed for the field or sub-field of study by relevant national, regional, or international professional bodies.

CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation and Transfer (CAT) will be applicable towards the qualification award as per the regulation of the ETP and in line with national policy on CAT.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

The Bachelor of Science in Mathematics and Statistics qualification provides career-path articulation options leading to a variety of horizontal articulation and vertical articulation as follows:

Horizontal Articulation

Qualifications at NCQF Level 7 that learners can pursue include:

- Bachelor of Science in Applied Mathematics
- Bachelor of Science in Mathematics
- Bachelor of Science in Statistics
- Bachelor of Science in Financial Mathematics
- Bachelor of Science in Actuarial Sciences

Vertical Articulation

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Qualifications at NCQF Levels 8 and 9 or equivalent that learners can progress to include:

- Bachelor of Science Honours in Mathematics
- Bachelor of Science Honours in Statistics
- Bachelor of Science Honours in Applied Mathematics
- Bachelor of Science Honours in Actuarial Science
- Bachelor of Science Honours in Data Science
- Master of Science in Statistics
- Master of Science in Mathematics
- Master of Science in Applied Mathematics
- Master of Science in Financial Mathematics

Employment wise, graduates will have requisite competencies and attributes to work as:

a. Statistician.
b. Data Analyst.
c. Data Scientist
d. Risk Analyst
e. Research Assistant

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QUALIFICATION AWARD AND CERTIFICATION

Minimum requirements of achievement for the award of the qualification

A candidate is required to achieve a minimum of 482 credits inclusive of the fundamental, core, and elective components, to be awarded Bachelor of Science in Mathematics and Statistics qualification.

Certification

Candidates meeting prescribed requirements will be awarded a certificate.

REGIONAL AND INTERNATIONAL COMPARABILITY

The Bachelor of Science in Mathematics and Statistics is generally comparable in terms qualification credits, course content, exit level outcomes, assessment criteria and employment pathways with the regional and international qualifications considered. The qualification facilitates both the vertical and horizontal articulation in the academic progression in statistics.

The Bachelor of Science in Mathematics and Statistics has been bench marked with similar qualifications offered by other Universities regionally and internationally. Regionally, University of Pretoria, South Africa was considered and internationally University of Sheffield, United Kingdom was considered.

There are no major differences between the proposed Bachelor of Science Mathematics and Statistics and the BSc (Mathematical Statistics) offered by the University of Pretoria. The core courses are generally of the same content and quality; differences are in the optional courses, with University of Pretoria leaning more towards actuarial sciences courses while the proposed one leans more towards mathematical statistics courses.

In comparison with the Bachelor of Science (Mathematical and Statistics) offered by the University of Sheffield, the core courses offered in the proposed Bachelor of Science in Mathematics and Statistics degree are similar in content and quality. However, the qualification offered by the

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University of Sheffield learns more towards statistical computing and life skills. It must be noted that the entry requirements for the two qualifications differ markedly. The entry requirement for the Bachelor of Science in Mathematical and Statistics offered by the University of Sheffield is an A-Level, an equivalence of NCQF Level 5, whereas the entry level for the proposed Bachelor of Science in Mathematics and Statistics) is NCQF Level 4 with at least a C credit in Mathematics.

REVIEW PERIOD

The qualification will be reviewed every 5 years.

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